



Vegetation Classification and Mapping Project Report, Capitol Reef National Park

Natural Resource Technical Report NPS/NCPN/NRTR—2009/187



ON THE COVER

Waterpocket Fold, Capitol Reef National Park (Photograph courtesy of NPS)

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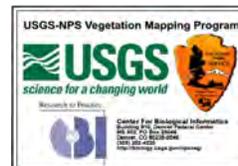
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Contents

SUMMARY	x
ACKNOWLEDGEMENTS	xii
INTRODUCTION	1
Vegetation Classification and Mapping Project, Capitol Reef National Park	1
The USGS-NPS Vegetation Mapping Program	1
Northern Colorado Plateau Network Inventory and Monitoring Program.....	2
Vegetation Mapping Program Standards.....	2
National Vegetation Classification Standard.....	3
Other Standards.....	4
PROJECT AREA DESCRIPTION	5
Location and Setting	5
Topography.....	6
Climate.....	9
Geology and Vegetation	10
Soils	23
Hydrology and Water Resources	24
Land Use and Settlement History	25
Previous Vegetation Studies.....	27
Plants.....	27
Vegetation	29
PROJECT OVERVIEW.....	30
General Approach and Timeline	30
Primary Partners and Project Roles.....	31
Aerial Photography	32
Stereoscopic Aerial Photo Coverage.....	33
Digital Orthophotos.....	35
Project Boundary and Map Extent	36
Minimum Mapping Unit	36
Ecological System Classification	36
VEGETATION CLASSIFICATION AND DESCRIPTION	39
Pre-Field Methods.....	39
Preliminary Classification List.....	39
Legacy Data Review.....	39
Field Methods	39
Field Sampling Approach	40
Plot Data Collection.....	40

Data Processing and Analysis.....	42
Observation Points.....	44
Classification Data Analysis.....	44
2003 data set.....	45
Legacy data set.....	46
Classification Results.....	49
Plant Community Descriptions.....	60
Upland Forest and Woodland Associations.....	60
Upland Shrubland Associations.....	61
Upland Herbaceous Associations.....	63
Riparian and Wetland Forest and Woodland Associations.....	63
Riparian and Wetland Shrubland Associations.....	64
Riparian and Wetland Herbaceous Associations.....	64
Field Key Preparation.....	65
Assessment of Global Rarity.....	65
FUELS DATA COLLECTION.....	67
VEGETATION MAPPING.....	68
Methods.....	68
Field Reconnaissance.....	68
Map Class and Polygon Attribute Development.....	68
Natural Resource Features of Special Interest.....	71
Mapping.....	71
Spatial Database Development.....	72
Map Classes.....	72
Results.....	73
Map Class Descriptions.....	83
Map Polygons.....	83
Discussion.....	94
ACCURACY ASSESSMENT.....	97
Methods.....	97
Introduction.....	97
Sampling Design.....	97
Field Data Collection.....	98
Data Analysis.....	99
Results and Discussion.....	103
REFERENCES.....	108
APPENDIX A: ECOLOGICAL SYSTEMS OF CAPITOL REEF NATIONAL PARK.....	114
APPENDIX B: PLOT, OBSERVATION POINT, ACCURACY ASSESSMENT POINT	

INSTRUCTIONS AND DATA FORMS	132
Appendix B.1. Plot and Observation Point Field Sampling Manual	133
Appendix B.2. Accuracy Assessment Point Field Sampling Manual	147
Appendix B.3. Example of a Vegetation Plot Data Form	178
Appendix B.4. Example of an Observation Point Data Form	182
Appendix B.5. Example of an Accuracy Assessment Data Form	184
APPENDIX C: DATABASE DOCUMENTATION	186
C.1. Plots Database Documentation	186
C.2. Geodatabase Documentation.....	203
APPENDIX D: PLANT SPECIES LIST AND CROSSWALK	212
APPENDIX E: FIELD PLOT CROSSWALK TO NVC ASSOCIATIONS.....	233
APPENDIX F: PLANT ASSOCIATION DESCRIPTIONS FOR CAPITOL REEF NATIONAL PARK.....	244
APPENDIX G: ILLUSTRATED KEYS TO THE PLANT ASSOCIATIONS OF CAPITOL REEF NATIONAL PARK	652
Key I: The Major Physiognomic Groups of Capitol Reef National Park	654
Key II: Forest and Woodland Associations of Capitol Reef National Park.....	656
Key III: Shrubland Associations of Capitol Reef National Park.....	693
Key IV: Herbaceous Associations of Capitol Reef National Park	729
APPENDIX H: MODIFIED ANDERSON LAND USE/LAND COVER CLASSIFICATION	743
APPENDIX I: ACCURACY ASSESSMENT ANALYSIS	751
APPENDIX J: MAP CLASS DESCRIPTIONS FOR CAPITOL REEF NATIONAL PARK.....	763

Figures

Figure 1. Location of CARE within the Northern Colorado Plateau network of parks	6
Figure 2. Map of the CARE vegetation mapping project area boundary showing adjacent land ownership.	8
Figure 3. Oblique aerial view of the Waterpocket Fold in Capitol Reef NP.....	9
Figure 4. Climate data for CARE (Western Regional Climate Center 2008).....	9
Figure 5. Typical summer afternoon thunderstorm building over Capitol Reef NP.....	10
Figure 6. Simplified geology map for CARE. Because of the monoclinial structure of Waterpocket Fold, older rocks are exposed on the west side of the park while younger rocks appear on the east side.	12
Figure 7. Pinyon-juniper woodlands typical of those on Kaibab Limestone exposures near Lower Muley Twist Trail.....	13
Figure 8. Moenkopi Formation-derived soils support a variety of badland, shrubland, and woodland plant communities. (a) Pinyon-juniper woodland along Lower Muley Twist Trail (b). Saltbush with galleta in a valley near Cedar Mesa. (c) Pinyon-juniper woodland with a sparse understory. (d) Extremely sparse saltbush badlands.	14
Figure 9. Pinyon-juniper woodlands with diverse shrub understory on Chinle Formation along Upper Muley Twist.....	15
Figure 10. Douglas fir woodland with an understory of pinyon, juniper and Gambel oak in North Coleman Canyon. Wingate Sandstone forms the cliffs visible in the background.....	15
Figure 11. Kayenta Formation woodlands.....	16
Figure 12. Navajo Sandstone communities.....	17
Figure 13. Carmel Formation communities.....	17
Figure 14. Communities on Entrada Sandstone. (a) Blackbrush shrubland in Hall’s Creek. (b) Crispleaf buckwheat in the Middle Desert. (c) Torrey Mormon-tea with Indian ricegrass near the Temple of the Sun. (d) Shadscale shrubland with galleta near the Temple of the Sun.	18
Figure 15. Plant communities occurring on Jurassic Curtis Formation.....	18
Figure 16. Summerville Formation communities.....	19
Figure 17. Plant communities common to the Salt Wash Member of the Morrison Formation...20	
Figure 18. A wide range of plant communities occurs on the Brushy Basin Member of the Morrison Formation.....	20
Figure 19. Pinyon-juniper woodland with mixed shrubs and bedrock exposures on Cedar Mountain Formation.....	21
Figure 20. Plant communities typical of Mancos Shale.....	22
Figure 21. Basalt boulder deposits in Upper Deep Creek.....	22
Figure 22. Alluvial communities on perennial (a) and intermittent (b) streams	23
Figure 23. Communities typical of wind-deposited sands.....	23
Figure 24. A series of waterpockets in Navajo Sandstone.....	25
Figure 25. Example of biological soil crusts on the Colorado Plateau (a) and in CARE (b).....	26

Figure 26. Last Chance Townsendia, a federally listed species that occurs within CARE.	29
Figure 27. Flight lines for 2001 stereo aerial photograph coverage of CARE.....	34
Figure 28. Example of a 9” x 9” aerial photograph taken for the CARE vegetation classification and mapping project.	35
Figure 29. Flight lines for 2002 orthophotography coverage of CARE.	37
Figure 30. Vegetation plot and observation point locations in the CARE mapping project area. Legacy data plots (Heil et al. 1993) for which precise plot locations were available are included in this map as observation points.	43
Figure 31. Three groups of outlier plots were identified in the complete 2003 data set using DCA ordination. The distorting effect of these outliers is apparent from the clumping of remaining plots along Axis 2. The outliers were removed to allow the remaining plots to “spread out” in ordination space.	46
Figure 32. DCA ordination diagram of the 2003 data set after several distinct sets of outlier plots were removed.	47
Figure 33. An example of a DCA conducted on a homogenous group of plots removed from the 2003 data set.	48
Figure 34. The globally imperiled <i>Pleuraphis jamesii</i> – <i>Sporobolus airoides</i> Herbaceous Vegetation association at CARE.....	66
Figure 35. Structure of the CARE geodatabase.	73
Figure 36a. The CARE vegetation map based on ecological system groups of map classes....	94
Figure 36b. The CARE vegetation map legend.	95
Figure 37. Location of accuracy assessment points sampled within CARE. The accuracy of the map outside of the park boundary was not assessed.....	100

Tables

Table 1. National Vegetation Classification System hierarchy for terrestrial vegetation (FGDC 1997).....	3
Table 2. Timeline for CARE classification and vegetation mapping project tasks.	30
Table 3. Plot sizes used for vegetation classification sampling at CARE.	41
Table 4. General plot data categories and specific data components collected at each vegetation classification plot.	41
Table 5. Vegetation cover and height classes used in the CARE vegetation mapping project. .	42
Table 6. Classified plant associations for the Capitol Reef National Park vegetation mapping project area, arranged by ecological system within each physiognomic group*.....	50
Table 7. Physiognomic attributes of polygons. In some cases, these attributes were assigned to individual polygons. Otherwise, they were assigned to an entire map class.	69
Table 8. Modifiers used to provide additional information for map polygons in the CARE vegetation mapping project area.....	70
Table 9. Map classes used in the final (post-AA) CARE vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. CARE vegetation map classes are arranged using the NatureServe ecological systems classification.	74
Table 10. Summary statistics for polygons of each map class developed for the CARE vegetation mapping project.....	85
Table 11. Final contingency table for CARE. This table represents the 44 map classes retained following accuracy assessment and revision whose accuracy was assessed ¹ . Five AA points were classified as types that were mapped only where encountered; polygon labels were therefore changed to match the field call. 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 77% (Kappa statistic = 70%). User's and producer's accuracy values for each map class appear in Tables 12 and 13.	101
Table 12. Final CARE vegetation map classes that met or exceeded the 80% program standard for both user's and producer's accuracy.	114
Table 13. CARE vegetation map classes where either the user's or producer's accuracy did not meet the 80% program standard.	114
Table 14. CARE vegetation map classes where neither the user's or producer's accuracy met the 80% program standard.	116

Acronyms and Abbreviations

AA	Accuracy Assessment
APFO	Aerial Photography Field Office
BLM	United States Bureau of Land Management
BOR	United States Bureau of Reclamation
BPU	Biophysical Unit
CARE	Capitol Reef National Park
CEGL	Community Element Code
cfs	Cubic Feet Per Second
CNHP	Colorado Natural Heritage Program
DBH	Diameter At Breast Height (4.5 feet)
DEM	Digital Elevation Model
DOQQ	Digital Orthophotograph Quarter Quadrangle
DRC	Diameter at Root Crown
e ² M	engineering-environmental Management, Incorporated
ES	Ecological System
ESRI	Environmental Systems Research Institute
FGDC	Federal Geographic Data Committee
ft	Feet
GIS	Geographic Information System
GPS	Global Positioning System
I&M	Inventory and Monitoring Program
ITIS	Integrated Taxonomic Information System
LC/LU	Land Cover/Land Use
MMU	Minimum Mapping Unit
NAD	North American Datum
NBII	National Biological Information Infrastructure Program
NCPN	Northern Colorado Plateau Network
NPS	National Park Service
NPS FirePro	National Park Service Fire Program
NRCS	Natural Resources 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)
SCS	Soil Conservation Service
TNC	The Nature Conservancy
TSN	Taxonomic Serial Number
UNESCO	United Nations Education, Science, and Cultural Organization
USDA	United States Department of Agriculture
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
WRCC	Western Region Climate Center

Summary

With the support of the U.S. Geological Survey - National Park Service Vegetation Mapping Program, the Northern Colorado Plateau Network Inventory and Monitoring Program described and mapped existing vegetation at Capitol Reef National Park (CARE). This collaborative effort involved many project partners, particularly the Natural Resources staff of Capitol Reef National Park, the Western Region office of NatureServe, engineering-environmental Management, Inc., and their cooperators.

The mapping area is 146,754 hectares (362,637 acres), encompassing the entire park as well as an environs of adjacent public and private lands. Ecologists and photointerpreters worked together to identify plant associations for CARE 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 243 vegetation classification plots and 17 observation points to supplement a vegetation data set of 305 plots sampled in 1986-1988. Assessment of map accuracy entailed sampling another 1313 plots. Fieldwork and mapping were completed between 2002 and 2005.

Analysis of the classification plot data revealed 175 National Vegetation Classification plant associations, alliances, or park special vegetation types within the Park and environs. Thirteen associations were documented from accuracy assessment data, the remainder from vegetation plots, observation points, or field notes.

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-screen in an ArcView environment. The project used the program standard minimum mapping unit of 0.5 ha with few exceptions.

The 18,633 map polygons representing 70 natural and semi-natural vegetation map classes cover 134,377 ha (332,053 acres, 91.6% of the project area). Map classes representing 1,720 polygons of unvegetated bedrock, talus, wash channels or sand sheets total 11,515 ha (28,454 acres; 7.8% of the project area). Nine map classes describing 634 polygons of land use categories, including roads, ranch developments and NPS facilities, total 862 ha (2,130 acres; 0.6% of the project area). Average polygon size across all map classes is 7.0 ha (17.3 acres). The most frequent vegetation map class is the Pinyon-Juniper / Mesic Shrubs Woodland Complex (Map Class 16 / W-PJME) with 5,122 polygons covering 42,197 ha (104,271) acres or 28.7% of the project area.

Map accuracy was assessed within the CARE boundary only. Results from a thematic accuracy assessment of 44 vegetation map classes remaining after accuracy assessment analysis indicated an estimate of 77% overall map accuracy (Kappa statistic = 70%). Eleven 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 detail in the Accuracy Assessment section of this report, along with the justification for retaining them.

Products resulting from the CARE 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 elsewhere¹:

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

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

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

Acknowledgements

This project was completed through the effort and dedication of numerous individuals and organizations. The role of each person mentioned here is described in more detail in the Project Overview section. Angela Evenden (NPS), Tammy Hamer (NPS), Karl Brown (USGS/NPS), and Mike Mulligan (USGS) provided project oversight and coordination with support from Jim Von Loh of engineering-environmental Management, Inc (e²M). 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.

Numerous individuals collected plot, observation point, and accuracy assessment field data. We appreciate the hard work of Liz Ballenger, Debi Clark, Janet Coles, Bruce Condie, Michelle Dela Cruz, Ken Heil, Dan Niosi, Bill Romme, Stephanie Shoemaker, Buddy Smith, Amy Tendick, Sarah Topp, Jim Von Loh, and Pete Williams. Aerial photointerpretation and map polygon attribution were skillfully performed by Debi Clark and Michelle Dela Cruz.

The vegetation map database was produced by Gery Wakefield and Aneth Wight of the NPS Southeast Utah Group. Debi, Michelle, Tom, and Janet spent several days hiking in the Park to relate preliminary plant association names to unique photo signatures and to relate legacy data collected by Heil and Romme to plant associations determined by NatureServe staff. Gery and Aneth provided random accuracy assessment point coverages and field maps for the collection of accuracy assessment data. Liz Ballenger was instrumental in planning and coordinating accuracy assessment point sampling trips to insure they were accomplished as effectively and efficiently as possible. Debi, Janet, and Gery were instrumental in convening an effective meeting for the accuracy assessment for the vegetation and land use map.

The CARE preliminary vegetation classification was prepared by Karin Decker of the Colorado Natural Heritage Program and Janet Coles of NatureServe with input from Bill Romme of Colorado State University and Debi Clark from CARE. The final vegetation classification was created by Janet Coles and Marion Reid of NatureServe, and was provided in a timely manner to guide preparation of the field key to plant associations and support efficient design and performance of the accuracy assessment field work. Janet developed a method to test and improve the field key for this project. Marion also created and supplied the standardized local plant association description template for this project. Keith Schulz revised and wrote many of the global plant association descriptions.

Participation and guidance by the staff of Capitol Reef National Park, under the direction of Natural Resources Director Tom Clark was critical to the success of this project. Debi Clark was a wealth of information concerning the plant associations and their distribution within CARE and she and Tom were instrumental in imparting access information to field crews. CARE staff also provided horse-packing expertise to allow researchers to sample remote portions of the Park.

For these and other contributors to the success of the project, we are grateful.

Introduction

Vegetation Classification and Mapping Project, Capitol Reef National Park

The Capitol Reef National Park (CARE) Vegetation Mapping Project was organized and coordinated by the Northern Colorado Plateau Network (NCPN) Inventory and Monitoring (I&M) Program between 2002 and 2006, with assistance from several cooperators. The purpose of this project was to describe and map existing vegetation on 146,754 hectares (362,637 acres) within CARE 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 others. The basic project components consist of a classification and description of the Park's vegetation and a spatial database encompassing an interpretation of the vegetation from aerial imagery.

In 2001, the NCPN I&M Program launched a multi-year project to complete vegetation classifications and maps for network park units. Funding was provided by the U.S. Geological Survey (USGS) – National Park Service (NPS) Vegetation Mapping Program and the Northern Colorado Plateau Network. The CARE Vegetation Classification and Mapping Project was initiated by the NCPN, engineering-environmental Management, Inc., and NatureServe. Project work was coordinated with the USGS-NPS Vegetation Mapping Program. Vegetation plot and observation point data collection occurred in 2003-2004 and map accuracy assessment was completed in 2005.

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 CARE mapping project area. Later sections document the methods and results for each of the major steps in the project: scoping, vegetation classification and description, vegetation mapping, and map accuracy assessment.

The USGS-NPS Vegetation Mapping Program

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

Northern Colorado Plateau Network Inventory and Monitoring Program

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

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

Vegetation Mapping Program Standards

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

Protocols

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

Standards

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

These documents are available on the USGS-NPS Vegetation Mapping 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 National Park Service 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 proposed by the Vegetation Subcommittee (2006) and adopted by the FGDC in 2008 (FGDC 2008) are not used in this project.

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

The 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

Level	Criteria Delineating Level	Example
Group	Leaf morphology (broad leaf, microphyllous, xeromorphic), leaf phenology, and climatic conditions	Temperate or subpolar needle-leaved evergreen woodland
Subgroup	Relative degree of human disturbance	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland
Formation	Additional physiognomic characteristics, general environmental conditions, relative landscape position, and hydrologic regimes	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland
Alliance	Dominant or diagnostic species of uppermost or dominant stratum	<i>Pinus edulis</i> – (<i>Juniperus</i> spp.) Woodland Alliance
Association	Other dominant or diagnostic species from any stratum	<i>Pinus edulis</i> – <i>Juniperus osteosperma</i> / <i>Amelanchier utahensis</i> 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

On August 2, 1937, President Franklin D. Roosevelt signed a proclamation setting aside 14,998 ha (37,060 acres) as Capitol Reef National Monument. The purpose of the proclamation was to preserve for the public “narrow canyons displaying evidence of ancient sand dune deposits of unusual scientific value, and...various other objects of geological and scientific interest.” President L.B. Johnson extended the monument boundary by 87,026 ha (215,046 acres) in 1969 to include the Waterpocket Fold and Cathedral Valley. After several attempts to change the unit’s designation from national monument to national park, Congress designated 97,895 ha (241,904 acres) of Capitol Reef National Park in 1971. Subsequent minor boundary adjustments brought the park to its current 98,650 ha (243,768 acres). CARE is approximately 112 km (70 miles) long and just 16 km (10 miles) wide at its widest point.

The park was established to protect the majority of the Waterpocket Fold, the longest exposed monocline in North America. Waterpocket Fold extends 160 km (100 miles) from Thousand Lakes Mountain southeast to a section of the Colorado River now inundated by Lake Powell (Graham 2006). About 120 km (75 miles) of the Waterpocket Fold is preserved within the park boundary.

The name “Capitol Reef” derives from two sources. The first part of the name was inspired by the massive Navajo Sandstone domes dotting the Fold that resemble capitol building rotundas. The second part of the name is derived from early pioneers, who saw the Waterpocket Fold as a reef posing a barrier to travel (Morris et al. 2000). The term “waterpocket” refers to the depressions found in the sandstone layers capping the Waterpocket Fold that fill with rainwater.

CARE is located in south-central Utah, in the southern part of the Northern Colorado Plateau network of parks (Figure 1). Although CARE is the second largest national park in the state, it is much less visited than others in southern Utah, receiving approximately 700,000 visitors annually. Most visitation is centered around the historic town of Fruita, settled in the late 1800s by Mormon families, and currently the location of the park visitor center.

Utah State Highway 24 follows the Fremont River through the park, connecting the towns of Torrey (4.8 km / 3 miles west of the park) and Hanksville (88 km / 55 miles to the east). Attractions along the highway include Fremont Culture rock art panels and hiking trails giving access to remote and scenic areas of the park.

CARE is bounded primarily by public lands, including the Fishlake and Dixie national forests, the Grand Staircase/Escalante National Monument (administered by BLM), and Glen Canyon National Recreation Area (Figure 2). State of Utah lands and private property adjoin a small part of the park boundary.

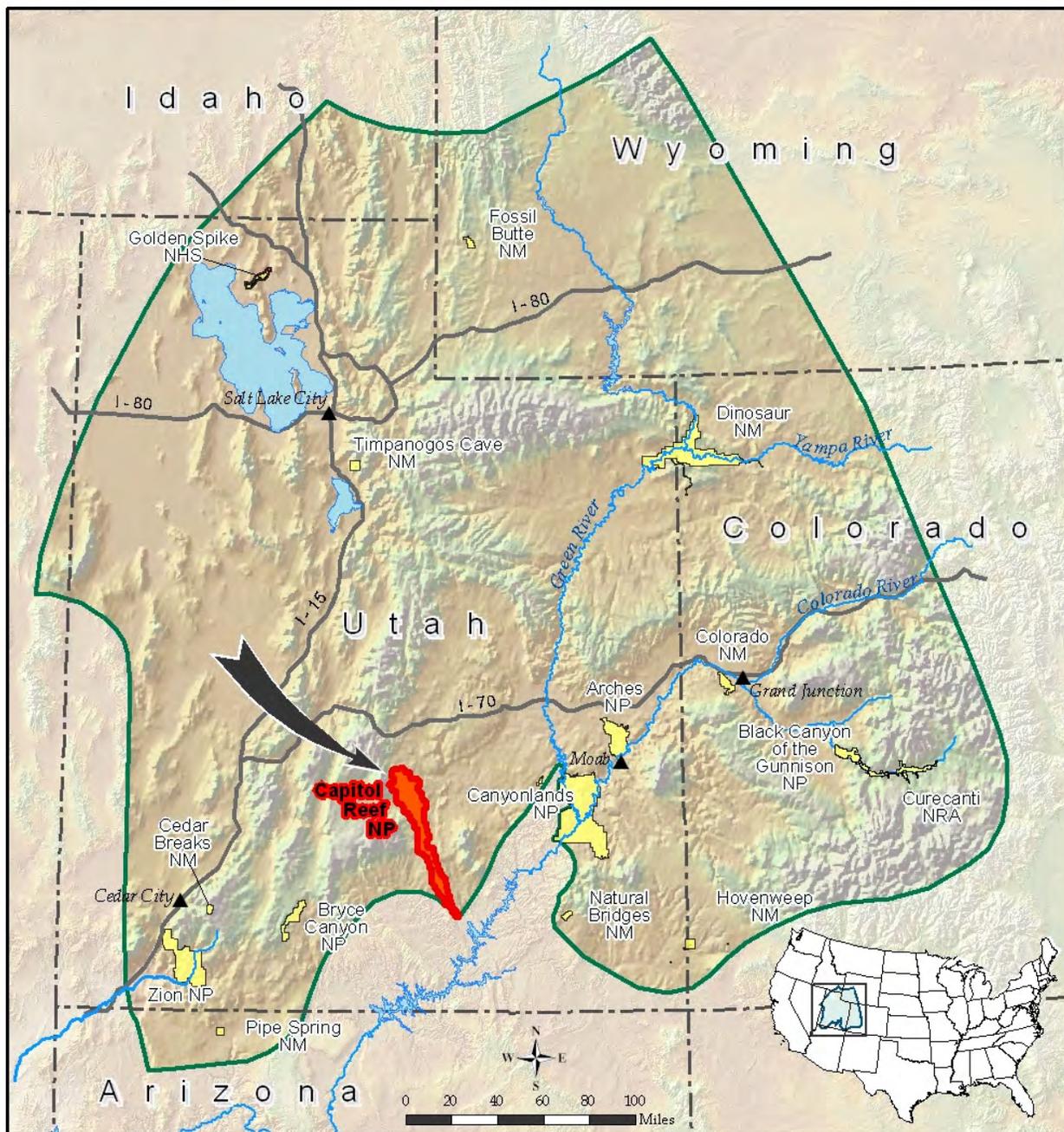


Figure 1. Location of CARE within the Northern Colorado Plateau network of parks.

Topography

Capitol Reef National Park is located on the western edge of the Colorado Plateaus Physiographic Province (Fenneman 1946). The primary topographic feature encompassed by Capitol Reef National Park is the Waterpocket Fold, the longest exposed monocline in North America (Graham 2006). The fold formed around 65 to 80 million years ago during the uplift of

the Rocky Mountains. A secondary topographic feature for which the park is noted is Cathedral Valley, a flat valley punctuated by sheer mudstone spires and fins.

The CARE landscape is visually dominated by the Waterpocket Fold and its unique geology (Figure 3). Erosion of the Fold has produced most of the unique geologic features in the park. Huge and colorful sandstone monoliths, slot canyons, landslides, and graceful arches offer spectacular scenery. Streams eroding downward through bedrock form sharp, incised meanders or “goosenecks.” (Graham 2006).

The dramatic scenery of CARE results from erosion of the 17 rock layers exposed within the park, most of which were exposed during the past 10 million years of regional uplift. The Waterpocket Fold is deeply cut along its length with west-to-east draining canyons. These canyons create cold north-facing and hot south-facing slopes supporting very different plant communities. Between the canyons are prominent sandstone domes and tilted slickrock plates. Several north-south oriented strike valleys mark the eastern edge of the park. These valleys are usually less than 400m (¼ mile) wide and are bounded by the Waterpocket Fold on the west and cliffs on the east.

West of the Fold lies the elevated topography of the High Plateaus subprovince; to the east are the narrow, steep-sided gorges of the Canyon Lands subprovince (Fenneman 1946). Elevation within the park decreases gradually from north to south and rapidly from west to east with a vertical range of more than 1,525m (5,000 ft), from 2,730m (8,960 ft) on Thousand Lakes Mountain in the northwest to 1,180m (3,880 ft) where Halls Creek crosses the southern boundary.

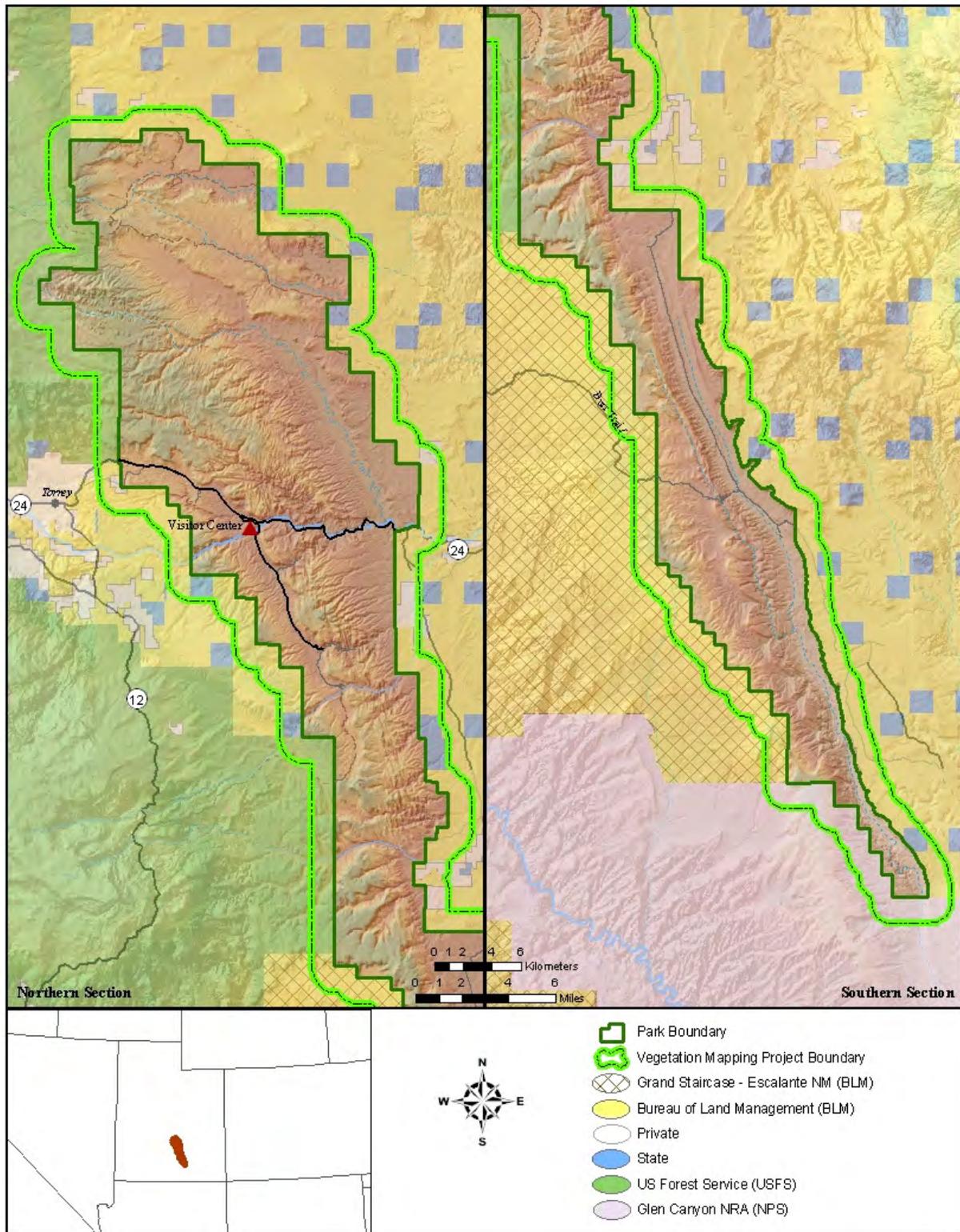


Figure 2. Map of the CARE vegetation mapping project area boundary showing adjacent land ownership.



Photo credit: NPS

Figure 3. Oblique aerial view of the Waterpocket Fold in Capitol Reef NP.

Climate

Records of climatic conditions have been maintained at the CARE visitor center since 1938. CARE is characterized by an arid climate, averaging 18.2 cm (7.2 inches) of annual precipitation (Figure 4). Most precipitation falls during the months of July and August in the form of afternoon thunderstorms. Snowfall is usually light, especially at lower elevations around Fruita and Halls Creek. Humidity is generally low (Western Regional Climate Center 2008).

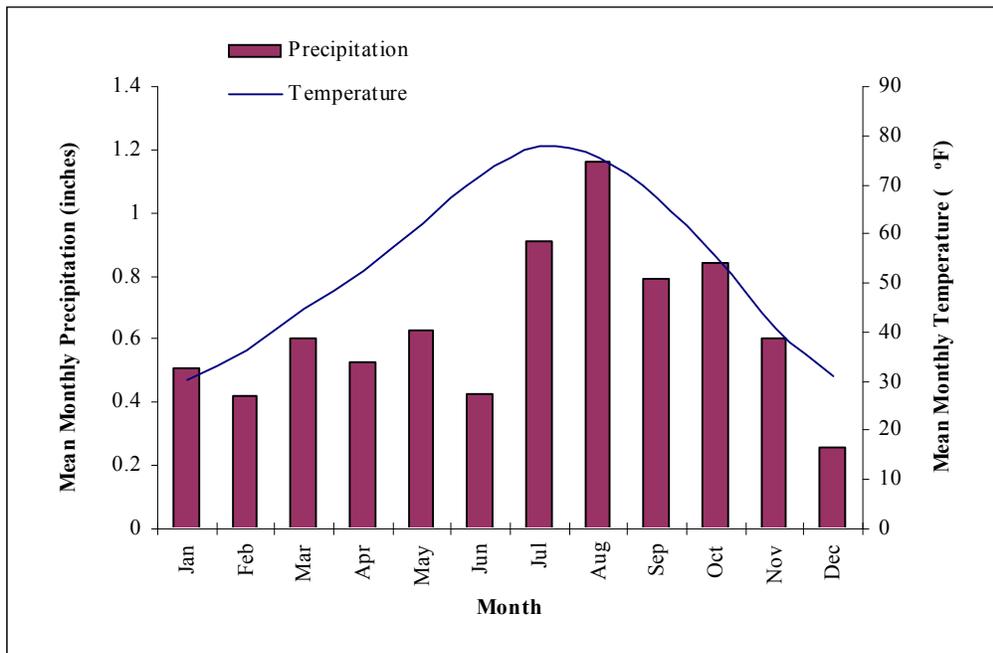


Figure 4. Climate data for CARE (Western Regional Climate Center 2008).

Conditions within the park are typical of moderate elevations in the continental interior. Summers are long with hot days averaging 35°C (95°F) and warm nights averaging 16°C (60°F) in July. The hot days typically approach 43 °C (110 °F). Winters are cold, with an average maximum temperature of 7°C (45°F) and an average minimum temperature of -4°C (25°F) occurring in January.

Tropical Gulf, tropical Pacific, and polar Pacific air masses influence weather patterns on the Colorado Plateau and, therefore at CARE. Westerly winds prevail throughout the year with easterly up-slope winds during daytime hours in summer. During summers, sporadic heavy rainfall from seasonal thunderstorms moves into the area from the Gulf of Mexico or as a result of rotation around high-pressure systems (Figure 5). During this monsoonal period, intense lightning may occur in storms accompanied by flash flooding in narrows canyons within the park. Years with high winter moisture generally occur when storms move into the area from the southwest. The normal winter precipitation pattern has storm fronts moving in from the northwest.



Photo credit: Dan Sealy / NPS

Figure 5. Typical summer afternoon thunderstorm building over Capitol Reef NP.

Geology and Vegetation

Capitol Reef National Park has some of the most spectacular exposed geology in the western United States. Because of the brilliantly colored canyon walls, the Navajo people called it the “Land of the Sleeping Rainbow.” Examples of the natural beauty of this desert landscape include the rugged spine of the Waterpocket Fold, high-walled gorges cut through the fold, monoliths,

ridges, buttes, and miles of colorful canyons. The rocks of CARE range in age from Permian to Paleocene and record more than 200 million years of earth history. The strata represent a variety of ancient environments including deep water marine, beach and shallow marine, river, lake, and desert (Graham 2006). The structure and north-south trend of the Fold mean that in general, the oldest rocks are exposed in canyons cutting into the western side of the park; youngest rocks appear as hogbacks and strike valleys on the eastern side (Figure 6).

While Waterpocket Fold is the dominant geologic feature of CARE, the park also contains classic elongated “strike” valleys cut into soft rocks paralleling the fold, as well as volcanic dikes and sills, intrusive gypsum domes, massive landslides, fossilized oyster beds, petrified logs, dinosaur bones, and unusual soft-sediment deformational features (Graham 2006).

CARE’s unique and diverse landscape reveals the dynamic and ever-changing interactions among geology, climate, plant and animal communities, and human cultures. The park is situated on the western edge of the Colorado Plateau in the rain shadow of the high range of mountains that run north to south through the center of Utah. This xeric environment supports bristlecone pine and other conifers at higher elevations, pinyon pine and Utah juniper woodlands on middle elevation slopes, and desert shrublands and grasslands at lower elevation and on valley floors.

The distribution of vegetation is controlled primarily by substrate (geology and soils), elevation, and to a lesser extent, aspect. The remainder of this section is a summary of the general distribution of vegetation in relation to geology across the mapping area, organized from oldest to youngest rocks. Descriptions of each geological stratum are derived from Morris et al. (2000).

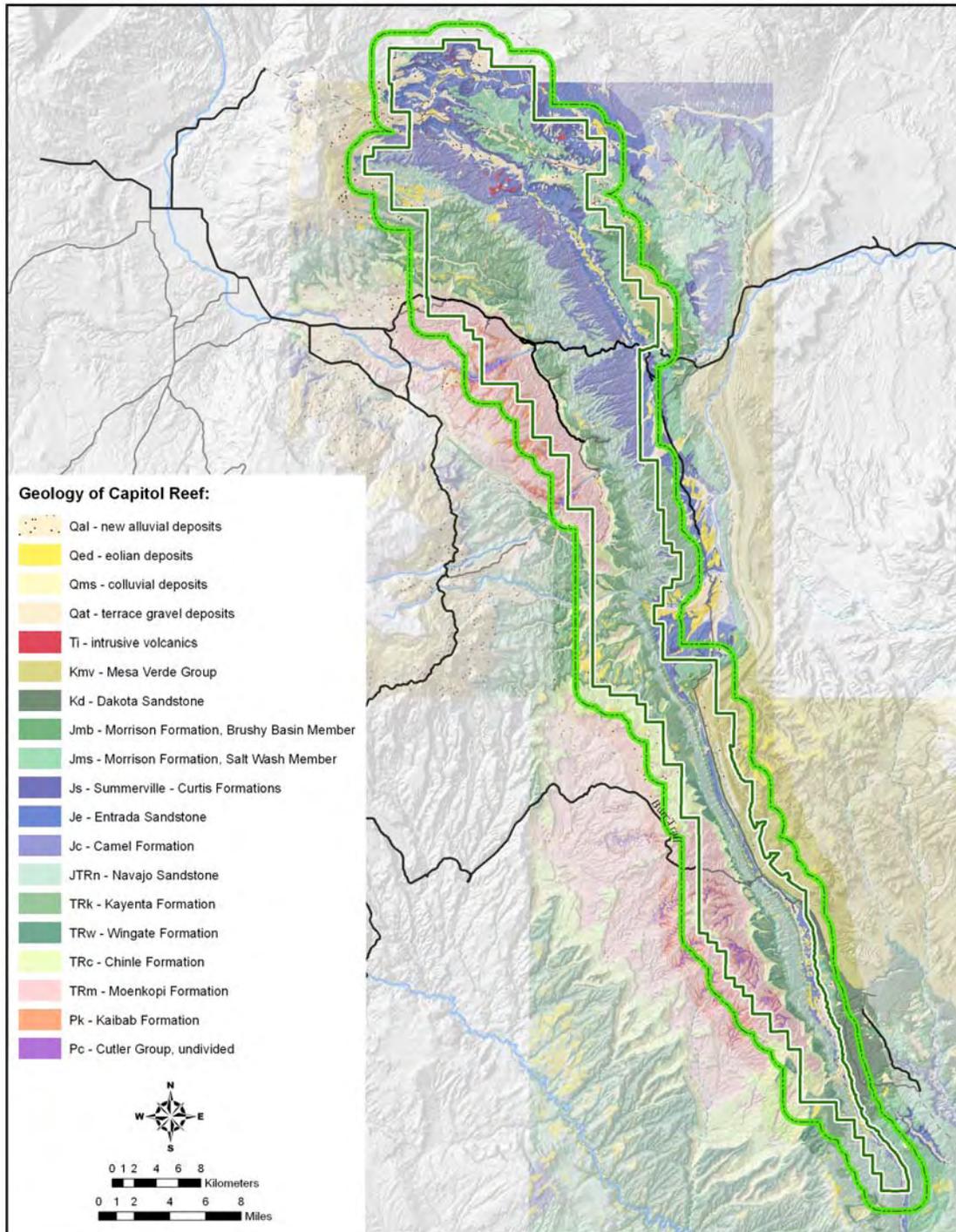


Figure 6. Simplified geology map for CARE. Because of the monoclinial structure of Waterpocket Fold, older rocks are exposed on the west side of the park while younger rocks appear on the east side.

Cutler Formation (Permian)

Only the two sandstone units of the Cutler Group (Cedar Mesa and White Rim) are exposed in the park; these are difficult to distinguish. They represent a coastal dune environment and are

best exposed in the steep walls of drainages cut into the in the western edge of the park. No plot data were collected in this geologic formation, but exposures are generally mapped as open two-needle pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) woodlands with varying understory composition of shrubs and grasses.

Kaibab Limestone (Permian)

The Kaibab Limestone is also exposed only in the deeper canyons along the western margin of the park. This formation represents the last of the series of shallow seas that covered CARE throughout most of the Paleozoic Era. Non-cliff exposures typically exhibit rocky, shallow soils interrupted by bedrock outcrops, and support pinyon-juniper woodlands (Figure 7).

Characteristic understory grasses include Salina lyme grass (*Leymus salinus*), needle-and-thread (*Hesperostipa comata*), and blue grama (*Bouteloua gracilis*). Some sites have an understory containing roundleaf buffaloberry (*Shepherdia rotundifolia*) and a few sites have a sparse understory.



Figure 7. Pinyon-juniper woodlands typical of those on Kaibab Limestone exposures near Lower Muley Twist Trail.

Moenkopi Formation (Triassic)

The shales, siltstones, and sandstones of the Moenkopi Formation are exposed as reddish-brown, ledgy badlands at the base of cliffs on the western side of the Waterpocket Fold. The rocks were deposited in a coastal plain / shallow sea environment. Clay-rich soils derived from the Moenkopi Formation support relatively sparse vegetation due to their chemistry, tendency to swell and shrink in wet-dry cycles, and poor water-holding capacity (Figure 8). Vegetation most often supported by the Moenkopi Formation are open pinyon-juniper woodlands with a variety of shrubs in the understory, including green Mormon-tea (*Ephedra viridis*) and roundleaf buffaloberry (Figure 8a). Salina lyme grass is a common component of stands on north-facing slopes. Some woodland stands lack understory vegetation (Figure 8c). Locations underlain by the marine shale unit of this formation tend to form badlands with extremely sparse vegetation characterized by saltbush species (*Atriplex* spp.; Figure 8d). On valley floors with developed soils, this community is denser and often contains the short bunchgrass galleta (*Pleuraphis jamesii*; Figure 8b).



Figure 8. Moenkopi Formation-derived soils support a variety of badland, shrubland, and woodland plant communities. (a) Pinyon-juniper woodland along Lower Muley Twist Trail (b). Saltbush with galleta in a valley near Cedar Mesa. (c) Pinyon-juniper woodland with a sparse understory. (d) Extremely sparse saltbush badlands.

Chinle Formation (Triassic)

The purple and orange clay slopes above the Moenkopi Formation and beneath the Wingate Cliffs along the entire length of the west-facing Waterpocket Fold escarpment define the Chinle Formation at CARE. Due to its position directly below the eroding Wingate sandstone cliffs, the Chinle typically is steep and gullied. The slopes are usually partly to entirely covered by Wingate sandstone colluvium, which creates pockets of moisture and stability for trees and shrubs to root. Pinyon-juniper woodlands with a mixed understory of tall shrubs, primarily true mountain mahogany (*Cercocarpus montanus*), Utah serviceberry (*Amelanchier utahensis*), and roundleaf buffaloberry are the most common communities on Chinle slopes (Figure 9).



Figure 9. Pinyon-juniper woodlands with diverse shrub understory on Chinle Formation along Upper Muley Twist.

Wingate Sandstone (Jurassic)

Salmon-colored Wingate Sandstone caps the western escarpment of Waterpocket Fold and is also exposed in North Coleman Canyon. Cool, mesic canyon sites support Douglas-fir (*Pseudotsuga menziesii*) woodlands with understories dominated by Gambel oak (*Quercus gambelii*). Some of these woodlands have emergent ponderosa pine (*Pinus ponderosa*). Also significant are woodlands dominated by two-needle pinyon pine and Utah juniper with Gambel oak or true mountain mahogany, Utah serviceberry, and roundleaf buffaloberry (Figure 10).



Figure 10. Douglas fir woodland with an understory of pinyon, juniper and Gambel oak in North Coleman Canyon. Wingate Sandstone forms the cliffs visible in the background.

Kayenta Formation (Jurassic)

The Kayenta Formation was deposited on top of the Wingate Sandstone, and is characterized by sandstone ledges interspersed with thin shale lenses typical of sediments deposited in a river floodplain. Pinyon-juniper woodlands are the most common vegetation, usually with a mix of shrubs in the understory, including true mountain mahogany, Utah serviceberry, roundleaf buffaloberry, little-leaf mountain mahogany (*Cercocarpus intricatus*), blackbrush (*Coleogyne ramosissima*), and Mormon-tea (*Ephedra* spp.; Figure 11a). Stands on deeper soils have large crowns and a sparse understory (Figure 11b).



Figure 11. Kayenta Formation woodlands.

Navajo Sandstone (Jurassic)

The Navajo Sandstone represents fossilized cross-bedded sand dunes. It forms one of the most distinctive formations within the park, with its massive domes and rolling uplands along the summit of Waterpocket Fold. Navajo Sandstone consists of broad, slickrock expanses marked by joint systems and “potholes” where soil development allows plants to root (Figure 12a). Biological crusts are usually well-developed in these joints and potholes, and woody vegetation is typically sparse and stunted (Figure 12b). The most common vegetation type is open pinyon-juniper woodlands with scattered mats of greenleaf manzanita (*Arctostaphylos patula*) or little-leaf mountain mahogany. A unique community of ponderosa pine replaces the pinyon-juniper woodlands on a few sites, and where eroded sand has accumulated, sandhill muhly (*Muhlenbergia pungens*) may dominate the understory (Figure 12c).

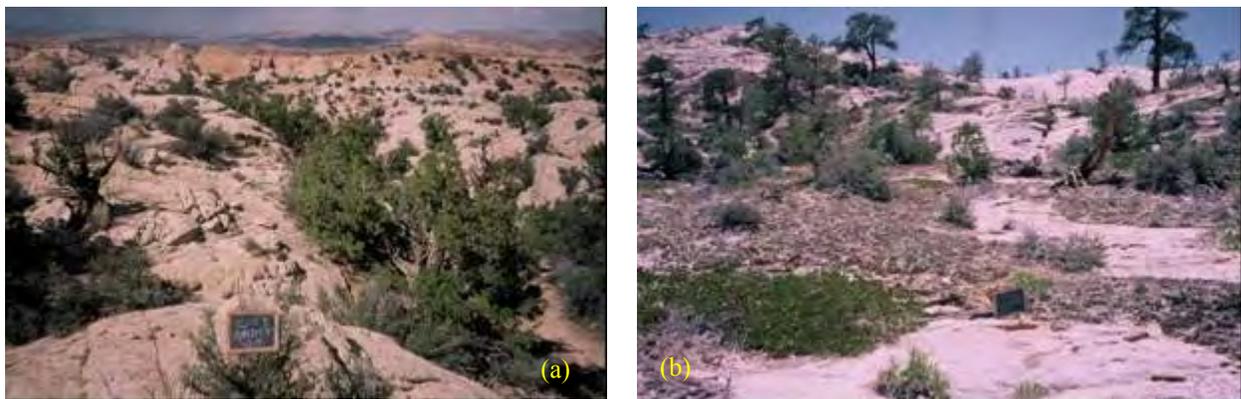




Figure 12. Navajo Sandstone communities.

Carmel Formation (Jurassic)

The Carmel Formation is varied, but it contains a layer of gypsum that forms distinctive badlands with only sparse Torrey Mormon-tea (*Ephedra torreyana*) and often with a nearly solid cover of gypsiferous lichens (Figure 13a). It also forms “flatirons” lying against the eastern face of the Waterpocket Fold. The formation’s mudstones, siltstones, and fossiliferous limestones produce a distinctive banded appearance, usually supporting pinyon-juniper woodlands with an understory most often consisting of roundleaf buffaloberry, green Mormon-tea and true mountain mahogany (Figure 13b).



Figure 13. Carmel Formation communities.

Entrada Sandstone (Jurassic)

This easily eroded sandstone forms the monolithic “cathedrals” of Cathedral Valley. It is only vegetated where it has eroded and blown or washed onto valley floors and slopes (Figure 14). Characteristic plant communities include shrublands dominated by blackbrush (*Coleogyne ramosissima*), shadscale (*Atriplex confertifolia*), Torrey Mormon-tea, or crispleaf buckwheat (*Eriogonum corymbosum*), and often with a perennial grass component of galleta or Indian ricegrass (*Achnatherum hymenoides*). Biological soil crusts are often well-developed and extensive.



Figure 14. Communities on Entrada Sandstone. (a) Blackbrush shrubland in Hall's Creek. (b) Crispleaf buckwheat in the Middle Desert. (c) Torrey Mormon-tea with Indian ricegrass near the Temple of the Sun. (d) Shadscale shrubland with galleta near the Temple of the Sun.

Curtis Formation (Jurassic)

The sandstones and siltstones of the Curtis Formation form a light-colored capstone atop the Entrada Sandstone monoliths. Otherwise, the Curtis Formation is limited in extent at CARE. Vegetation documented from this formation generally consists of sparse shrublands or shrub-herbaceous communities of Torrey Mormon-tea, shadscale, or siltbush (*Zuckia brandegeei*; Figure 15a); and with the grasses needle-and-thread and galleta (Figure 15b). Biological soil crusts are often well-developed and extensive.

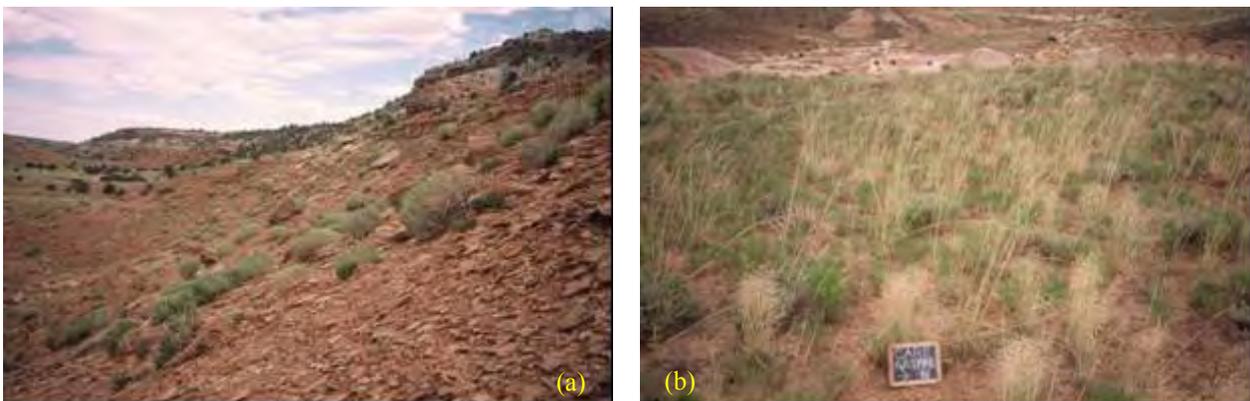


Figure 15. Plant communities occurring on Jurassic Curtis Formation.

Summerville Formation (Jurassic)

The best exposures of the Summerville Formation are in Cathedral Valley where it appears as reddish slopes above the Curtis Formation caprock, and along the northern part of the Notom Road. Soils derived from the Summerville Formation are often covered with plates and chips of shale, and the terrain may take the form of gullied badlands (Figure 16a). Vegetation is generally sparse, and can range from open pinyon-juniper woodlands (Figure 16b) to shrublands dominated by shadscale, siltbush, Gardner's saltbush (*Atriplex gardneri*), and a sparse herbaceous layer including needle-and-thread.



Figure 16. Summerville Formation communities.

Morrison Formation (Jurassic)

The Morrison Formation is best known for its dinosaur bones, although these are rare within the park. The two members of this formation exposed at CARE are the Salt Wash and the Brushy Basin. The Salt Wash Member consists of conglomerate ledges appearing as hogbacks. Oyster Shell Reef in the southern portion of the park is an example of the Salt Wash Member. Salt Wash exposures often support stunted pinyon-juniper woodlands with a mix of shrubs, including Torrey Mormon-tea, Bigelow sagebrush (*Artemisia bigelovii*), blackbrush, and little-leaf mountain mahogany (Figure 17a-17c). In areas of deeper, sandier soils, trees are either taller or absent, and grasses such as galleta and blue grama dominate (Figure 17d).



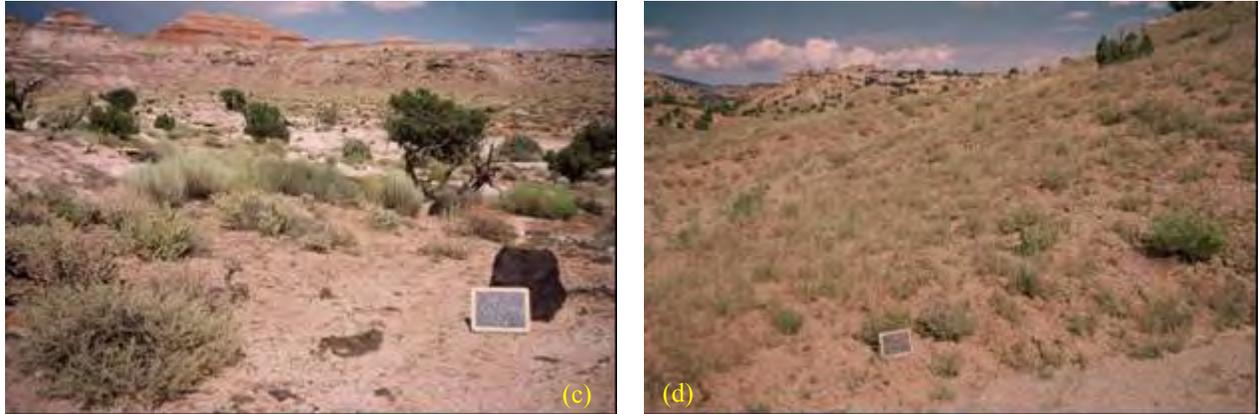


Figure 17. Plant communities common to the Salt Wash Member of the Morrison Formation.

The Brushy Basin Member of the Morrison Formation is composed of gray, maroon, white, and green clays. The Brushy Basin Member commonly supports sparse pinyon-juniper woodlands with Torrey Mormon-tea and roundleaf buffaloberry (Figure 18a), or sparse shrublands of Torrey Mormon-tea, saltbush, and galleta (Figure 18b). The most dramatic exposures are the nearly unvegetated Bentonite Hills north of River Ford (Figure 18c).



Figure 18. A wide range of plant communities occurs on the Brushy Basin Member of the Morrison Formation.

Dakota Sandstone and Cedar Mountain Formation (Cretaceous)

These relatively thin sandstone units form small cliffs and hogbacks on the east flank of Waterpocket Fold. Petrified logs and marine fossils are common. Soils are light-colored and pebbly, or eroded and sandy, always with poor water-holding capacity. Vegetation is therefore relatively sparse, dominated by pinyon pine and Utah juniper with a variety of shrubs and galleta grass (Figure 19).



Figure 19. Pinyon-juniper woodland with mixed shrubs and bedrock exposures on Cedar Mountain Formation.

Mancos Shale (Cretaceous)

The Mancos Shale underlies much of the eastern side of CARE. It consists of bentonitic clays, siltstones and sparse limestones interrupted by weak sandstone layers that may appear as hogbacks or small cliffs. Otherwise, the Mancos Shale erodes easily and generally forms valleys. Floodplains and washes cut into Mancos Shale support black greasewood (*Sarcobatus vermiculatus*) and tamarisk (*Tamarix chinensis*), often with an understory of cheatgrass (*Bromus tectorum*; Figure 20a). Uplands adjacent to the floodplains typically support a sparse community of shadscale and mat saltbush (*Atriplex confertifolia*, *A. corrugata*, *A. garrettii*) on a level to rolling surface (Figure 20b, Figure 20c). Herbaceous cover is usually minimal and may include the perennials Mojave woodyaster (*Xylorhiza tortifolia*), galleta, or weedy annual species.





Figure 20. Plant communities typical of Manco Shale.

Boulder deposits (Pleistocene and Holocene)

The area now occupied by CARE was once buried by up to 2,130 m (7,000 ft) of sedimentary rocks capped by Tertiary (Oligocene through Pliocene) basalts. In the past 10 million years, regional uplift and erosion removed most of these rocks from broad areas, leaving large remnants in the form of Boulder Mountain and Thousand Lakes Mountain. Floods, landslides, and debris flows deposited material from the slopes of these highlands over parts of CARE, although for the most part, only black boulders of erosion-resistant basalt remain. These areas are visually striking, and vegetation is generally sparse (Figure 21). Boulder deposits are visible along the highway west of CARE and in the middle section of the park.



Figure 21. Basalt boulder deposits in Upper Deep Creek.

Alluvial Deposits (Holocene)

Deposits of water-distributed sand and gravel occur on terraces and in floodplains (Fremont River) and in minor washes. Vegetation on these surfaces varies according to the availability of ground and surface water. Areas with a perennially high water table tend to support mixed communities of Fremont cottonwood (*Populus fremontii*), coyote willow (*Salix exigua*) and

tamarisk (Figure 22a). Intermittently flooded washes in broad valleys typically support rubber rabbitbrush (*Ericameria nauseosa*), basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*), and greasewood (Figure 22b). These intermittent washes may contain scattered stands of cottonwood and willow where groundwater is near to the surface. Extensive grasslands of alkali sacaton (*Sporobolus airoides*), Indian ricegrass, or needle-and-thread may occupy alluvial flats created by overland sheet flows



Figure 22. Alluvial communities on perennial (a) and intermittent (b) streams.

Eolian sands (Holocene)

Sands eroded from formations such as the Navajo and Entrada sandstones are moved by wind and deposited in sheets on valley floors. Deep, well-drained soils and semi-active dune fields often result. These sites may support pinyon-juniper woodlands, often with blue grama (Figure 23a), or sand sagebrush (*Artemisia filifolia*) and Indian ricegrass (Figure 23b).



Figure 23. Communities typical of wind-deposited sands.

Soils

The 1991 SCS soils map and survey for CARE were updated recently (NRCS 2006). The current soils map identifies 63 map units representing 36 soil series or families in four categories. The four categories, which describe the physiographic and climatic setting of the soil, are: (1) valley bottoms, alluvial fans, and terraces with very deep, well drained soil; (2) structural benches and valley sides with deep soils; (3) low benches, rolling hills, hillsides, escarpments, canyon slopes,

and mountainsides with very shallow to very deep soil; and (4) high benches, mesas, mountains, and escarpments with very shallow to very deep soil.

The Fruita Valley contains 27.5 ha (68 acres) of prime agricultural lands. These lands are composed of orchards, pastures, and open fields, which are part of a National Register-listed cultural landscape. As such, these lands are protected under the National Historic Preservation Act, which restricts development within the district.

Hydrology and Water Resources

Permanent surface water at CARE is relatively rare. Water resources at CARE include six perennial streams, many wetlands, and waterpockets that provide aquatic habitat for native fish and aquatic insects.

The perennial streams in the park are the Fremont River, Sulphur Creek, Pleasant Creek, Oak Creek, Polk Creek, and Halls Creek. Short sections of flowing water occur most years in Spring Canyon, Sheets Gulch, and Salt Wash. Isolated backwaters and old channels along perennial streams may support marshy wetlands and pools where they intersect the water table or contain a perched water table. The Fremont River and, to a lesser degree, Sulphur Creek, were important resources supporting settlement and agriculture in historic Fruita (Gilbert and McKoy 1997).

Many dry canyons and washes dissect the park, but these contain surface water only during spring snowmelt and following summer thunderstorms. All drainages within CARE, whether intermittent or perennial, are subject to flooding, especially following summer thunderstorms. Floods erode and re-deposit bank sediments and tend to prevent the development of dense or extensive floodplain vegetation.

Numerous small seeps and springs occur throughout the park and are critical resources for wildlife. Seeps usually occur at the base of hill slopes or canyon side slopes. Hanging gardens occur in scattered locations mostly in the southern half of the park where seeps emerge from canyon walls and in alcoves. Small rock pools, called tinajas or waterpockets, occur on slickrock surfaces throughout the park (Figure 24). Some tinajas contain water year-round, but most are ephemeral.

Water quality in perennial streams is generally good. Natural water quality and flows in the Fremont River have been altered by irrigation diversion upstream and in Fruita Valley. Analyses of recent water quality data for the Fremont River and other perennial streams have not been completed. A study of water chemistry of waterpockets showed that water from these sources varies depending on mineralogy and the amount of surrounding vegetation. Most have high pH and good resistance to acidification.



Figure 24. A series of waterpockets in Navajo Sandstone.

Biological Soil Crusts

Biological soil crusts occur within CARE, particularly where thin, sandy soils overlie slickrock (Figure 25). On deeper soils, crusts occupy the nutrient-poor openings between tree canopies and clumps of vascular plants. These crusts are a complex community of cyanobacteria, green algae, lichens, mosses, microfungi, and other true bacteria (Belnap et al. 2001). The cyanobacteria and microfungi have filaments that weave through the top few millimeters of soil, creating a matrix that stabilizes and protects soil surfaces from wind and water erosion. Other attributes of biological soil crusts include fixing atmospheric nitrogen, building soil organic matter (Eldridge and Green 1994), and retaining soil moisture (Belnap et al. 2001). They are diverse in terms of species composition, often including more species than the associated vascular plant community (Rosentreter 1986 and Ponzetti et al. 1998). Where land uses such as livestock grazing have removed the crusts, decades can pass before they begin to reestablish.

Land Use and Settlement History

Traces of aboriginal peoples associated with the Desert Archaic Culture dating to 2,000 years ago have been documented within the park. The early peoples were primarily nomadic hunter-gatherers; the only long-term prehistoric residents of the CARE vicinity were associated with the Fremont Culture, who occupied the area between the 9th and 13th centuries. Fremont peoples farmed the floodplains and lived on high ground near the region's few perennial streams. By 1275 A.D. the Fremont settlements had been abandoned, and until European settlement in the late 19th century, nomadic Paiute tribes using the area seasonally were the only human presence (Frye 1998).

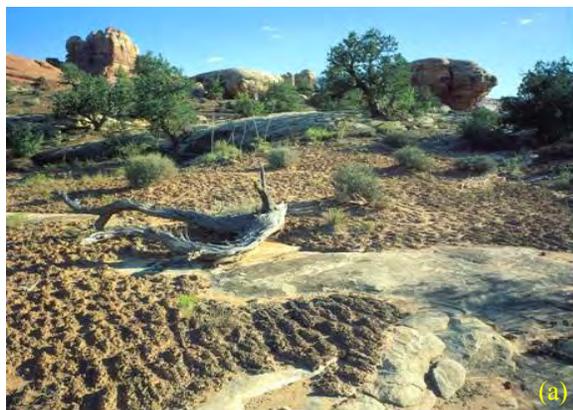


Photo credits: National Park Service

Figure 25. Example of biological soil crusts on the Colorado Plateau (a) and in CARE (b).

Following the Civil War, the (Mormon) Church of Jesus Christ of Latter Day Saints sent missionaries into remote areas of the intermountain west. In 1866, a Mormon expedition visited the high valleys to the west of what is now CARE, followed by settlers who established farms in the river valleys and grazed animals on the surrounding hills. The first homestead title in Fruita, now within the park, was granted in 1897 (Frye 1998).

Fruita's location in a sheltered canyon with a permanent source of water supported fruit orchards and vineyards from the earliest European settlement. Most homesteads included orchards ranging from 0.2 to 8 ha (0.5 to 20 acres) in size. By the early 1920s the population of Fruita peaked at 108 people. An agricultural depression began in the 1920s, and many families throughout Utah attempted to sell their lands. By the early 1960s, Fruita and its historic fruit orchards were purchased and maintained by the park. Many historic structures have been refurbished under NPS management for public enjoyment and education. The entire Fruita Historic District is now on the National Register because it represents a unique rural cultural landscape that preserves the historic Mormon community of Fruita and illustrates community characteristics at the closing of the American frontier (Gilbert and McKoy 1997).

The settled portions of the Fruita and Pleasant Creek valleys have been extensively altered from their natural condition. Native riparian habitats within these areas are very different in vegetation composition from pre-settlement times. Several homesteads with farming and livestock operations were abandoned in the early 1900s, but these lands still have not recovered to natural vegetation communities.

The rugged terrain and remoteness of CARE helped to keep most of the area outside of the Fruita valley relatively undisturbed. However, grazing and mining have occurred within the park since the late 1800s and have significantly affected some types of vegetation. Uranium exploration was permitted in CARE between 1953 and 1956. Although uranium-bearing formations were mapped within the NPS boundary, the ore was not economically significant (Frye 1998). Mining impacts to geology, soils, and vegetation are usually intensive but localized; at CARE they consist of numerous quarry sites of one to several hectares and a network of exploratory roads.

Developments for livestock grazing include stock ponds, corrals, spring diversions, and other range modifications that altered or removed the native vegetation from thousands of acres of pinyon-juniper, sagebrush, and desert scrub vegetation. Effects related to grazing are usually less intense and more widespread than those of mining, and are characterized primarily by reductions in the cover of native plants and the spread of invasive species. Accelerated erosion caused by overgrazing has created deep gullies in many locations throughout the park. A 25-year phase-out of grazing was authorized in the 1971 bill that converted CARE from a national monument to a national park (Gilbert and McKoy 1997). Domestic livestock grazing persists in a few allotments in the northern part of the park.

Previous Vegetation Studies

The particular combination of climate, geology, soils, hydrology, topography, and historic land use at CARE creates a high diversity of plant associations and wildlife habitat as well as one of the largest concentrations of endemic, threatened, and endangered plant species within the National Park System. This diversity, in turn, has attracted botanists and ecologists to the park since the early 20th century. Only studies from the past 20 years will be discussed here. More detailed information on past vegetation studies is available elsewhere (e.g., Fertig 2007).

Plants

The earliest known plant collections from the area of CARE were made by Bertrand F. Harrison, Ben Markham, and Elden Beck of Brigham Young University in 1938 (Fertig 2007). The first plant checklist for the park, documenting only about 60 species, was created by W.B. McDougall after a brief visit in 1940 (Frye 1998). Only occasional collecting of new plant specimens occurred between 1941 and 1972.

Several major botanical studies in the mid 1970s and early 1980s (e.g., Camp 1978) greatly increased the park herbarium collections and expanded the list of species known from the park to 512 taxa. Another major survey and plant collection study (Heil et al. 1993) was undertaken concurrently with the 1986-1989 vegetation mapping project led by Ken Heil, Mark Porter, and Bill Romme (Romme et al. 1993). This study added another 353 taxa to the park checklist, 33 of which are considered rare, threatened, or endangered. In the past 20 years, collections of plant species added to the CARE herbarium have leveled off, but not stopped. Rare, uncommon, and invasive species continue to be discovered (Fertig 2007).

Studies specifically designed to inventory or study CARE's rare plant species were initiated in the late 1980s and early 1990s (Heil et al. 1993, San Juan College 1994). In 1996, CARE received a two-year Canon Grant to survey and establish monitoring for six rare plant species in high visitor use areas near headquarters. Many new localities were documented for the targeted species as a result of this study (Clark and Clark 1999). To learn more about the life history of these plants and examine potential impacts from visitor use, monitoring plots were established for five of these species. In 1998, CARE and the BLM funded a joint survey team to inventory for two federally listed cactus species occurring on lands managed by NPS and BLM. Field crews surveyed the entire distribution of the two closely related species and collected samples for a DNA genetics study funded by the BLM (Clark 1999, Porter et al. 1999).

Due to the success of the joint survey team and because CARE and adjacent lands managed by the USDA Forest Service and BLM have so many rare plant species and habitats in common, the agencies developed an Interagency Agreement in 1999 to hire and fund an interagency botany technician to manage botanical work and oversee field crews. The interagency team has surveyed for numerous rare plant species in the Waterpocket Fold and San Raphael Swell.

In addition to the inventory and monitoring work described above, several other rare plant research projects have been completed or are ongoing in the park. The Center for Plant Conservation has established endowments with Red Butte Garden (Salt Lake) and Denver Botanical Gardens for seed banking two cactus species and for conducting life history studies of the Rabbit Valley *Gilia*, respectively. Scientists from Utah State University have conducted genetic studies on all species of *Gilia* present within the park (Wolf and McCracken 1998). Researchers from Utah Valley State College are conducting life history studies and monitoring of Maguire's daisy (*Erigeron maguirei*). Additionally, park staff have established monitoring plots for Winkler's cactus (*Pediocactus winkleri*) and Wright's fishhook cactus (*Sclerocactus wrightiae*).

The documented vascular flora of CARE currently includes 809 species (Fertig 2007). Of this total, 117 species (14.5%) are non-native: 29 perennial grasses or forbs, 88 annuals, and 40 species of cultivated trees or shrubs. Two cultivated tree species have escaped and are targeted for removal throughout the park: Russian olive (*Elaeagnus angustifolia*) and tamarisk (*Tamarix chinensis*). The high number of cultivated non-native species reflects the effect of human settlement and development of the Fruita area; most of the cultivated species are fruit, shade, and ornamental trees. Four of the perennial exotic species are on the Utah noxious weed list: quackgrass (*Agropyron repens*), field bindweed (*Convolvulus arvensis*), Russian knapweed (*Centaurea repens*), and whitetop (*Cardaria draba*).

Capitol Reef National Park and surrounding areas support more than 40 rare or endemic plant species. The park's flora includes eight plant species that are federally listed as threatened or endangered and one candidate for federal listing; this represents almost half of the listed plants in Utah. (Clark 2002). CARE is in the unique position of sharing management responsibilities for rare plant species with the BLM and two national forests adjacent to the park (Clark 2002). Cooperation among these agencies supports unique range-wide vegetation studies targeting these species.



Figure 26. Last Chance Townsendia, a federally listed species that occurs within CARE.

Vegetation

In response to congressional interest in the grazing program at CARE, several studies evaluating the effects of cattle grazing on the park's vegetation were completed between 1987 and 1997 (Pistrang 1987, Henderson et al. 1988, Barth and McCullough 1988, Fisher et al. 1991, San Juan College 1994, Willey 1994, Cole et al. 1997). Studies of the effects of grazing on biological soil crusts were also completed during this period (e.g., Williams 1993, Williams et al. 1995a, 1995b).

Between 1986 and 1989, W.H. Romme of Fort Lewis College and colleagues undertook a systematic survey of the vegetation of CARE. The result was a vegetation classification and vegetation map used by the park until the NCPN vegetation mapping project began in 2002. The Romme map and classification were supported by 344 plots of vegetation data collected within the park. This classification identified 34 plant communities and 13 phases of these communities that were used as map units. Data from this study were used extensively by the NCPN vegetation mapping program in completing the current project.

The vegetation of CARE was described as "complex and diverse" by Romme et al. (1993). The plant communities and phases described for CARE by Romme et al. (1993) were compared with other classification systems developed on the Colorado Plateau, including the Brown, Lowe, and Pase (1980) system in use by all national park units in the Intermountain region of the NPS.

Project Overview

General Approach and Timeline

The goals of this project were to inventory, describe, and map the existing vegetation at Capitol Reef National Park and environs to national standards. The project at CARE 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 Mapping Program to cost-share network I&M funding with the National Vegetation Mapping Program funding to complete vegetation maps for all network parks (Evenden 2001). A meeting to determine the CARE project boundary, review legacy data, determine plot sampling needs, discuss photointerpretation approaches, and define additional special park data was held in November 2002. Table 2 is a timeline for the completion of major project components.

NCPN negotiated interagency agreements with the USDA Aerial Photo Field Office and the USDI Bureau of Reclamation Remote Sensing and Geographic Information Group to acquire aerial photography for each park, including CARE. Stereo aerial photography for CARE was acquired during September 2001; orthophotography was acquired in June 2002.

Table 2. Timeline for CARE classification and vegetation mapping project tasks.

TASK DESCRIPTION	2001	2002	2003	2004	2005	2006	2007-08
Planning and Scoping		██████████					
Acquire Aerial Imagery	██	██					
Field Data Collection			██	██			
Photo Interpretation		██████████	██████████	██████████			
Vegetation Classification			██	██		██	
Local & Global Descriptions				██		██	
Spatial Database			██████████	██████████		██	
Field Key to Plant Associations				██			
Accuracy Assessment					██		
Final Report and Products							██

New vegetation plot and observation point data collection at CARE occurred during the 2003 and 2004 field seasons. An analysis of legacy data (Heil et al. 1993) and comparison with the preliminary list of plant associations (engineering-environmental Management, Inc. 2002)

suggested that between 300 and 500 new classification plots would be needed to complete sampling of the full range of vegetation types within the park.

New and legacy plot data were entered into a MS Access database developed for the project and were analyzed in the fall following the 2003 field season. Both sets of data were analyzed by ecologists contracted by e²M, who prepared a preliminary vegetation classification report (Decker 2003). The final assignment of plots to associations of the National Vegetation Classification was made by NatureServe ecologists in 2006. Local and global plant association descriptions based on the classification were drafted in 2004-2005 and completed in 2006. An illustrated field key to CARE plant associations was developed, illustrated, and tested prior to map accuracy assessment (AA) in 2005.

Interpretation of aerial photos and digital database development for the CARE vegetation map were completed between the fall of 2002 and the spring of 2005. Map classes were defined for the project by the primary photointerpreter / park botanist with input from NCPN staff. A traditional photo interpretation was performed, with interpreted polygons drawn and attributed on-screen in a GIS environment. Polygon attribution followed standards developed by NCPN for all network mapping projects (Evenden 2004). A guide to the map classes was drafted in 2005 and revised in 2007.

A draft vegetation map and associated spatial database were completed in the spring of 2005. Accuracy assessment data collection occurred during the 2005 field season. Data were then entered into the CARE project database and analyzed, with results tabulated into a contingency matrix. A meeting of project cooperators in January 2006 determined which map classes should be retained and which should be combined or eliminated because they failed to meet the 80% accuracy standard. Final revisions were made to the vegetation classification, field keys, map, and spatial database in 2007 and 2008. 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 Capitol Reef National Park Classification and Vegetation Mapping Project. The roles of each contributor are described below.

engineering-environmental Management, Inc.

- *Jim Von Loh, Senior Biologist* – prepared work plan, participated in scoping meeting, collected AA data, wrote draft field key, wrote association local descriptions, contributed to final report
- *Sharon Anderson, PhD, Staff Ecologist* – prepared work plan
- *Sarah Boyes, Staff Biologist* – collected plot data
- *Karin Decker, Consulting Ecologist (Colorado Natural Heritage Program)* – prepared preliminary vegetation classification
- *Jack Doria, Software Designer* – designed project MSAccess databases
- *Wanda Lafferty, Technical Editor* – formatted and edited workplan
- *Dan Niosi, Natural Resources Specialist* – prepared work plan, collected plot data
- *Stephanie Shoemaker, Consulting Ecologist* – collected AA data
- *Buddy Smith, Consulting Ecologist* – collected plot data
- *Peter Williams, Consulting Ecologist* – collected AA data

National Park Service, Northern Colorado Plateau Network

- *Angie Evenden, Ph.D., Vegetation Program Manager* – overall project coordination and management, set NCPN project standards, organized project meetings, managed budgets, agreements and contracts
- *Janet Coles, Vegetation Ecologist* – Technical editor of the final report; coordinated creation of final products, wrote sections of the final report
- *Margaret Beer, Data Manager* – project database development
- *Helen Thomas, Data Manager* – project database support, photo database development and QC
- *Russ DenBleyker* – project database support and QC
- *Liz Ballenger, Biological Technician* – collected plot, observation point, and AA data, revised map class guide and association field key
- *Amy Tendick, Biological Technician* – collected plot, observation point, and AA data
- *Bruce Condie, Biological Technician* – collected plot, observation point, and AA data
- *Sarah Topp, Biological Technician* – collected plot, observation point, and AA data
- *Gery Wakefield, GIS Team Leader* – managed the GIS and remote sensing database construction, selected AA points and prepared maps to support the AA
- *Aneth Wight, GIS Technician* – produced geodatabase; plots database support, project metadata
- *David Svendson, Biological Technician* – plots and photo database QC, assisted with creating final GIS products and documentation

National Park Service, Capitol Reef National Park

- *Debi Clark, Botanist* – primary photointerpreter, map concept development, AA data analysis, collected plot data, wrote sections of report and map class guide
- *Tom Clark, Chief of Resources* – logistical assistance to field crews, assisted with map class development, wrote report sections
- *Michelle Dela Cruz, Biological Technician* – photointerpreter, collected plot data
- *G. Lenhart, C. Groebner, L. Anderton, K. Durfey, Q. Willis, Biological Technicians* – collected plot data

NatureServe

- *Marion Reid, Senior Regional Ecologist* – reviewed classification and final report
- *Janet Coles, Regional Ecologist* – Reviewed field key, reviewed draft local descriptions, prepared global association descriptions, trained field crews in AA methodology
- *Keith Schulz, Regional Ecologist* – Wrote global association descriptions, reviewed final report.
- *Mary Russo, Ecology Data Manager* – Entered CARE 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. 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

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 environment and is the basis for interpreting vegetation patterns. Stereo photographs acquired vertically from the air, with adequate overlap, allow three-dimensional, high-resolution photointerpretation when viewed under a stereoscope (Avery 1978). At the beginning of the NCPN vegetation mapping program, network staff decided to acquire new stereo pair aerial photography, as well as orthorectified imagery at a 1:12,000 scale for eleven of the 16 network park units, including CARE.

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 vegetative 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.

Most NCPN park units are characterized by semi-arid and desert landscapes. Herbaceous vegetation in these systems tends to cure early. The year 2002 (when the orthoimagery was acquired) presented special challenges due to extreme drought conditions across the Colorado Plateau. The orthoimagery acquired in 2002 represents extremely arid conditions and did not capture average vegetation expression in the park. Many annual plants emerged minimally or not at all in 2002, and many perennial herbaceous plants, including dominant grasses, died or had dropped their leaves by the time the new imagery was acquired. Because of this, the stereo photographs flown in 2001 were especially valuable in detecting community boundaries.

Stereoscopic Aerial Photo Coverage

NCPN contracted with the USDA - Farm Services Agency Aerial Photography Field Office (APFO) to acquire new 23 cm x 23 cm (9 in x 9 in) true color aerial photographs for CARE. The photographs were flown on September 8-10, 2001 by the subcontractor, 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 1060 linear km (658.5 miles) divided among 30 flight lines and 710 individual photos (Figure 27).

Figure 28 is an example of the 23 cm x 23 cm aerial stereo photographs for CARE. These photographs were used for photo interpretation during the mapping phase of the project, as well as by field crews during classification 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 CARE; the other is retained at the NCPN offices in Moab, Utah.

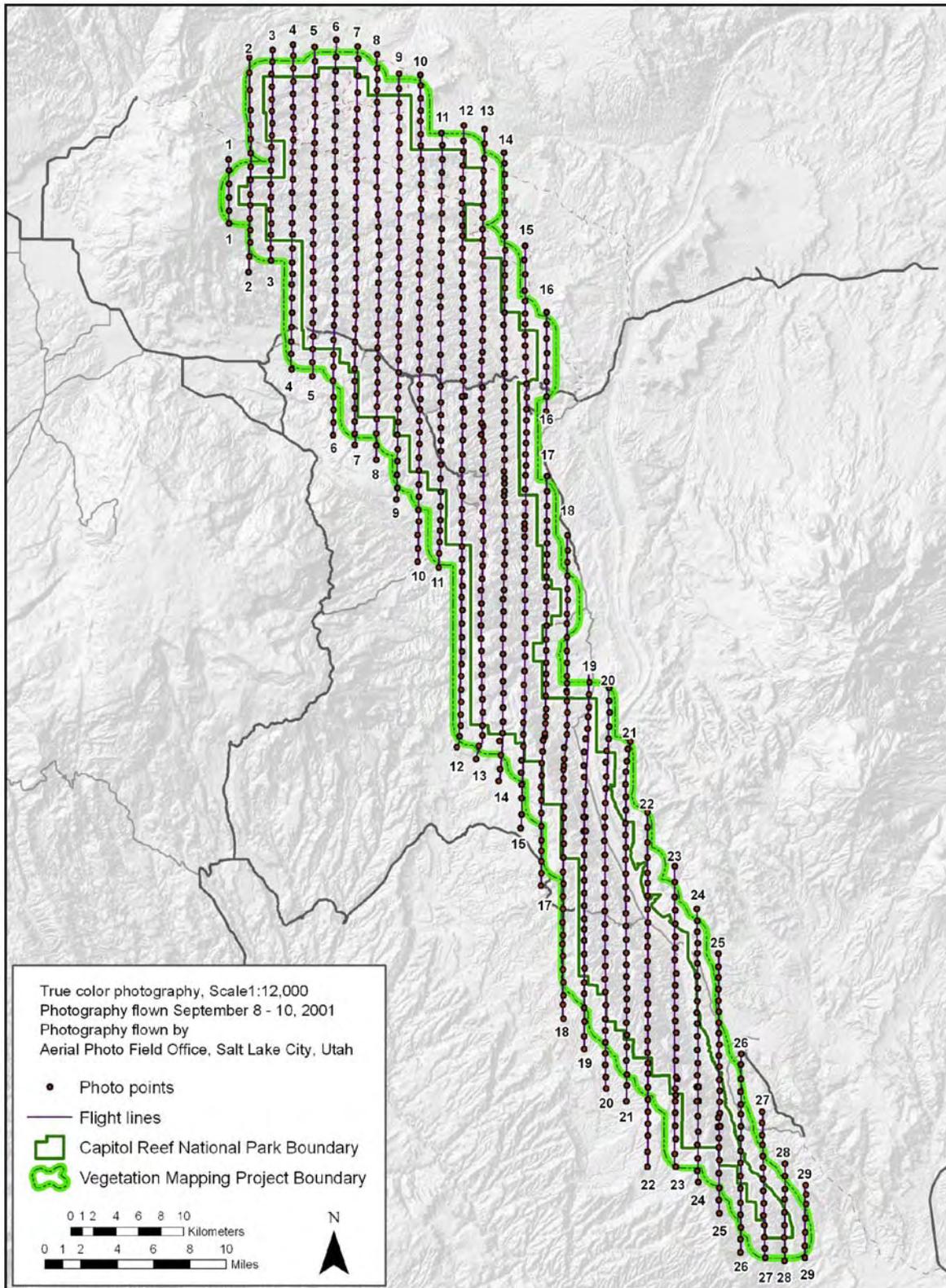


Figure 27. Flight lines for 2001 stereo aerial photograph coverage of CARE.



Figure 28. Example of a 9" x 9" aerial photograph taken for the CARE vegetation classification and mapping project.

Digital Orthophotos

The USDI Bureau of Reclamation Remote Sensing and Geographic Information Group (BOR) in Denver, Colorado, produced 1:12,000 scale digital orthophotography for CARE from new imagery. This work was subcontracted to Horizons Inc. of Rapid City, South Dakota. The photography was flown on June 27 and 28, 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 RMK15/23 camera with a 15.2 cm (6 in) lens was used with AGFA100 film. The project extended over 612 linear km (380 miles) divided among 14 flight lines and 181 individual photos (Figure 29).

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 area 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, better imagery (usually 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 CARE 2002 color digital orthophotos are permanently archived in airtight containers at the USBOR Remote Sensing and Geographic Information Group offices in Denver, Colorado.

Project Boundary and Map Extent

A project boundary of approximately 1.6 km (1 mile) around the edge of the park (environs) was chosen by network and CARE staff during the November 2002 scoping meeting (Figure 1). The total project mapping area is 146,754 ha (362,637 acres). Of this area, 98,650 ha (243,769 acres) occur within the CARE boundary and 48,104 ha (118,868 acres) are in the environs.

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 (1.2 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 2003b) as a framework for organizing and presenting plant community data. An ES is defined as a group of plant associations from two or more alliances that tend to co-exist in a given landscape due to similar ecologic processes, substrates, and/or environmental gradients. The ES classification was developed to provide larger scale classification units for application to resource management, mapping, and conservation. Current estimates are that Utah contains more than 80 ecological systems (NatureServe Explorer 2006). This approach complements the NVC; the finer-scale associations provide a basis for interpreting larger-scale ES patterns and concepts. A description of each ecological system identified in CARE appears in Appendix A.

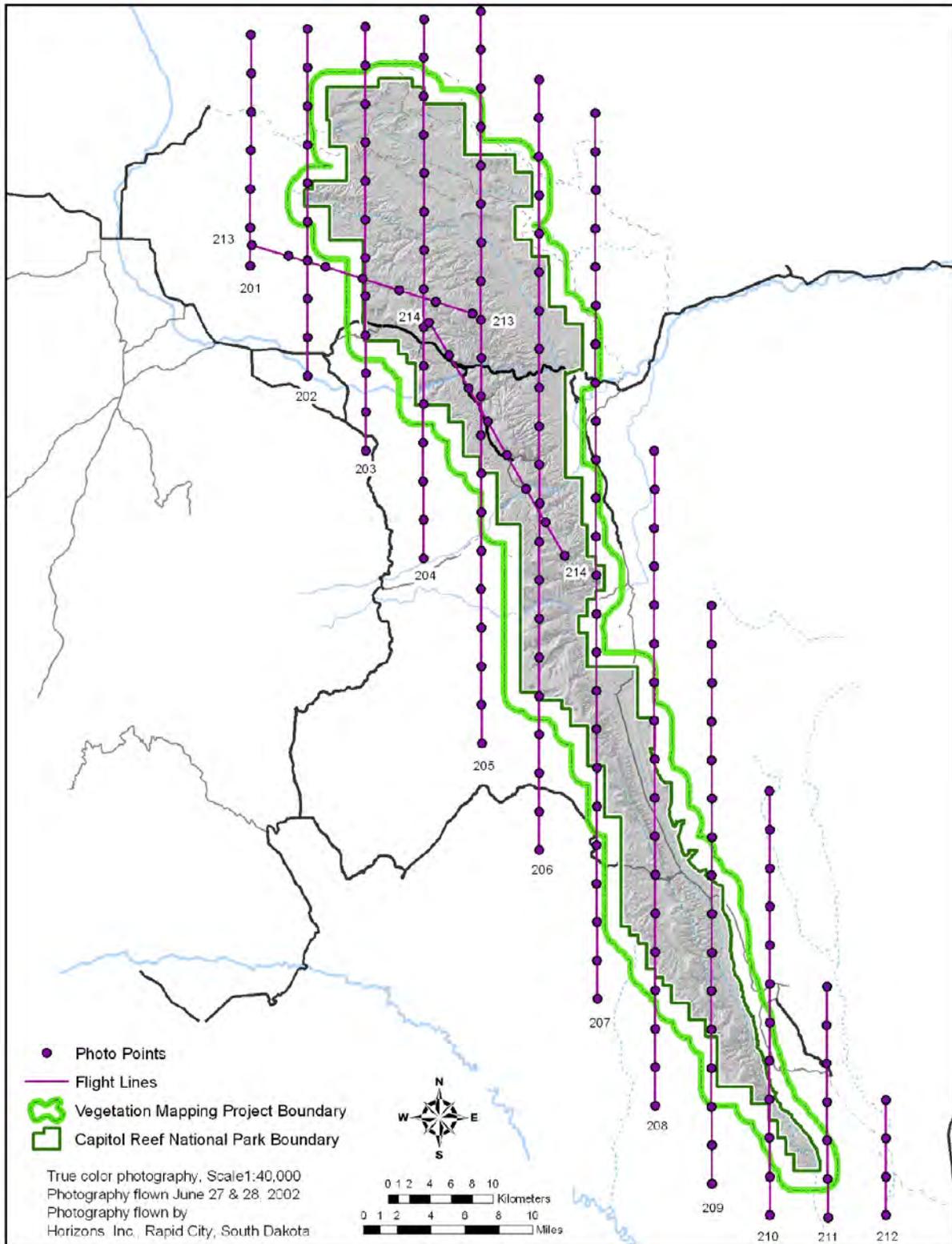


Figure 29. Flight lines for 2002 orthophotography coverage of CARE.

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

- Colorado Plateau Blackbrush-Mormon-tea Shrubland (CES304.763)
- Colorado Plateau Hanging Garden (CES304.764)
- Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)
- Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762)
- Colorado Plateau Pinyon-Juniper Shrubland (CES304.766)
- Colorado Plateau Pinyon-Juniper Woodland (CES304.767)
- Great Basin Semi-Desert Chaparral (CES304.001)
- Inter-Mountain Basins Active and Stabilized Dune (CES304.775)
- Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)
- Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland (CES304.772)
- Inter-Mountain Basins Greasewood Flat (CES304.780)
- 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)
- North American Arid West Emergent Marsh (CES300.729)
- North American Warm Desert Riparian Woodland and Shrubland (CES302.753)
- Rocky Mountain Aspen Forest and Woodland (CES306.813)
- 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 Woodland (CES306.833)
- Southern Colorado Plateau Sand Shrubland (CES304.793)
- 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 Ponderosa Pine Woodland (CES306.648)

Vegetation Classification and Description

Pre-Field Methods

Preliminary Classification List

NatureServe compiled a preliminary list of vegetation associations and alliances for CARE (engineering-environmental Management, Inc. 2002). This list was developed by intersecting NVC associations and alliances (e.g., NatureServe Explorer 2005) with Bailey ecoregions (2001). Previous vegetation classification work (e.g., Romme et al. 1993), floristic information for CARE (e.g., Heil et al. 1993), the park's plant species list, and expert local knowledge were used to refine the list. This process resulted in a preliminary list of 179 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. Based on a review of the legacy data (see below), members of the scoping team determined that approximately 150 new plots representing a list of targeted vegetation types would be needed to complete sampling of the park's vegetation.

Legacy Data Review

Existing vegetation data for CARE were reviewed for possible use in the classification and/or mapping. The primary dataset (344 plots) reviewed was created by Romme et al. (1993) from vegetation sampled between 1986 and 1989 for a vegetation mapping project. These data were determined to be too spatially imprecise to contribute significantly to the mapping phase of the NCPN project. Park staff supported using the Romme et al. (1993) data in the classification phase, in order to reduce the amount of new data that would need to be collected. However, they noted that at least a dozen plant community types existed within the park that were not documented during the Romme et al. study.

Park staff had used the Romme et al. (1993) data, classification, and field maps to support a project to map the vegetation at CARE using 1:24,000 black and white orthophotography and topographic maps. During the 2002 scoping meeting, it was decided to incorporate as much of this work as possible into the NCPN mapping project, although the scale and the classification systems differed considerably.

Field Methods

The primary purpose of collecting new classification plot data was to supplement the Romme et al. (1993) data in order to complete documentation of the composition and structure of CARE vegetation and associated environmental conditions. These data formed the basis for classifying the vegetation within the park. Field methods used in 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 classification plot dataset enhanced the legacy data of Romme et al. (1993), which was treated as observation point data in analysis.

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

Field Sampling Approach

Because the CARE project area is large, complex, and access can be logistically difficult, the areas to be sampled were selected in advance of the 2003 field season. The sampling area included the entire park as well as public lands in the environs. Private lands in the environs were not visited. The types to be sampled were based on an analysis of the Romme et al. (1993) data to determine which probable vegetation types within the park had not been adequately described. The areas selected for sampling were based on biophysical units designed to ensure that all major environmental settings were visited and a good spatial dispersion of sample plots achieved.

The biophysical units (BPUs) used to guide sampling were constructed by layering soils, solar budget, and elevation information. The result was a set of polygons representing unique combinations of these environmental factors. The “cost” of accessing each polygon was calculated, and the polygons deemed too difficult to access were withdrawn and replaced by polygons closer to roads and trails. A random sample of 435 polygons representing each combination of factors became the target areas for sampling.

Field crews were led by ecologists with experience sampling plant communities in national parks and other landscapes. The list of 179 potential plant associations provided a starting point for naming communities sampled in the field. The sampling goal was to collect between three and five plots in every vegetation association within the CARE project area. An effort was made to capture the full range of variation of each association.

The initial data collection was conducted between May and October, 2003. One hundred sixty-five vegetation classification plots and 11 observation points were sampled. After reviewing a preliminary classification of the data, park staff identified sites and vegetation types still missing from the data. These sites and others were sampled during the 2004 field season using 78 vegetation plots and six observation points.

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, such as hanging gardens and riparian terraces. Plot size and shape requirements were consistent with national Vegetation Mapping Program guidelines (TNC and ESRI 1994a). Plot size was determined by the physiognomy of the community being sampled (Table 3). CARE plot shape was adjusted as needed to sample linear bands of vegetation in drainage bottoms. Plot size and shape were recorded for all plots.

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

Vegetation Class	Area (m ²)	Radius (m)
Forest and Woodland	400	22.6
Shrubland	400	22.6
Herbaceous	100	11.3

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 4):

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

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

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

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

Environmental Description The physical characteristics of each plot were documented in both categorical and narrative fields (Table 4; Appendix B). These included topographic 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 and land-use 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 5. 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.

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.

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

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

Data Processing and Analysis

Two hundred forty-three vegetation plots were sampled within the mapping project area during the 2003 and 2004 field seasons (Figure 30). Plot data were manually entered into the CARE Vegetation Mapping Project Database, developed by e²M and 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 CARE plots database are described in Appendix C.

Each 35 mm slide associated with the project was scanned into digital format. The 535 digital images were stored in a photograph database. A unique identifier allows each photograph to be linked with the plots and spatial databases.

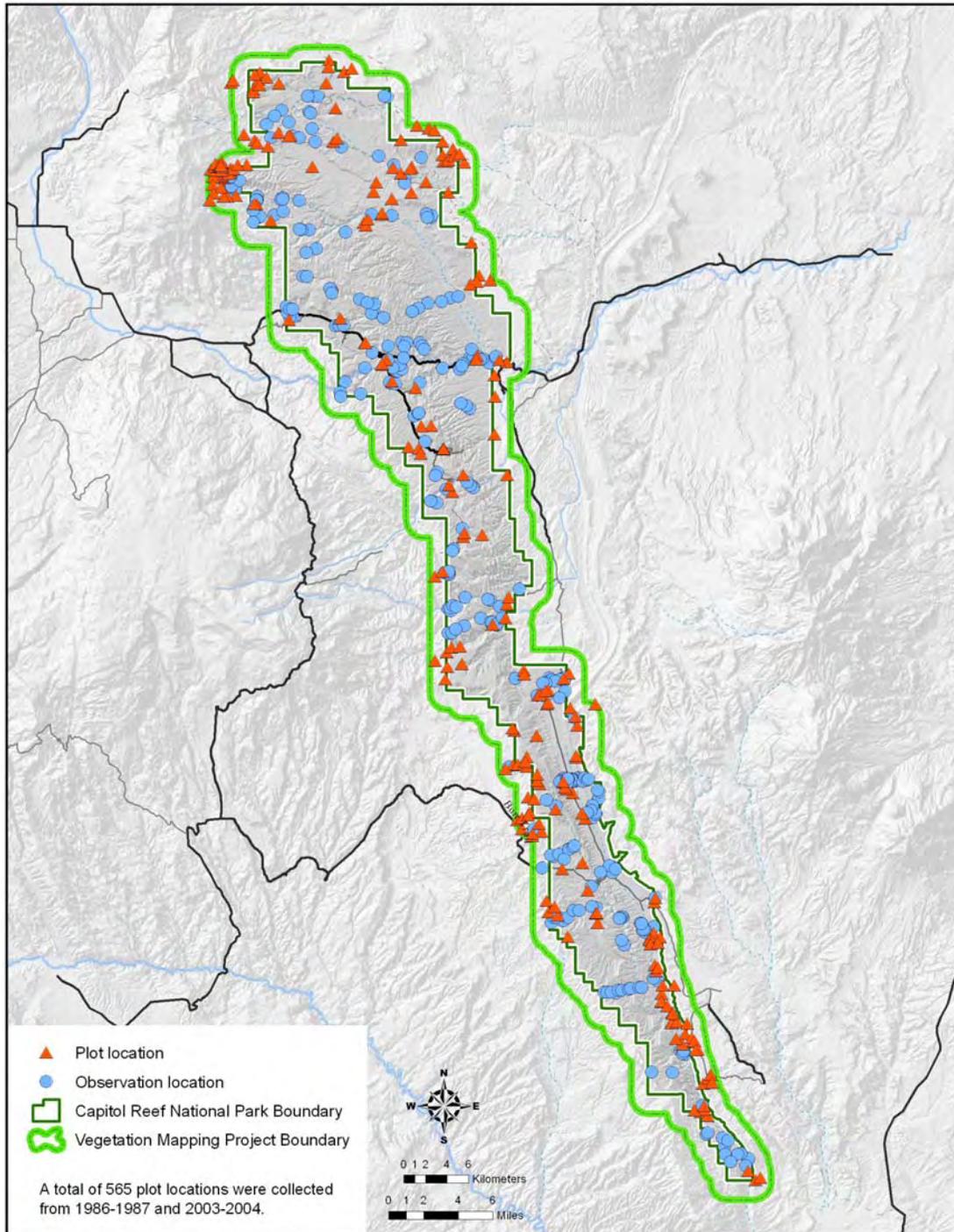


Figure 30. Vegetation plot and observation point locations in the CARE mapping project area. Legacy data plots (Heil et al. 1993) for which precise plot locations were available are included in this map as observation points.

Observation Points

Data were collected at 17 observation points within CARE. The 344 plots of Romme et al. (1993) legacy data substituted for the usual number of observation points. Data collected at observation points reflected the vegetation of a loosely defined area around the point (the “stand”) rather than a measured plot, and were less detailed (Appendix B). These data were intended primarily to support modeling and interpretation of the aerial imagery, 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 within the NVC
- 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 MSAccess 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 CARE 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 e²M 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.

Classification Data Analysis

Vegetation classification was accomplished through a multivariate analysis of vegetation plot data augmented by observation point data (Decker 2003). The first data set to be analyzed was the 163 plots collected in 2003, as well as the legacy data of Romme et al. (1993). The 2004 field data were analyzed in a separate step following the 2004 field season. Species cover data were exported in list format from the plots database, then imported into PC-Ord (McCune and Mefford, 1999). Midpoints of canopy cover classes were used in all data analysis procedures.

Because the 2003 vegetation plot data (163 vegetation plots / 305 species) and the legacy data (344 plots / 473 species) were collected using different field protocols and during different climatic conditions, they were analyzed as two separate data sets. The data sets were first evaluated to find outliers, which potentially distort the matrix (Figure 31). Exploratory multivariate statistical analyses (detrended correspondence analysis [DCA], outlier analysis, two-way indicator species analysis [TWINSPAN], and cluster 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.

2003 Data Set

An outlier analysis and initial DCA of the 2003 data set revealed three groups of samples that were extremely different from the main group of plots (Figure 31). The three groups (quaking aspen-snowberry, herbaceous wetland, and extreme-sparse shadscale) represent good but limited samples of distinct vegetation types, reflecting the fact that the 2003 plots were chosen specifically to augment the legacy data rather than as a comprehensive park-wide sample. A similar pattern of outlier plots appeared in subsequent analyses, probably for the same reason.

Distinct groups or plots were removed from the data set and three more rounds of DCA performed. After each DCA, the most distinct and homogenous groups were removed from the data set to be analyzed separately. After four iterations, about half of the samples had been grouped, and the remaining set of 80 plots constituted a nebulous group of predominantly shrubby vegetation types (Figure 32). Rare species were removed from the data set, and this allowed further DCA and TWINSPAN routines to separate remaining groups (Figure 33). The sparsely vegetated plots were analyzed separately. All DCA results were compared with TWINSPAN output for the 80 samples, and together with cluster analyses were used as an aid to assigning plots to associations.

Primary groups identified through the above process were:

- Quaking aspen/snowberry
- Herbaceous wetland
- Mixed conifer
- Big sagebrush shrublands
- Pinyon-juniper woodlands and wooded shrublands
- Blackbrush shrubland
- Rabbitbrush shrubland
- Mormon-tea shrublands
- Mixed shrublands
- Saltbush shrublands
- Extreme sparse vegetation



Figure 31. Three groups of outlier plots were identified in the complete 2003 data set using DCA ordination. The distorting effect of these outliers is apparent from the clumping of remaining plots along Axis 2. The outliers were removed to allow the remaining plots to “spread out” in ordination space.

Legacy Data Set

The legacy data set showed distinct differences from the 2003 data set. Plots tended to be richer both in number of species and in total cover. This may partly be due to the lingering effects of the extreme drought of 2002 in the 2003 data set. Some legacy plots appeared to be ecotonal, containing elements of several distinct associations. Romme (personal communication 2003) believes this is due to the patchy or linear nature of some vegetation; the standard plot size may have overlapped several vegetation types.

In general, the same procedure of iterative DCA described above was used. In the initial rounds, small groups identified by DCA were removed from the data set before TWINSPLAN was used to break large heterogeneous groups into smaller groups for further ordination. Groups separated by initial DCA were:

- saltbush shrublands
- hanging garden / riparian
- bristlecone pine
- mixed conifer-deciduous
- greasewood shrublands
- cottonwood floodplain

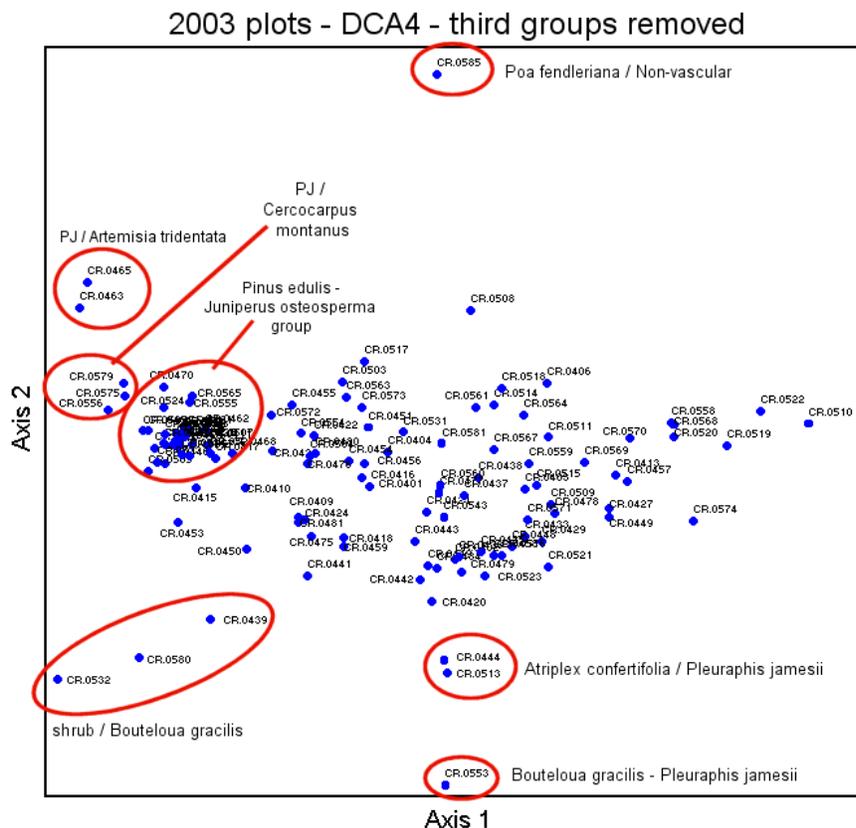


Figure 32. DCA ordination diagram of the 2003 data set after several distinct sets of outlier plots were removed.

After four iterations, no additional distinct groups were detected. The remaining dataset was separated by TWINSPLAN into a pinyon-juniper group and a shrubland/grassland group for further DCA and TWINSPLAN analysis. These procedures identified the following subgroups:

- pinyon-juniper - tall shrub
- pinyon-juniper - low shrub, shrub dominated
- pinyon-juniper - low shrub, grassy
- Mormon-tea shrubland without pinyon or juniper
- other shrub/grass vegetation

Cluster analysis (hierarchical agglomerative, Euclidian distance, Ward's group linkage method) was used to detect association-level relationships within these categories.

For both 2003 data and legacy data, plots were assigned to associations by inspection within groups or as individual plots identified during the analysis. Because the CARE plots were intended to fit into an existing national classification instead of a 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. 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 submitted to NatureServe, whose ecologists reviewed each plot association assignment and made adjustments to ensure consistency with NVC concepts. NatureServe was also responsible for deciding whether to add new associations to the NVC or assigning them to a “Park Special” category.

The initial analysis identified a total of 91 possible associations or groups of closely related associations, forty-two of which were represented by only one or two plots. Discussions with NatureServe ecologists and NPS staff refined the list to 80 plant associations or alliances. Of these, 50 were alliances or associations previously described in the USNVC and 30 were not previously described. These results prompted ecologists from e²M, NPS and NCPN to recommend collecting additional plot data in target vegetation types in 2004. Eighty-four plots and observation points were collected and analyzed in similar fashion as the 2003 and legacy data. The 2004 plot data added 24 associations to the classification. Following accuracy assessment data collection in 2005, types not previously recognized from the park were analyzed for possible inclusion in the classification. Thirteen associations were added to the CARE final classification following the accuracy assessment in 2005.

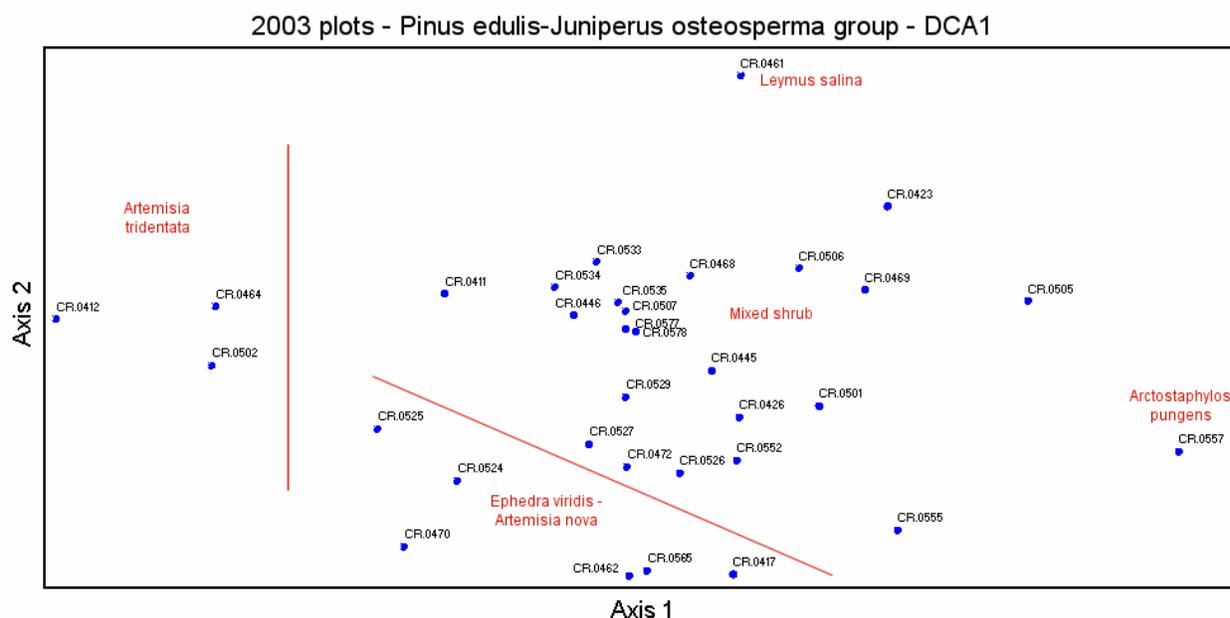


Figure 33. An example of a DCA conducted on a homogenous group of plots removed from the 2003 data set.

Significant revisions were made to the CARE classification in 2006. This was possible because between 2004 and 2006, the analysis and classification of plot data from other southeastern Utah national park units was completed (Arches NP, Canyonlands NP, Natural Bridges NM, and Hovenweep NM). NatureServe ecologists collated the plot data from these parks, combined them with the CARE data, and re-analyzed the data set. This analysis revealed that 51 associations recognized at other parks were also present in CARE.

The final classification for CARE was issued by NatureServe in June 2006. Slight revisions in 2007 included amending the classification to include information gathered during the accuracy assessment phase and to update assignments of associations to ecological systems. Also in 2007, seven associations, known to park staff but unsupported by NCPN plot data, were added to the classification in support of map classes based on them.

Classification Results

The vegetation of the CARE mapping project area was classified into 175 community types (Table 6). Of these, 164 are described at the plant association level; three others are described at the alliance level. The remaining eight are described as ‘park specials’ because they occur primarily in small stands and/or appear to be unique to the park. Park specials are not assigned to NVC associations or alliances. Thirteen of the associations are documented exclusively from data gathered during accuracy assessment. Seven additional vegetation types were not documented by plot data, but exist within the park or environs as map classes. The vegetation of the mapping project area is relatively diverse, including 76 NVC alliances and 29 ecological systems. Woodlands and saltbush shrublands dominate the vegetation, accounting for 58 associations.

All but seven of CARE’s associations, alliances, or park specials are represented by at least one and as many as 37 plot samples (Appendix E). The average number of plots per type was 3.7. Types with only one plot may have been rare in the park, or were simply undersampled as a result of difficult access or the limitations of the biophysical unit sampling design. Many of the types that appeared to be rare after the initial sampling were found to be more common during accuracy assessment. Seven associations or park specials were described from field notes only; most occur in the environs and therefore were not eligible for sampling during the accuracy assessment phase of the project.

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

NVCS Association	Common Name	Code
UPLAND ASSOCIATIONS		
UPLAND FORESTS		
Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland (CES304.790)		
<i>Pinus longaeva</i> Woodland	Intermountain Bristlecone Pine Woodland	CEGL002380
Rocky Mountain Aspen Forest and Woodland (CES306.813)		
<i>Populus tremuloides</i> / <i>Symphoricarpos oreophilus</i> Forest	Quaking Aspen / Mountain Snowberry Forest	CEGL000610
Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)		
<i>Pinus ponderosa</i> – <i>Pseudotsuga menziesii</i> / <i>Purshia tridentata</i> Woodland	Ponderosa Pine - Douglas-fir / Bitterbrush Woodland	CEGL000214
<i>Pseudotsuga menziesii</i> / <i>Cercocarpus ledifolius</i> Woodland	Douglas-fir / Curl-leaf Mountain-mahogany Woodland	CEGL000897
<i>Pseudotsuga menziesii</i> / <i>Cercocarpus montanus</i> Forest	Douglas-fir / Mountain-mahogany Forest	CEGL000898
<i>Pseudotsuga menziesii</i> / <i>Quercus gambelii</i> Forest	Douglas-fir / Gambel Oak Forest	CEGL000452
<i>Pseudotsuga menziesii</i> Scree Woodland	Douglas-fir Scree Woodland	CEGL000911
<i>Pseudotsuga menziesii</i> / <i>Symphoricarpos oreophilus</i> Forest	Douglas-fir / Mountain Snowberry Forest	CEGL000462
Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)		
<i>Pseudotsuga menziesii</i> / <i>Acer glabrum</i> Forest	Douglas-fir / Rocky Mountain Maple Forest	CEGL000418
Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)		
<i>Pinus ponderosa</i> / <i>Arctostaphylos patula</i> Woodland	Ponderosa Pine / Greenleaf Manzanita Woodland	CEGL000842
<i>Pinus ponderosa</i> / <i>Artemisia nova</i> Woodland	Ponderosa Pine / Black Sagebrush Woodland	CEGL000846
<i>Pinus ponderosa</i> / <i>Artemisia tridentata</i> ssp. <i>vaseyana</i> Woodland	Ponderosa Pine / Mountain Big Sagebrush Woodland	CEGL002794
<i>Pinus ponderosa</i> / <i>Cercocarpus ledifolius</i> Woodland	Ponderosa Pine / Curl-leaf Mountain-mahogany Woodland	CEGL000850
<i>Pinus ponderosa</i> / <i>Purshia tridentata</i> Woodland	Ponderosa Pine / Bitterbrush Woodland	CEGL000867
<i>Pinus ponderosa</i> / <i>Quercus gambelii</i> Woodland	Ponderosa Pine / Gambel Oak Woodland	CEGL000870
UPLAND WOODLANDS		

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

NVCS Association	Common Name	Code
Colorado Plateau Pinyon-Juniper Woodland (CES304.767)		
<i>Juniperus osteosperma</i> / <i>Artemisia tridentata</i> ssp. <i>tridentata</i> Woodland	Utah Juniper / Basin Big Sagebrush Woodland	CEGL002360
<i>Juniperus osteosperma</i> / <i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> Woodland	Utah Juniper / Wyoming Big Sagebrush Woodland	CEGL000730
<i>Juniperus osteosperma</i> / <i>Bouteloua gracilis</i> Woodland	Utah Juniper / Blue Grama Woodland	CEGL002361
<i>Juniperus osteosperma</i> / <i>Hesperostipa comata</i> Woodland	Utah Juniper / Needle-and-Thread Woodland	CEGL002815
<i>Juniperus osteosperma</i> / <i>Leymus salinus</i> Woodland	Utah Juniper / Salinas Lyme Grass Woodland	CEGL003109
<i>Juniperus osteosperma</i> / <i>Pleuraphis jamesii</i> Woodland	Utah Juniper / James' Galleta Woodland	CEGL002362
<i>Juniperus osteosperma</i> / Sparse Understory Woodland	Utah Juniper / Sparse Understory Woodland	CEGL000732
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / <i>Achnatherum hymenoides</i> Woodland	Two-needle Pinyon - Utah Juniper / Indian Ricegrass Woodland	CEGL002364
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / <i>Amelanchier utahensis</i> Woodland	Two-needle Pinyon - Utah Juniper / Utah Serviceberry Woodland	CEGL002329
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / <i>Arctostaphylos patula</i> Woodland	Two-needle Pinyon - Utah Juniper / Greenleaf Manzanita Woodland	CEGL002939
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / <i>Artemisia bigelovii</i> Woodland	Two-needle Pinyon - Utah Juniper / Bigelow Sagebrush Woodland	CEGL002118
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / <i>Artemisia nova</i> Woodland	Two-needle Pinyon - Utah Juniper / Black Sagebrush Woodland	CEGL002331
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / <i>Artemisia pygmaea</i> Woodland	Two-needle Pinyon - Utah Juniper / Pygmy Sagebrush Woodland	CEGL002365
<i>Pinus edulis</i> - <i>Juniperus</i> spp. / <i>Artemisia tridentata</i> (ssp. <i>wyomingensis</i> , ssp. <i>vaseyana</i>) Woodland	Two-needle Pinyon - Juniper Species / Wyoming Big Sagebrush Woodland	CEGL000776
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / <i>Atriplex</i> spp. Woodland	Two-needle Pinyon - Utah Juniper / Saltbush species Woodland	CEGL002366
<i>Pinus edulis</i> - (<i>Juniperus osteosperma</i>) / <i>Bouteloua gracilis</i> Woodland	Two-needle Pinyon - (Utah Juniper) / Blue Grama Woodland	CEGL000778
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / <i>Bromus tectorum</i> Semi-natural Woodland	Two-needle Pinyon - Utah Juniper / Cheatgrass Semi-natural Woodland	CEGL002367
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / <i>Cercocarpus ledifolius</i> Woodland	Two-needle Pinyon - Utah Juniper / Curl-leaf Mountain-mahogany Woodland	CEGL002940
<i>Pinus edulis</i> - <i>Juniperus</i> spp. / <i>Cercocarpus montanus</i> - Mixed Shrub Woodland	Two-needle Pinyon - Juniper Species / Mountain-mahogany Mixed Shrub Woodland	CEGL000780

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

NVCS Association	Common Name	Code
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / <i>Coleogyne ramosissima</i> Woodland	Two-needle Pinyon - Utah Juniper / Blackbrush Woodland	CEGL000781
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / Cushion Plant Woodland	Two-needle Pinyon - Utah Juniper / Cushion Plant Woodland	CEGL002375
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / <i>Ephedra torreyana</i> - <i>Artemisia bigelovii</i> Woodland	Two-needle Pinyon - Utah Juniper / Torrey Joint-fir - Bigelow Sagebrush Woodland	CEGL002369
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / <i>Ephedra viridis</i> Woodland	Two-needle Pinyon - Utah Juniper / Mormon-tea Woodland	CEGL002370
<i>Pinus edulis</i> - (<i>Juniperus monosperma</i> , <i>Juniperus osteosperma</i>) / <i>Hesperostipa comata</i> Woodland	Two-needle Pinyon - (One-seed Juniper, Utah Juniper) / Needle-and-Thread Woodland	CEGL000797
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / <i>Hesperostipa neomexicana</i> Woodland	Two-needle Pinyon - Utah Juniper / New Mexico Needlegrass Woodland	CEGL002371
<i>Pinus edulis</i> - <i>Juniperus</i> spp. / <i>Leymus salinus</i> Woodland	Two-needle Pinyon-Juniper species / Salinas Lyme Grass Woodland	CEGL002340
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / <i>Muhlenbergia pungens</i> Woodland	Two-needle Pinyon - Utah Juniper / Sandhills Muhly Woodland	CEGL002373
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / <i>Opuntia fragilis</i> Woodland	Two-needle Pinyon - Utah Juniper / Brittle Prickly-pear Woodland	CEGL002374
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / <i>Pleuraphis jamesii</i> Woodland	Two-needle Pinyon – Utah Juniper / James' Galleta Woodland	CEGL002379
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / <i>Psathyrostachys juncea</i> Semi-natural Woodland	Two-needle Pinyon - Utah Juniper / Russian Wildrye Semi-natural Woodland	CEGL002368
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / <i>Purshia stansburiana</i> Woodland	Two-needle Pinyon - Utah Juniper / Stansbury Cliffrose Woodland	CEGL000782
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / <i>Purshia tridentata</i> Woodland	Two-needle Pinyon – Utah Juniper / Antelope Bitterbrush Woodland	CEGL000789
<i>Pinus edulis</i> - <i>Juniperus</i> spp. / <i>Quercus gambelii</i> Woodland	Two-needle Pinyon-Juniper species / Gambel Oak Woodland	CEGL000791
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / <i>Quercus havardii</i> var. <i>tuckeri</i> Woodland	Two-needle Pinyon - Utah Juniper / Tucker Sand Shinnery Oak Woodland	CEGL002497
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / <i>Shepherdia rotundifolia</i> Woodland	Two-needle Pinyon - Utah Juniper / Roundleaf Buffaloberry Woodland	CEGL002335
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / Sparse Understory Woodland	Two-needle Pinyon - Utah Juniper / Sparse Understory Woodland	CEGL002148
Inter-Mountain Basins Mountain Mahogany Woodland and Shrubland (CES304.772)		
<i>Cercocarpus ledifolius</i> / <i>Artemisia tridentata</i> ssp. <i>vaseyana</i> Woodland	Curl-leaf Mountain-mahogany / Mountain Big Sagebrush Woodland	CEGL001022

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

NVCS Association	Common Name	Code
UPLAND SHRUBLANDS		
Great Basin Semi-Desert Chaparral (CES304.001)		
<i>Arctostaphylos patula</i> Shrubland	Greenleaf Manzanita Shrubland	CEGL002696
Colorado Plateau Blackbrush-Mormon-tea Shrubland (CES304.763)		
<i>Coleogyne ramosissima</i> - <i>Purshia stansburiana</i> - <i>Quercus havardii</i> var. <i>tuckeri</i> Shrubland	Blackbrush - Stansbury Cliffrose - Tucker Sand Shinnery Oak Shrubland	CEGL002348
<i>Coleogyne ramosissima</i> / <i>Pleuraphis jamesii</i> Shrubland	Blackbrush / James' Galleta Shrubland	CEGL001334
<i>Coleogyne ramosissima</i> Shrubland	Blackbrush Shrubland	CEGL001332
<i>Ephedra viridis</i> / (<i>Achnatherum hymenoides</i> , <i>Hesperostipa comata</i>) Shrubland	Mormon-tea / (Indian Ricegrass, Needle-and-thread) Shrubland	CEGL002354
<i>Ephedra viridis</i> / <i>Bromus tectorum</i> Semi-natural Shrubland	Mormon-tea / Cheatgrass Semi-natural Shrubland	CEGL002355
<i>Ephedra viridis</i> / <i>Pleuraphis jamesii</i> Shrubland	Mormon-tea / James' Galleta Shrubland	CEGL002356
Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762)		
<i>Artemisia bigelovii</i> Shrubland	Bigelow Sagebrush Shrubland	CEGL000276
<i>Artemisia frigida</i> - (<i>Bouteloua gracilis</i> , <i>Achnatherum hymenoides</i> , <i>Poa secunda</i>) - Lichens Rocky Mesa Dwarf-shrubland	Fringed Sagebrush - (Blue Grama, Indian Ricegrass, Curly Bluegrass) - Lichens Rocky Mesa Dwarf-shrubland	CEGL002344
<i>Artemisia nova</i> - <i>Purshia tridentata</i> / <i>Poa fendleriana</i> Shrubland	Black Sagebrush - Bitterbrush / Muttongrass Shrubland	CEGL002345
<i>Artemisia nova</i> / <i>Poa fendleriana</i> Shrubland	Black Sagebrush / Muttongrass Shrubland	CEGL002698
Colorado Plateau Pinyon-Juniper Shrubland (CES304.766)		
<i>Juniperus osteosperma</i> - (<i>Pinus edulis</i>) / <i>Coleogyne ramosissima</i> - <i>Purshia stansburiana</i> - <i>Quercus havardii</i> var. <i>tuckeri</i> Wooded Shrubland	Utah Juniper - (Two-needle Pinyon) / Blackbrush - Stansbury's Cliffrose - Tucker Sand Shinnery Oak Wooded Shrubland	CEGL003774
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / (<i>Shepherdia rotundifolia</i> , <i>Amelanchier utahensis</i>) Wooded Shrubland	Two-needle Pinyon - Utah Juniper / (Roundleaf Buffaloberry, Utah Serviceberry) Wooded Shrubland	CEGL002334
Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)		
<i>Artemisia tridentata</i> / <i>Achnatherum hymenoides</i> Shrubland	Basin Big Sagebrush / Indian Ricegrass Shrubland	CEGL001006
<i>Artemisia tridentata</i> - (<i>Ericameria nauseosa</i>) / <i>Bromus tectorum</i> Semi-	Basin Big Sagebrush - (Rubber Rabbitbrush) / Cheatgrass Semi-	CEGL002699

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

NVCS Association	Common Name	Code
natural Shrubland	natural Shrubland	
<i>Artemisia tridentata</i> ssp. <i>tridentata</i> / <i>Pleuraphis jamesii</i> Shrubland	Basin Big Sagebrush / James' Galleta Shrubland	CEGL001015
<i>Artemisia tridentata</i> ssp. <i>tridentata</i> / <i>Sporobolus airoides</i> Shrubland	Basin Big Sagebrush / Alkali Sacaton Shrubland	CEGL002200
<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> / (<i>Agropyron cristatum</i> , <i>Psathyrostachys juncea</i>) Seeded Grasses Semi-natural Shrubland	Wyoming Big Sagebrush / Crested Wheatgrass, Russian Wildrye) Seeded Grasses Semi-natural Shrubland	CEGL002185
<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> / <i>Bouteloua gracilis</i> Shrubland	Wyoming Big Sagebrush / Blue Grama Shrubland	CEGL001041
<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> / Disturbed Understory Semi-natural Shrubland	Wyoming Big Sagebrush / Disturbed Understory Semi-natural Shrubland	CEGL002083
Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)		
<i>Atriplex canescens</i> / <i>Bouteloua gracilis</i> Shrubland	Fourwing Saltbush / Blue Grama Shrubland	CEGL001283
<i>Atriplex canescens</i> / <i>Sporobolus airoides</i> Shrubland	Fourwing Saltbush / Alkali Sacaton Shrubland	CEGL001291
<i>Atriplex canescens</i> Shrubland	Fourwing Saltbush Shrubland	CEGL001281
<i>Atriplex confertifolia</i> - <i>Krascheninnikovia lanata</i> Shrubland	Shadscale - Winter-fat Shrubland	CEGL001301
<i>Atriplex confertifolia</i> - <i>Sarcobatus vermiculatus</i> Shrubland	Shadscale - Black Greasewood Shrubland	CEGL001313
<i>Atriplex confertifolia</i> / <i>Achnatherum hymenoides</i> Shrubland	Shadscale / Indian Ricegrass Shrubland	CEGL001311
<i>Atriplex confertifolia</i> / <i>Pleuraphis jamesii</i> Shrubland	Shadscale / James' Galleta Shrubland	CEGL001304
<i>Atriplex confertifolia</i> Great Basin Shrubland	Shadscale Great Basin Shrubland	CEGL001294
Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818)		
<i>Quercus gambelii</i> / <i>Amelanchier utahensis</i> Shrubland	Gambel Oak / Utah Serviceberry Shrubland	CEGL001110
<i>Quercus gambelii</i> / Sparse Understory Shrubland	Gambel Oak / Sparse Understory Shrubland	CEGL002337
Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)		
<i>Amelanchier utahensis</i> Shrubland	Utah Serviceberry Shrubland	CEGL001067
<i>Symphoricarpos oreophilus</i> Shrubland	Mountain Snowberry Shrubland	CEGL002951
Inter-Mountain Basins Active and Stabilized Dune (CES304.775)		
<i>Artemisia filifolia</i> Colorado Plateau Shrubland	Sand Sagebrush Colorado Plateau Shrubland	CEGL002697

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

NVCS Association	Common Name	Code
<i>Ericameria nauseosa</i> Sand Deposit Sparse Shrubland	Rubber Rabbitbrush Sand Deposit Sparse Shrubland	CEGL002980
<i>Eriogonum leptocladon</i> / <i>Muhlenbergia pungens</i> Shrubland	Sand Wild Buckwheat / Sandhill Muhly Shrubland	CEGL002821
<i>Eriogonum leptocladon</i> Sparse Vegetation	Sand Wild Buckwheat Sparse Vegetation	CEGL002822
<i>Muhlenbergia pungens</i> Herbaceous Vegetation	Sandhills Muhly Herbaceous Vegetation	CEGL002363
<i>Poliomintha incana</i> - <i>Artemisia filifolia</i> - <i>Vanclevea stylosa</i> Shrubland	Hoary Rosemarymint - Sand Sagebrush - Pillar False Gumweed Shrubland	CEGL002418
<i>Quercus havardii</i> var. <i>tuckeri</i> Shrubland	Tucker Sand Shinnery Oak Shrubland	CEGL002486
Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785)		
<i>Artemisia tridentata</i> ssp. <i>vaseyana</i> / <i>Poa fendleriana</i> Shrubland	Mountain Big Sagebrush / Muttongrass Shrubland	CEGL002812
Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)		
<i>Achnatherum hymenoides</i> Shrub Herbaceous Alliance	Indian Ricegrass Shrub Herbaceous Alliance	A.1543
<i>Atriplex canescens</i> / <i>Pleuraphis jamesii</i> Shrubland	Fourwing Saltbush / James' Galleta Shrubland	CEGL001288
<i>Ephedra torreyana</i> / <i>Achnatherum hymenoides</i> - <i>Pleuraphis jamesii</i> Shrubland	Torrey Joint-fir / Indian Ricegrass - James' Galleta Shrubland	CEGL002352
<i>Ephedra torreyana</i> / <i>Bouteloua gracilis</i> - <i>Pleuraphis jamesii</i> Shrubland	Torrey Joint-fir / Blue Grama - James' Galleta Shrubland	CEGL002351
<i>Ericameria nauseosa</i> / <i>Bouteloua gracilis</i> Shrub Herbaceous Vegetation	Rubber Rabbitbrush / Blue Grama Shrub Herbaceous Vegetation	CEGL003495
<i>Ericameria nauseosa</i> / <i>Bromus tectorum</i> Semi-natural Shrubland	Rubber Rabbitbrush / Cheatgrass Semi-natural Shrubland	CEGL002937
<i>Grayia spinosa</i> Shrubland	Spiny Hop-sage Shrubland	CEGL002358
<i>Gutierrezia sarothrae</i> / <i>Sporobolus airoides</i> - <i>Pleuraphis jamesii</i> Shrub Herbaceous Vegetation	Snakeweed / Alkali Sacaton - James' Galleta Shrub Herbaceous Vegetation	CEGL001776
<i>Krascheninnikovia lanata</i> / <i>Pleuraphis jamesii</i> Dwarf-shrubland	Winter-fat / James' Galleta Dwarf-shrubland	CEGL001322
<i>Krascheninnikovia lanata</i> Dwarf-shrubland	Winter-fat Dwarf-shrubland	CEGL001320
Inter-Mountain Basins Greasewood Flat (CES304.780)		
<i>Ericameria nauseosa</i> / <i>Sporobolus airoides</i> Shrubland	Rubber Rabbitbrush / Alkali Sacaton Shrubland	CEGL002918
<i>Halogeton glomeratus</i> Semi-natural Herbaceous Vegetation	Saltlover Semi-natural Herbaceous Vegetation	Park Special

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

NVCS Association	Common Name	Code
<i>Sarcobatus vermiculatus</i> / <i>Artemisia tridentata</i> Shrubland	Black Greasewood / Basin Big Sagebrush Shrubland	CEGL001359
<i>Sarcobatus vermiculatus</i> / <i>Atriplex confertifolia</i> - (<i>Picrothamnus desertorum</i> , <i>Suaeda moquinii</i>) Shrubland	Black Greasewood / Shadscale - (Bud Sagebrush, Shrubby Seepweed) Shrubland	CEGL001371
<i>Sarcobatus vermiculatus</i> / <i>Distichlis spicata</i> Shrubland	Black Greasewood / Saltgrass Shrubland	CEGL001363
<i>Sarcobatus vermiculatus</i> / <i>Sporobolus airoides</i> Shrubland	Black Greasewood / Alkali Sacaton Shrubland	CEGL001368
<i>Sarcobatus vermiculatus</i> Disturbed Shrubland	Black Greasewood Disturbed Shrubland	CEGL001357
UPLAND GRASSLANDS		
Inter-Mountain Basins Semi-Desert Grassland (CES304.787)		
<i>Achnatherum hymenoides</i> Colorado Plateau Herbaceous Vegetation	Indian Ricegrass Colorado Plateau Herbaceous Vegetation	CEGL002343
<i>Bouteloua eriopoda</i> - <i>Pleuraphis jamesii</i> Herbaceous Vegetation	Black Grama - James' Galleta Herbaceous Vegetation	CEGL001751
<i>Bouteloua gracilis</i> - <i>Hesperostipa comata</i> Herbaceous Vegetation	Blue Grama - Needle-and-Thread Herbaceous Vegetation	CEGL002932
<i>Bouteloua gracilis</i> - <i>Pleuraphis jamesii</i> Herbaceous Vegetation	Blue Grama - James' Galleta Herbaceous Vegetation	CEGL001759
<i>Bromus tectorum</i> Semi-natural Herbaceous Vegetation	Cheatgrass Semi-natural Herbaceous Vegetation	CEGL003019
<i>Hesperostipa comata</i> Great Basin Herbaceous Vegetation	Needle-and-Thread Great Basin Herbaceous Vegetation	CEGL001705
<i>Pleuraphis jamesii</i> Herbaceous Vegetation	James' Galleta Herbaceous Vegetation	CEGL001777
<i>Pleuraphis jamesii</i> - <i>Sporobolus airoides</i> Herbaceous Vegetation	James' Galleta - Alkali Sacaton Herbaceous Vegetation	CEGL001778
<i>Poa fendleriana</i> / Non-vascular Herbaceous Vegetation	Muttongrass/ Non-vascular Herbaceous Vegetation	Park Special
<i>Sporobolus airoides</i> Southern Plains Herbaceous Vegetation	Alkali Sacaton Southern Plains Herbaceous Vegetation	CEGL001685
<i>Sporobolus flexuosus</i> Herbaceous Alliance	Mesa Dropseed Herbaceous Alliance	A.1268
UPLAND SPARSE VEGETATION		
Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)		
<i>Atriplex canescens</i> – <i>Ephedra viridis</i> Talus Shrubland	Fourwing Saltbush – Green Mormon-tea Talus Shrubland	CEGL002346
<i>Atriplex</i> spp. Extreme Sparse Shrubland	Saltbush species Extreme Sparse Shrubland	Park Special
<i>Celtis laevigata</i> var. <i>reticulata</i> Slickrock Canyon Woodland	Netleaf Hackberry Slickrock Canyon Woodland	CEGL002359

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

NVCS Association	Common Name	Code
<i>Cercocarpus intricatus</i> Slickrock Sparse Vegetation	Littleleaf Mountain-mahogany Slickrock Sparse Vegetation	CEGL002977
<i>Chrysothamnus viscidiflorus</i> Talus Shrubland	Green Rabbitbrush Talus Shrubland	CEGL002347
<i>Ephedra torreyana</i> Sparse Vegetation	Torrey Joint-fir Sparse Vegetation	CEGL002353
<i>Juniperus osteosperma</i> / <i>Cercocarpus intricatus</i> Woodland	Utah Juniper / Littleleaf Mountain-mahogany Woodland	CEGL000733
<i>Pinus edulis</i> – <i>Juniperus osteosperma</i> / <i>Cercocarpus intricatus</i> Woodland	Two-needle Pinyon – Utah Juniper / Littleleaf Mountain-mahogany Woodland	CEGL000779
<i>Pinus edulis</i> – <i>Juniperus osteosperma</i> / <i>Petradoria pumila</i> Woodland	Two-needle Pinyon – Utah Juniper / Grassy Rock-goldenrod Woodland	CEGL002332
<i>Pinus ponderosa</i> / Sparse Understory Woodland	Ponderosa Pine / Sparse Understory Woodland	CEGL002384
<i>Pinus ponderosa</i> Slickrock Sparse Vegetation	Ponderosa Pine Slickrock Sparse Vegetation	CEGL002972
Slickrock Fin Pocket [Park Special]	Slickrock Fin Pocket [Park Special]	Park Special
Sparse Cushion Plant Herbaceous Vegetation	Sparse Cushion Plant Herbaceous Vegetation	Park Special
Waterpocket Community [Park Special]	Waterpocket Community [Park Special]	Park Special
Inter-Mountain Basins Shale Badland (CES304.789)		
<i>Atriplex corrugata</i> Dwarf-shrubland	Mat Saltbush Dwarf-shrubland	CEGL001437
<i>Atriplex gardneri</i> / <i>Achnatherum hymenoides</i> Dwarf-shrubland	Gardner's Saltbush / Indian Ricegrass Dwarf-shrubland	CEGL001444
<i>Atriplex gardneri</i> / <i>Pleuraphis jamesii</i> Dwarf-shrubland	Gardner's Saltbush / James' Galleta Dwarf-shrubland	CEGL001441
<i>Atriplex gardneri</i> / <i>Xylorhiza venusta</i> Dwarf-shrubland	Gardner's Saltbush / Charming Woody-aster Dwarf-shrubland	CEGL001446
<i>Atriplex gardneri</i> Dwarf-shrubland	Gardner's Saltbush Dwarf-shrubland	CEGL001438
<i>Ephedra torreyana</i> - <i>Artemisia bigelovii</i> Sparse Vegetation	Torrey Joint-fir – Bigelow Sagebrush Sparse Vegetation	CEGL002350
<i>Ephedra torreyana</i> - (<i>Atriplex</i> spp.) / Nonvascular Gypsum Sparse Vegetation	Torrey Joint-fir - (Saltbush species) / Nonvascular Gypsum Sparse Vegetation	CEGL002349
<i>Eriogonum corymbosum</i> Badlands Sparse Vegetation	Crispleaf Wild Buckwheat Badlands Sparse Vegetation	CEGL002979
<i>Leymus salinus</i> Shale Sparse Vegetation	Salinas Lyme Grass Shale Sparse Vegetation	CEGL002745
<i>Zuckia brandegeei</i> Sparse Vegetation	Siltbush Sparse Vegetation	CEGL002493

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

NVCS Association	Common Name	Code
Inter-Mountain Basins Wash (CES304.781)		
<i>Atriplex canescens</i> Desert Wash Shrubland	Fourwing Saltbush Desert Wash Shrubland	CEGL003470
<i>Ericameria nauseosa</i> Desert Wash Shrubland	Rubber Rabbitbrush Desert Wash Shrubland	CEGL002261
<i>Fallugia paradoxa</i> Desert Wash Shrubland	Apache Plume Desert Wash Shrubland	CEGL002357
<i>Fraxinus anomala</i> Woodland	Singleleaf Ash Woodland	CEGL002752
Mesic Canyon Bottom Shrubland	Mesic Canyon Bottom Shrubland	Park Special
RIPARIAN, WETLAND AND MESIC ASSOCIATIONS		
RIPARIAN AND WETLAND WOODLANDS AND SHRUBLANDS		
North American Warm Desert Riparian Woodland and Shrubland (CES302.753)		
<i>Tamarix</i> spp. Temporarily Flooded Shrubland	Salt-cedar species Temporarily Flooded Shrubland	CEGL003114
Rocky Mountain Lower Montane Riparian Woodland and Shrubland (CES306.821)		
<i>Acer negundo</i> - <i>Ostrya knowltonii</i> Woodland	Box-elder - Knowlton's Hop-hornbeam Woodland	CEGL002342
<i>Acer negundo</i> / <i>Quercus gambelii</i> Woodland	Box-elder / Gambel Oak Woodland	CEGL002797
<i>Acer negundo</i> / <i>Rhus trilobata</i> Woodland	Box-elder / Skunkbush Woodland	CEGL002750
<i>Betula occidentalis</i> Shrubland	River Birch Shrubland	CEGL001080
<i>Cornus sericea</i> Shrubland	Red-osier Dogwood Shrubland	CEGL001165
<i>Populus angustifolia</i> / <i>Rhus trilobata</i> Woodland	Narrowleaf Cottonwood / Skunkbush Woodland	CEGL000652
<i>Populus fremontii</i> / <i>Acer negundo</i> Forest	Fremont Cottonwood / Box-elder Forest	CEGL000662
<i>Populus fremontii</i> / <i>Ericameria nauseosa</i> Woodland	Fremont Cottonwood / Rubber Rabbitbrush Woodland	CEGL002465
<i>Populus fremontii</i> / Mesic Forbs Woodland	Fremont Cottonwood / Mesic Forbs Woodland	CEGL002470
<i>Populus fremontii</i> / Mesic Graminoids Woodland	Fremont Cottonwood / Mesic Graminoids Woodland	CEGL002473
<i>Populus fremontii</i> / <i>Salix exigua</i> Forest	Fremont Cottonwood / Coyote Willow Forest	CEGL000666
<i>Populus fremontii</i> - <i>Salix gooddingii</i> Woodland	Fremont Cottonwood - Goodding's Willow Woodland	CEGL000944

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

NVCS Association	Common Name	Code
<i>Pseudotsuga menziesii</i> / <i>Betula occidentalis</i> Woodland	Douglas-fir / River Birch Woodland	CEGL002639
<i>Rhus trilobata</i> Intermittently Flooded Shrubland	Skunkbush Intermittently Flooded Shrubland	CEGL001121
<i>Salix exigua</i> / Barren Shrubland	Coyote Willow / Barren Shrubland	CEGL001200
<i>Salix exigua</i> / Mesic Graminoids Shrubland	Coyote Willow / Mesic Graminoids Shrubland	CEGL001203
<i>Salix gooddingii</i> Temporarily Flooded Woodland Alliance	Goodding's Willow Temporarily Flooded Woodland Alliance	A.640
Rocky Mountain Subalpine-Montane Riparian Woodland (CES306.833)		
<i>Picea pungens</i> / <i>Cornus sericea</i> Woodland	Blue Spruce / Red-osier Dogwood Woodland	CEGL000388
RIPARIAN AND WETLAND HERBACEOUS COMMUNITIES		
Colorado Plateau Hanging Garden (CES304.764)		
<i>Aquilegia micrantha</i> - <i>Mimulus eastwoodiae</i> Herbaceous Vegetation	Mancos Columbine - Eastwood's Monkeyflower Herbaceous Vegetation	CEGL002729
North American Arid West Emergent Marsh (CES300.729)		
<i>Eleocharis palustris</i> Herbaceous Vegetation	Marsh Spikerush Herbaceous Vegetation	CEGL001833
<i>Juncus balticus</i> Herbaceous Vegetation	Baltic Rush Herbaceous Vegetation	CEGL001838
<i>Phragmites australis</i> Western North America Temperate Semi-natural Herbaceous Vegetation	Common Reed Western North America Temperate Semi-natural Herbaceous Vegetation	CEGL001475
<i>Schoenoplectus pungens</i> Herbaceous Vegetation	Threesquare Herbaceous Vegetation	CEGL001587
<i>Typha</i> (<i>latifolia</i> , <i>angustifolia</i>) Western Herbaceous Vegetation	(Broadleaf, Narrowleaf Cattail) Western Herbaceous Vegetation	CEGL002010
Wet Meadow Herbaceous Vegetation	Wet Meadow Herbaceous Vegetation	Park Special

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

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

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

Plant Community Descriptions

This section provides a summary of CARE vegetation by physiognomic group. Appendix F provides detailed local and global descriptions of the 175 plant associations, alliances and park special vegetation types found within the park. Local descriptions are based on classification plot, observation point, and accuracy assessment point data from the park and environs, supplemented by input from knowledgeable park staff. Global descriptions characterize the association across its range and are based primarily on published and unpublished literature.

Most of the vegetation types sampled within CARE fit into existing NVC association concepts, or were considered significant enough to create new NVC associations for them. Eight associations were considered unique to the park, and were designated as ‘park specials’. Three vegetation types fit into alliance concepts but lacked sufficient justification for creating new associations. Seven types were documented from personal communications or field notes only, and do not have local or global descriptions, although they are incorporated into the map classes.

Upland Forest and Woodland Associations

Woodlands and forests are the most common and widely distributed vegetation types within CARE. They occupy nearly every available habitat, from riparian corridors to rock outcrops to mountain slopes. Canopy density is generally controlled by the availability of soil moisture or rooting sites. Most lower-elevation stands at CARE do not have the closed tree canopy that usually characterizes forest (as opposed to more open woodland) associations. All stands are subject to fire; those on steep canyon walls are also vulnerable to downslope soil movement or rock fall. The upland forest and woodland associations at CARE include:

- *Cercocarpus ledifolius* / *Artemisia tridentata* ssp. *vaseyana* Woodland
- *Juniperus osteosperma* - (*Pinus edulis*) / *Coleogyne ramosissima* - *Purshia stansburiana* - *Quercus havardii* var. *tuckeri* Wooded Shrubland
- *Juniperus osteosperma* / *Artemisia tridentata* ssp. *tridentata* Woodland
- *Juniperus osteosperma* / *Cercocarpus intricatus* Woodland
- *Juniperus osteosperma* / *Leymus salinus* Woodland
- *Pinus edulis* - (*Juniperus monosperma*, *Juniperus osteosperma*) / *Hesperostipa comata* Woodland
- *Pinus edulis* - (*Juniperus osteosperma*) / *Bouteloua gracilis* Woodland
- *Pinus edulis* - *Juniperus osteosperma* / (*Shepherdia rotundifolia*, *Amelanchier utahensis*) Wooded Shrubland
- *Pinus edulis* - *Juniperus osteosperma* / *Amelanchier utahensis* Woodland
- *Pinus edulis* - *Juniperus osteosperma* / *Arctostaphylos patula* Woodland
- *Pinus edulis* - *Juniperus osteosperma* / *Artemisia bigelovii* Woodland
- *Pinus edulis* - *Juniperus osteosperma* / *Atriplex* spp. Woodland
- *Pinus edulis* - *Juniperus osteosperma* / *Bromus tectorum* Semi-natural Woodland
- *Pinus edulis* - *Juniperus osteosperma* / *Cercocarpus intricatus* Woodland
- *Pinus edulis* - *Juniperus osteosperma* / *Cercocarpus ledifolius* Woodland
- *Pinus edulis* - *Juniperus osteosperma* / *Coleogyne ramosissima* Woodland
- *Pinus edulis* - *Juniperus osteosperma* / Cushion Plant Woodland
- *Pinus edulis* - *Juniperus osteosperma* / *Ephedra torreyana* - *Artemisia bigelovii* Woodland
- *Pinus edulis* - *Juniperus osteosperma* / *Ephedra viridis* Woodland
- *Pinus edulis* - *Juniperus osteosperma* / *Opuntia fragilis* Woodland
- *Pinus edulis* - *Juniperus osteosperma* / *Petradoria pumila* Woodland
- *Pinus edulis* - *Juniperus osteosperma* / *Pleuraphis jamesii* Woodland
- *Pinus edulis* - *Juniperus osteosperma* / *Psathyrostachys juncea* Semi-natural Woodland

- *Pinus edulis* - *Juniperus osteosperma* / *Purshia stansburiana* Woodland
- *Pinus edulis* - *Juniperus osteosperma* / *Quercus havardii* var. *tuckeri* 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* / *Purshia tridentata* Woodland
- *Pinus ponderosa* / *Arctostaphylos patula* Woodland
- *Pinus ponderosa* / *Artemisia nova* Woodland
- *Pinus ponderosa* / *Artemisia tridentata* ssp. *vaseyana* Woodland
- *Pinus ponderosa* / *Cercocarpus ledifolius* Woodland
- *Pinus ponderosa* / *Purshia tridentata* Woodland
- *Pinus ponderosa* / *Quercus gambelii* Woodland
- *Pinus ponderosa* Slickrock Sparse Vegetation
- *Populus tremuloides* / *Symphoricarpos oreophilus* Forest
- *Pseudotsuga menziesii* / *Cercocarpus ledifolius* Woodland
- *Pseudotsuga menziesii* / *Cercocarpus montanus* Woodland
- *Pseudotsuga menziesii* / *Quercus gambelii* Forest
- *Pseudotsuga menziesii* / *Symphoricarpos oreophilus* Forest
- *Pseudotsuga menziesii* Scree Woodland

Woodland types are represented by juniper woodland, pinyon-juniper woodland, bristlecone pine, Douglas-fir, and ponderosa pine. Bristlecone pine woodlands are the rarest woodland type, restricted to slopes and ridgelines of the Carmel Formation above 2,300 m (7,545 ft) elevation. Woodlands and forests dominated by quaking aspen or Douglas-fir are also restricted to specialized habitats at CARE, occurring primarily in cold canyons draining Thousand Lakes Mountain or on open slopes above 2,230 m (7,300 ft) elevation. Ponderosa pine woodlands occur primarily in one of two habitats: sparse communities of dwarfed trees growing in slickrock cracks, or tall, moderately dense woodlands on deep, although still rocky, soils on mesa tops and mountain slopes. Juniper and pinyon-juniper woodlands are among the most diverse and widespread communities within the mapping area. Pinyon tends to be absent from stands on dry or low-elevation sites. Deeper soils support dense pinyon-juniper stands with understories of shrubs or grasses; shallow rocky soils support sparser, but more diverse vegetation. Pinyon-juniper stands on deep sand have trees with large crowns but little groundcover other than biological soil crusts. Marine shales support juniper stands that tend to be very open, but also diverse in their understory composition.

Upland Shrubland Associations

Shrublands are the most diverse community type within the mapping area. Some communities on badlands are extremely sparse, while others on deep soils with good water holding capacity are densely vegetated. The upland shrubland associations of CARE include:

- *Amelanchier utahensis* Shrubland
- *Arctostaphylos patula* Shrubland
- *Artemisia bigelovii* Shrubland
- *Artemisia filifolia* Colorado Plateau Shrubland
- *Artemisia frigida* - (*Bouteloua gracilis*, *Achnatherum hymenoides*, *Poa secunda*) - Lichens Rocky Mesa

Dwarf-shrubland

- *Artemisia nova* - *Purshia tridentata* / *Poa fendleriana* Shrubland
- *Artemisia nova* / *Poa fendleriana* Shrubland
- *Artemisia tridentata* - (*Ericameria nauseosa*) / *Bromus tectorum* Semi-natural Shrubland
- *Artemisia tridentata* ssp. *tridentata* / *Sporobolus airoides* Shrubland
- *Artemisia tridentata* ssp. *vaseyana* / *Poa fendleriana* Shrubland
- *Artemisia tridentata* ssp. *wyomingensis* / (*Agropyron cristatum*, *Psathyrostachys juncea*) Seeded Grasses Semi-natural Shrubland
- *Artemisia tridentata* ssp. *wyomingensis* / *Bouteloua gracilis* Shrubland
- *Atriplex canescens* - *Ephedra viridis* Talus Shrubland
- *Atriplex canescens* / *Bouteloua gracilis* Shrubland
- *Atriplex canescens* / *Sporobolus airoides* Shrubland
- *Atriplex canescens* Desert Wash Shrubland
- *Atriplex confertifolia* - *Krascheninnikovia lanata* Shrubland
- *Atriplex confertifolia* - *Sarcobatus vermiculatus* Shrubland
- *Atriplex confertifolia* / *Pleuraphis jamesii* Shrubland
- *Atriplex corrugata* Dwarf-shrubland
- *Atriplex gardneri* / *Pleuraphis jamesii* Dwarf-shrubland
- *Atriplex gardneri* Dwarf-shrubland
- *Cercocarpus intricatus* Slickrock Sparse Vegetation
- *Chrysothamnus viscidiflorus* Talus Shrubland
- *Coleogyne ramosissima* - *Purshia stansburiana* - *Quercus havardii* var. *tuckeri* Shrubland
- *Coleogyne ramosissima* / *Pleuraphis jamesii* Shrubland
- *Coleogyne ramosissima* Shrubland
- *Ephedra torreyana* - (*Atriplex* spp.) / Nonvascular Gypsum Sparse Vegetation
- *Ephedra torreyana* - *Artemisia bigelovii* Sparse Vegetation
- *Ephedra torreyana* / *Bouteloua gracilis* - *Pleuraphis jamesii* Shrubland
- *Ephedra viridis* / (*Achnatherum hymenoides*, *Hesperostipa comata*) Shrubland
- *Ephedra viridis* / *Bromus tectorum* Semi-natural Shrubland
- *Ephedra viridis* / *Pleuraphis jamesii* Shrubland
- *Ericameria nauseosa* / *Bouteloua gracilis* Shrub Herbaceous Vegetation
- *Ericameria nauseosa* / *Sporobolus airoides* Shrubland
- *Ericameria nauseosa* Desert Wash Shrubland
- *Eriogonum corymbosum* Badlands Sparse Vegetation
- *Eriogonum leptocladon* Sparse Vegetation
- *Krascheninnikovia lanata* Dwarf-shrubland
- *Poliomintha incana* - *Artemisia filifolia* - *Vanclaveva stylosa* Shrubland
- *Quercus gambelii* / *Amelanchier utahensis* Shrubland
- *Quercus havardii* var. *tuckeri* Shrubland
- *Sarcobatus vermiculatus* / *Artemisia tridentata* Shrubland
- *Sarcobatus vermiculatus* / *Distichlis spicata* Shrubland
- *Sarcobatus vermiculatus* / *Sporobolus airoides* Shrubland
- *Sarcobatus vermiculatus* Disturbed Shrubland
- *Symphoricarpos oreophilus* Shrubland
- *Zuckia brandegeei* Sparse Vegetation

Desert shrublands are the most common type within CARE, occupying areas of shallow or poor soils throughout the park. Shadscale, mat saltbush, Torrey Mormon-tea, and other desert shrubs dominate the sparse canopy, often in a mix. Valley floors with alkaline soils support black greasewood where an impermeable layer slows water infiltration, or basin big sagebrush, winterfat (*Krascheninnikovia lanata*), rabbitbrush, or fourwing saltbush (*Atriplex canescens*) shrublands on sandy, well-drained soils. Deep, loose sands support unusual communities containing hoary rosemary-mint (*Poliomintha incana*), pillar false gumweed (*Vanclaveva stylosa*), or Tucker sand shinnery oak (*Quercus havardii* var. *tuckeri*). Shallower sands support sand

sagebrush or blackbrush communities. Black sagebrush (*Artemisia nova*) shrublands occur on the rocky slopes and ridges of Thousand Lakes Mountain. Rare shrublands include greenleaf manzanita and littleleaf mountain mahogany types growing on sandstone outcrops.

Upland Herbaceous Associations

Grass-dominated associations are common but patchy in distribution within the mapping area. Most grasslands occupy relatively small openings within woodland communities. Larger stands tend to occupy sandy deposits on valley floors in a mosaic with desert shrublands. Fire does not appear to be a major factor in creating or maintaining most of the grassland communities at CARE. Forb-dominated types tend to result from severe disturbance and are generally weed-dominated. The upland herbaceous associations of CARE include:

- *Achnatherum hymenoides* Colorado Plateau Herbaceous Vegetation
- *Bouteloua eriopoda* - *Pleuraphis jamesii* Herbaceous Vegetation
- *Bouteloua gracilis* - *Pleuraphis jamesii* Herbaceous Vegetation
- *Bromus tectorum* Semi-natural Herbaceous Vegetation
- *Halogeton glomeratus* Semi-natural Herbaceous Vegetation
- *Hesperostipa comata* Great Basin Herbaceous Vegetation
- *Leymus salinus* Shale Sparse Vegetation
- *Muhlenbergia pungens* Herbaceous Vegetation
- *Pleuraphis jamesii* Herbaceous Vegetation
- *Poa fendleriana* / Non-vascular Herbaceous Vegetation
- Sparse Cushion Plant Herbaceous Vegetation
- *Sporobolus airoides* Southern Plains Herbaceous Vegetation
- *Sporobolus flexuosus* Herbaceous Alliance

Woodland openings tend to support grasslands. Loose, sandy sites will sometimes support grasslands of sand dropseed (*Sporobolus cryptandrus*), alkali sacaton, or Indian ricegrass. Disturbed marine shales will support communities dominated by non-native species including kochia (*Kochia americana*), saltlover (*Halogeton glomeratus*), and cheatgrass. Disturbed sandy sites will often be dominated by Russian thistle (*Salsola tragus*). A unique grassland dominated by black grama (*Bouteloua eriopoda*), a species that is more common in the southern Colorado Plateau, occurs on the summit of Johnson Mesa. Rare, sparse communities of cushion-type forbs like phlox (*Phlox* spp.) occur in gravelly sites throughout the park.

Riparian and Wetland Forest and Woodland Associations

Riparian woodlands are restricted in their distribution to floodplains, tributary canyons, and below pouroffs. They vary according to the availability of water and tend to be dominated by box elder (*Acer negundo*) or Fremont cottonwood. Narrow, rock-walled canyon riparian zones sometimes include Douglas-fir or blue spruce (*Picea pungens*) in the canopy. Riparian forest and woodland associations of CARE include:

- *Acer negundo* - *Ostrya knowltonii* Woodland
- *Acer negundo* / *Quercus gambelii* Woodland
- *Celtis laevigata* var. *reticulata* Slickrock Canyon Woodland
- *Picea pungens* / *Cornus sericea* Woodland
- *Populus angustifolia* / *Rhus trilobata* Woodland
- *Populus fremontii* / *Acer negundo* Forest

- *Populus fremontii* / *Ericameria nauseosa* Woodland
- *Populus fremontii* / *Mesic Graminoids* Woodland
- *Populus fremontii* / *Salix exigua* Forest
- *Pseudotsuga menziesii* / *Acer glabrum* Forest
- *Pseudotsuga menziesii* / *Betula occidentalis* Woodland
- *Salix gooddingii* Temporarily Flooded Woodland Alliance

The Fremont cottonwood woodlands at CARE are generally sparsely vegetated and occur on permanent or intermittent streams in broader drainages. Narrow, shaded canyons such as Halls Creek have open to dense box-elder and Knowlton hophornbeam (*Ostrya knowltonii*) woodlands whose understory varies depending on the age of the stand and the depth to the water table. Rare blue spruce and narrowleaf cottonwood (*Populus angustifolia*) woodlands occupy canyon floors at higher elevations at the northern end of the park, while Douglas-fir stands occur in narrow canyons crossing the center of the park.

Riparian and Wetland Shrubland Associations

Mesic and wetland shrub communities are small in size and limited in distribution within the park. All types in this category are restricted to areas with high water tables, including stream banks, stock pond margins, pouroffs, seeps, and tinajas. Riparian and wetland shrubland associations of CARE include:

- *Betula occidentalis* Shrubland
- *Cornus sericea* Shrubland
- *Ericameria nauseosa* Desert Wash Shrubland
- *Fallugia paradoxa* Desert Wash Shrubland
- *Fraxinus anomala* Woodland
- *Rhus trilobata* Intermittently Flooded Shrubland
- *Salix exigua* / *Mesic Graminoids* Shrubland
- *Tamarix* spp. Temporarily Flooded Semi-natural Shrubland
- Waterpocket Community

The braided channels of intermittent washes contain sparse but distinctive shrub communities dominated by rubber rabbitbrush, single-leaf ash (*Fraxinus anomala*), Apache plume (*Fallugia paradoxa*), or fourwing saltbush. Higher terraces along permanent streams or below pouroffs may have dense clones of threeleaf sumac (*Rhus trilobata*). Coyote willow shrublands are most common on the banks of permanent streams. Waterpockets are diverse communities centered around bedrock depressions that hold water for long periods in the growing season. Deep, cold canyons may have shrublands dominated by red-osier dogwood (*Cornus sericea*) or river birch (*Betula occidentalis*). Tamarisk has displaced all of these mesic shrubland communities in many parts of the park.

Riparian and Wetland Herbaceous Associations

Riparian and wetland herbaceous associations at CARE are also uncommon and limited in distribution. All types are restricted to areas with water at or near the surface for some or all of the growing season, including seeps. Diversity is typically high, but most stands occur in patches smaller than the minimum mapping unit. Mesic herbaceous associations of CARE include:

- *Aquilegia micrantha* - *Mimulus eastwoodiae* Herbaceous Vegetation
- *Eleocharis palustris* Herbaceous Vegetation
- *Juncus balticus* Herbaceous Vegetation
- *Phragmites australis* Western North America Temperate Semi-natural Herbaceous Vegetation
- *Schoenoplectus pungens* Herbaceous Vegetation
- *Typha* (*latifolia*, *angustifolia*) Western Herbaceous Vegetation
- Wet Meadow Herbaceous Vegetation

Hanging gardens emerging from cracks or alcoves in canyon walls support communities of unusual species, including Mancos columbine (*Aquilegia micrantha*), ditch reed grass (*Calamagrostis scopulorum*), shooting star (*Dodecatheon pulchellum*) and hellborine orchid (*Epipactis gigantea*). Other kinds of seeps support a variety of graminoid communities, depending on water chemistry. The banks of perennial streams support patches of marsh spikerush (*Eleocharis palustris*) and threesquare (*Schoenoplectus pungens*); some waterpockets are ringed by patches of cattail (*Typha* spp).

Field Key Preparation

An illustrated dichotomous field key to the 175 plant associations of the CARE mapping project area was developed for this project (Appendix G). The key is designed to assist users in identifying vegetation associations in the field. The key has two levels; the first level is defined by the physiognomy of the vegetation, i.e., forest, woodland, shrubland, graminoid, or forb. The second level focuses on the dominant species as determined by 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 association field key was constructed from data collected during the classification phase of the mapping project and revised following map accuracy assessment. Because the key is based on a sample of the vegetation, it 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 ecologists using CARE 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 MS Access plots database. Additional testing of the key occurred in the field 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.

Assessment of Global Rarity

CARE represents the dry western edge of the Colorado Plateau and as such is a unique landscape. Because water is a limiting factor, riparian and wetland species, although regionally common, are rare to uncommon within CARE. Particularly rare are the plant species associated with hanging gardens and seeping ledges that occur where porous sandstones contact impervious rock layers and seeps emerge. Few plant associations at CARE are considered globally rare

(NatureServe 2006); however, not enough is known about the global distribution of many associations to evaluate their rarity.

NatureServe and its network of state natural heritage programs indicate the rarity and degree of imperilment of plant communities by assigning state and global conservation status ranks. The rank scale ranges from 1 to 5; a rank of 1 indicates critical imperilment due to rarity, endemism, and/or threats, while a rank of 5 indicates little or no risk of extirpation of the plant community.

No CARE plant associations are considered globally critically imperiled (G1). Five associations are considered imperiled (G2): *Populus fremontii* / *Acer negundo* Forest, *Populus fremontii* – *Salix gooddingii* Woodland, *Pinus edulis* – (*Juniperus monosperma*, *Juniperus osteosperma*) / *Hesperostipa comata* Woodland, *Pleuraphis jamesii* – *Sporobolus airoides* Herbaceous Vegetation, and *Aquilegia micrantha* – *Mimulus eastwoodiae* Herbaceous Vegetation. Twenty-six associations are ranked as vulnerable (G3). Fifty-one associations are ranked apparently secure to secure (G4 and G5) and the remaining associations are not yet ranked or are new to the NVC. Nine associations were not assigned conservation status because they are semi-natural, altered vegetation types.

All vegetation communities within CARE are subject to change over time; drought and fire are the most likely agents of change. Withdrawals of water for irrigation from the Fremont River threaten the integrity of the riparian system. Because of recent regional drought and a general change over time to a warmer and drier climate, all riparian, hanging garden, and wetland plant communities within CARE are threatened to some degree. This threat is heightened by the introduction of non-native plant species that readily invade mesic habitats.

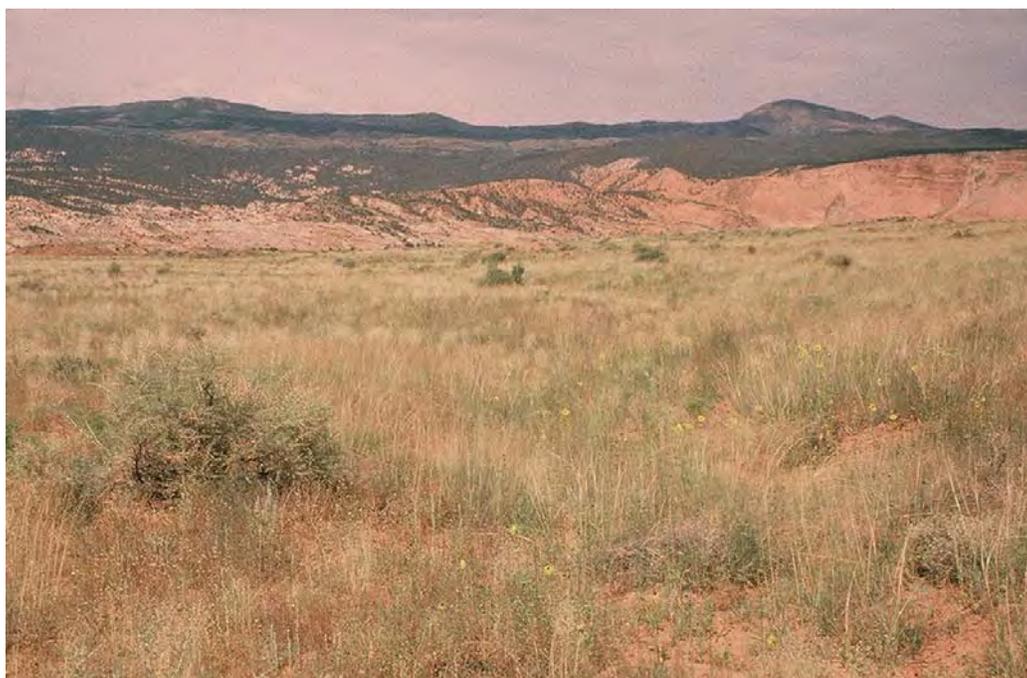


Photo credit: NCPN

Figure 34. The globally imperiled *Pleuraphis jamesii* – *Sporobolus airoides* Herbaceous Vegetation association at CARE.

Fuels Data Collection

Natural and prescribed fires are an established element of the CARE ecosystem. Under the current fire management plan, the park will use the appropriate management response as determined by considering the first priority, human safety, and then evaluating threat and potential damage to resources or property, fire resources available, and cost effectiveness (Clark 2005). Management response may vary from let-burn to full suppression depending on circumstances and the location of the fire.

During the November 2002 project scoping meeting it was determined that the Dixie National Forest and possibly the Fish Lake National Forest were preparing a fire management plan and that complementary data within CARE was desirable. Additionally, the BLM was collecting fire fuels data for sagebrush communities and supported extending data collection into the park. The data collected by the USGS-NPS vegetation mapping project at CARE will provide managers and neighbors with additional baseline data for fire planning and management.

Much of the CARE landscape is either sparsely vegetated by short and dwarf shrubs that would not carry fire well or is unvegetated bedrock. Fire fuels data were collected only in vegetation plots within shrublands, woodlands, and forests as part of the CARE vegetation classification and mapping project. Only small, scattered parcels of private land adjoin CARE, mostly near the town of Torrey. As such, fire within the wildland-urban interface is not of high priority.

The attributes described below were selected in consultation with fuels management experts to supplement the vegetation classification plot data and map class attributes in providing a complete picture of fire fuels for CARE. These data were entered in the MSAccess database. Fuels data were not analyzed as part of this project. Field forms, protocols, and definitions for collecting fuels data appear in Appendix B1 and Appendix B3.

Fuels field data forms and field definitions are located in Appendix B. Fuels data for vegetation plots at CARE included tree trunk diameter. Diameter at the root crown was recorded for woodland trees (two-needle pinyon pine and Utah juniper) greater than 4.5 feet tall. For forest trees (Douglas-fir, ponderosa pine, and Fremont cottonwood), diameter at breast height (4.5 feet) was recorded for all stems exceeding 5 cm in diameter. The dominant age class of two-needle pinyon pine and Utah juniper plots were recorded using the following categories: old-growth, mature, young, and invasive. Photographs taken to document conditions at all newly-sampled vegetation plots and observation points can also support fire fuels analyses. Stand cover was estimated by species for all vegetation plots and a density attribute was applied to all shrubland, woodland and forest polygons during the digitizing process.

Vegetation Mapping

Methods

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

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

Each step built upon the previous one. 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 field 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 assigned additional attributes (spatial database development).

Field Reconnaissance

From 1995 to 2002, CARE Botanist Debi Clark field-tested the vegetation map produced by Romme et al. (1993) then in use by the park, and found that in general polygons did not correspond well to vegetation distributions observed in the field. In an effort to improve the map, Ms. Clark began interpreting 1:24,000-scale aerial photography, mapping vegetation onto 7.5-minute topographic maps and ground-truthing areas not easily discernable by photointerpretation. She interpreted and mapped more than half of the park before the 2002 NCPN vegetation mapping program kick-off meeting. To a great extent, Ms. Clark's work took the place of the field reconnaissance stage of the current vegetation mapping project. In addition, the photointerpreters made several trips to the field to resolve cryptic photosignatures during the photointerpretation phase of this project.

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 CARE 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 such as park facilities and roads. The same map classes were used within CARE and in the environs.

The CARE vegetation map was initiated using the original standard for the USGS-NPS Vegetation Mapping Program projects (mapping to the plant association level of the NVC). However, the level of detail possible in a vegetation map is limited by the imagery, the skill and experience of the photointerpreter, and the availability of supporting information. At CARE, the relationships between map classes and plant associations are complex. The initial set of map

classes was developed from a crosswalk of Romme et al. (1993) map classes and association types with NVC associations. Most of these initial map classes had roughly a one-to-one relationship of NVC association to map class. As the mapping progressed, two facts became apparent: (1) the vegetation of CARE was far more diverse than indicated by the Romme et al. (1993) work, and (2) many associations would have to be combined into complexes or mosaics because of the difficulty of distinguishing them at the 1:12,000 scale. Map class definitions and concepts were adjusted throughout the project.

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., Wyoming Big Sagebrush / Blue Grama Shrubland). Map classes representing complexes of associations followed the convention of being named for the unifying botanic and environmental factors, e.g., Douglas-fir Canyon Woodland Complex.

To facilitate tracking and management of vegetation map class information, NCPN developed a map class coding system. Photointerpreters tend to assign a unique number to each map class as a shorthand way of labeling polygons. These numeric codes have been retained within the spatial database and map class guide (Appendix J). 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 Black Greasewood Shrubland Complex map class is represented by the alphacode “S-BLGR.” 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, height; Table 7), land use and disturbance. All map polygons were assigned to a land cover / land use type (Anderson et al. 2002; Appendix H). In addition, all polygons were assigned to higher levels of the NVC hierarchy, with the exception of non-vegetated map classes, which were coded as ‘unclassified’ or ‘unvegetated’ in the NVC columns.

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

Category	Attribute	Description
Vegetation Canopy Density (Applied to forest, woodland, and shrub-dominated map classes)	A	Closed Tree Canopy/Continuous (> 60% cover)
	B	Open Tree Canopy/Discontinuous (25- 60% cover)
	C	Dispersed – Sparse Tree Canopy (10-25% cover)
	D	Dense Shrub Canopy (> 40% cover)
	E	Light Shrub Canopy (10 – 40% cover)

Vegetation Pattern (Applied to all vegetation map classes)	1	Clumped/Bunched
	2	Linear
	3	Gradational/Transitional
	4	Regularly Alternating
	5	Homogenous
Vegetation Height (Applied to woody terrestrial vegetation map classes only)	F	Forest and Woodlands > 30 meters tall
	G	Forest and Woodlands 15 – 30 meters
	H	Forest and Woodlands 5 – 15 meters
	I	Forest and Woodlands 1 – 5 meters
	J	Forest and Woodlands < 0.5 meters
	K	Shrublands 1 – 5 meters
	L	Shrublands 0.5 – 1 meters
M	Shrublands 0 – 0.5 meters	

NCPN photointerpretation standards defined a suite of polygon modifiers to describe altered vegetation, landforms, transportation and utilities, and other situations (Evenden 2004). Table 8 is a list of the modifiers used in the CARE project.

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

Category	Code	Name	Description
Vegetation Modifiers	a	altered	Applies when some alteration is present, but the type is visually indistinguishable from unaltered stands
	d	chained	Applies to modification of a woodland or shrubland system by dragging an anchor chain through the community
	e	other treatments	Applies to systems modified by vegetation treatments such as disking, plowing, and spraying
	g	roller chopped	Applies to sagebrush systems that have been roller chopped to remove older sagebrush canopy
	h	overgrazed	Applies to grassland and related systems disturbed by overgrazing by domestic livestock
	i	invasive	Applies to systems dominated by invasive exotic plant species
	k	sparse, dwarfed trees	Applies to systems where the woodland overstory is both sparse in distribution and dwarfed in stature. Indicates an extreme environment for woodland systems
	m	burned	Applies to systems disturbed by burns more than one year old
q	talus	Rock fragments, usually large and angular, derived from and lying at the base of cliffs or steep rocky slopes and supporting little or no vegetation	

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

Category	Code	Name	Description
	y	dwarfed trees	Applies to woodland systems where the majority of trees are less than 3 m (10 ft) tall
Transportation Modifiers	t	Paved road	A transportation corridor consisting of a roadbed topped by an asphalt or concrete surface. Right-of-way typically extends to the limit of the cut and fill slopes
	u	Gravel/dirt road	A transportation corridor consisting of a roadbed of imported gravel or graded native soil. Cut and fill slopes may or may not be present

Natural Resource Features of Special Interest

In the scoping phase of the project, park staff identified several natural resource features of interest that might otherwise not have been identified. The non-vegetation features were photographed and noted by field ecologists as encountered, but were not sampled or mapped:

- Upland seeps and springs
- Cottonwood trees
- Tamarisk stands
- Stock ponds (as a disturbed land unit)
- Mine tailings
- Saltlover (*Halogeton glomeratus*) concentrations
- Linear facilities such as roads, buildings, and ditches
- Tinajas
- Pinyon-juniper density and stand structure
- Fire fuels data in pinyon-juniper and ponderosa pine stands

The USGS Rocky Mountain Mapping Center provided CARE and NCPN with a GIS layer of tree density. Fire fuels data (including stand structure) were collected (see Fuels Data Collection section) during the classification plot sampling phase and are included in the project geodatabase. Information describing the condition and location of the remaining natural resource features was provided directly to park staff and is not otherwise included in this report.

Mapping

The mapping component of the CARE project used traditional photointerpretation to identify polygons of uniform vegetation and assign map class attributes. On-screen digitizing of previously interpreted data was used to create map polygons in ArcGIS. A trained photointerpreter drew polygons in ArcGIS using one meter-resolution digital orthophoto quarter quadrangles (DOQQs) as the base imagery. In order to see fine detail, the interpreter examined

the 9 x 9-inch 1:12,000-scale aerial photographs in stereo. 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, alpha code and name, Anderson land use class, and vegetation density, pattern, and height attributes. 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 35. This format allows text and image information to be incorporated and linked to spatial coordinates. A detailed description of the geodatabase is provided in Appendix C.

Map Classes

The original set of mapping concepts developed for CARE was based on the types identified by Romme et al. (1993), augmented by associations identified by the preliminary classification developed after the 2003 field season. The intent was to map individual associations, if possible, through photointerpretation or ecological modeling. In practice, the set of map classes was reduced throughout the mapping phase of the project, as interpreters realized that some associations were difficult to recognize consistently on the imagery. Association-level map classes were combined as needed into complex or mosaic map classes based on ecological and morphological similarity. Changes to the map classes made following accuracy assessment are discussed in a later section of this report.

The final, post-accuracy assessment map legend consists of eighty-five classes (Table 9). Of these, 70 are vegetation map classes, six are unvegetated geologic map classes and nine are land-use map classes. Of the vegetation map classes, one type is represented by points and 39 represent single NVC plant associations. The remaining 30 vegetation map classes contain multiple plant associations.

Ecological systems (Comer et al. 2003) are used to organize the vegetation map classes (see discussion in the Project Overview section and Appendix A). They 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.

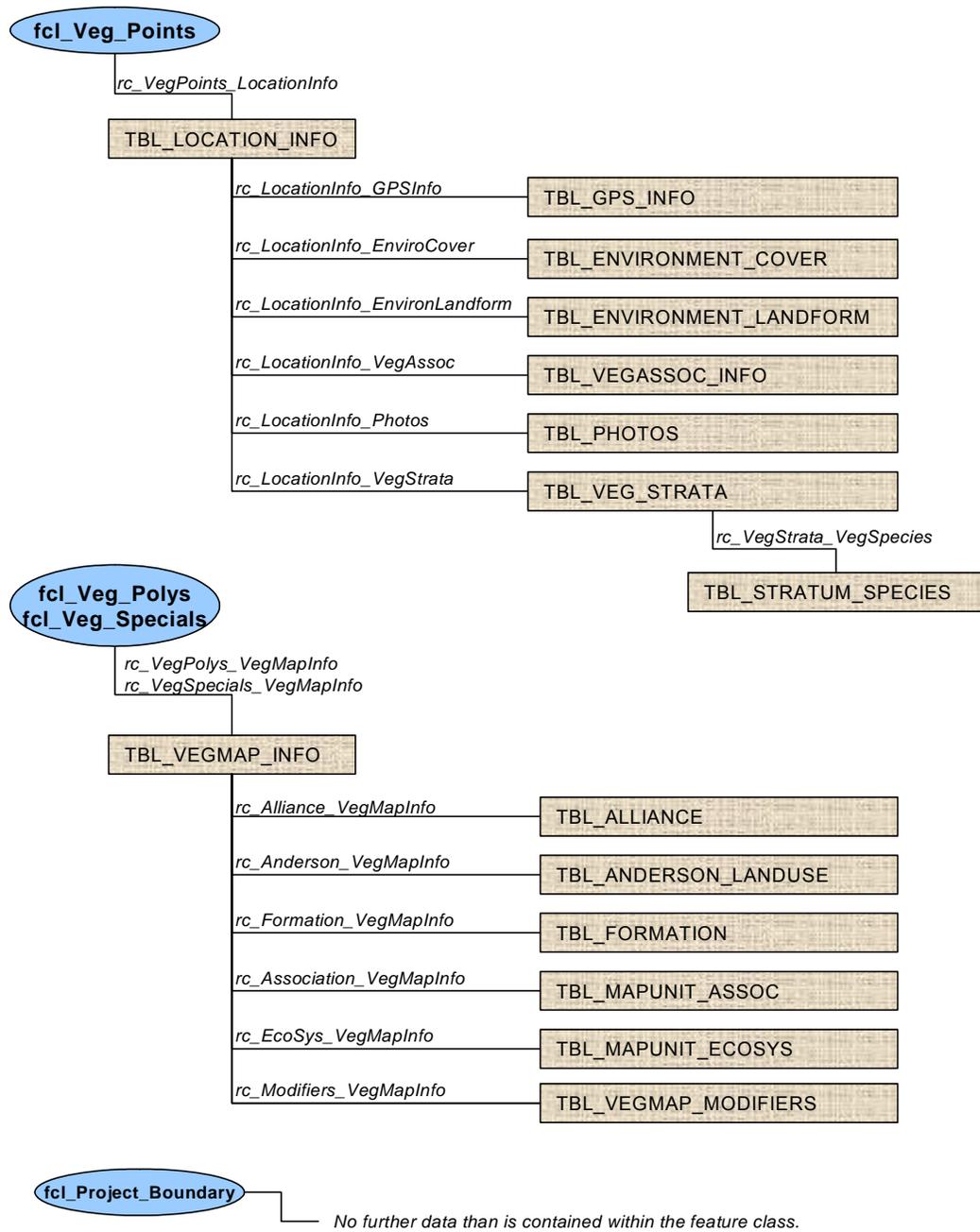


Figure 35. Structure of the CARE geodatabase.

Results

Table 9 shows the relationship of vegetation map classes to ecological systems, ordered roughly by physiognomy: upland forests, woodlands, shrublands, grasslands, and riparian communities. 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.

Table 9. Map classes used in the final (post-AA) CARE vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. CARE 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
Rocky Mountain Aspen Forest and Woodland (CES306.813)				
22	W-ASPE	Aspen / Snowberry Forest	Populus tremuloides / Symphoricarpos oreophilus Forest	1 : 1
Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)				
23a	W-DFME	Douglas-fir Montane Woodland Complex	Pinus ponderosa - Pseudotsuga menziesii / Purshia tridentata Woodland Pseudotsuga menziesii / Cercocarpus ledifolius Woodland Pseudotsuga menziesii / Cercocarpus montanus Woodland Pseudotsuga menziesii / Symphoricarpos oreophilus Forest Pseudotsuga menziesii Scree Woodland	1 : many
Multiple Ecological Systems:				
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)				
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)				
23c	W-DOFI	Douglas-fir Canyon Woodland Complex	Pseudotsuga menziesii / Betula occidentalis Woodland Pseudotsuga menziesii / Quercus gambelii Forest Pseudotsuga menziesii / Acer glabrum Forest	1 : many
Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland (CES304.790)				
20	W-PILO	Bristlecone Pine Woodland	Pinus longaeva Woodland	1 : 1
Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)				
33a	W-PPQG	Ponderosa Pine / Gambel Oak Woodland	Pinus ponderosa / Quercus gambelii Woodland	1 : 1
Multiple Ecological Systems:				
Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)				
Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)				
21	W-PPGM	Ponderosa Pine / Greenleaf Manzanita Woodland	Pinus ponderosa Slickrock Sparse Vegetation Pinus ponderosa / Arctostaphylos patula Woodland	1 : many
33	W-POPI	Ponderosa Pine Woodland Complex	Pinus ponderosa / Sparse Understory Woodland Pinus ponderosa / Artemisia nova Woodland Pinus ponderosa / Artemisia tridentata ssp. vaseyana Woodland Pinus ponderosa / Cercocarpus ledifolius Woodland Pinus ponderosa / Purshia tridentata Woodland	1 : many
Multiple Ecological Systems:				
Colorado Plateau Pinyon-Juniper Woodland (CES304.767)				
Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland (CES304.772)				

Table 9. Map classes used in the final (post-AA) CARE vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. CARE 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
12d	W-CELE	Curl-leaf Mountain Mahogany Woodland Complex	Pinus edulis - Juniperus osteosperma / Cercocarpus ledifolius Woodland Cercocarpus ledifolius / Artemisia tridentata ssp. vaseyana Woodland	1 : many
Multiple Ecological Systems:				
Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)				
Colorado Plateau Pinyon-Juniper Shrubland (CES304.766)				
Colorado Plateau Pinyon-Juniper Woodland (CES304.767)				
16	W-PJME	Pinyon-Juniper / Mesic Shrubs Woodland Complex	Juniperus osteosperma / Cercocarpus intricatus Woodland Pinus edulis - Juniperus osteosperma / Cercocarpus intricatus Woodland Pinus edulis - Juniperus osteosperma / (Shepherdia rotundifolia, Amelanchier utahensis) Wooded Shrubland Pinus edulis - Juniperus osteosperma / Amelanchier utahensis Woodland Pinus edulis - Juniperus osteosperma / Ephedra viridis Woodland Pinus edulis - Juniperus osteosperma / Purshia stansburiana Woodland Pinus edulis - Juniperus osteosperma / Purshia tridentata Woodland	1 : many
Colorado Plateau Pinyon-Juniper Woodland (CES304.767)				
14	W-PJMG	Pinyon-Juniper / Mixed Grass Woodland Complex	Juniperus osteosperma / Bouteloua gracilis Woodland Juniperus osteosperma / Hesperostipa comata Woodland Juniperus osteosperma / Leymus salinus Woodland Juniperus osteosperma / Pleuraphis jamesii Woodland Juniperus osteosperma / Sparse Understory Woodland Pinus edulis - (Juniperus monosperma, Juniperus osteosperma) / Hesperostipa comata Woodland Pinus edulis - (Juniperus osteosperma) / Bouteloua gracilis Woodland Pinus edulis - Juniperus osteosperma / Achnatherum hymenoides Woodland Pinus edulis - Juniperus osteosperma / Artemisia bigelovii Woodland Pinus edulis - Juniperus osteosperma / Ephedra torreyana - Artemisia bigelovii Woodland Pinus edulis - Juniperus osteosperma / Hesperostipa neomexicana Woodland Pinus edulis - Juniperus osteosperma / Muhlenbergia pungens Woodland Pinus edulis - Juniperus osteosperma / Pleuraphis jamesii Woodland Pinus edulis - Juniperus osteosperma / Shepherdia rotundifolia Woodland Pinus edulis - Juniperus spp. / Leymus salinus Woodland	1 : many
14b	W-PJCH	Pinyon-Juniper / Cheatgrass Semi-natural Woodland	Pinus edulis - Juniperus osteosperma / Bromus tectorum Semi-natural Woodland	1 : 1
14c	W-PJPJ	Pinyon-Juniper / Russian Wildrye Semi-natural Woodland	Pinus edulis - Juniperus osteosperma / Psathyrostachys juncea Semi-natural Woodland	1 : 1

Table 9. Map classes used in the final (post-AA) CARE vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. CARE 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
15	W-PJXE	Pinyon-Juniper / Xeric Shrubs Woodland Complex	Juniperus osteosperma / Sparse Understory Woodland Pinus edulis – Juniperus osteosperma / Artemisia bigelovii Woodland Pinus edulis – Juniperus osteosperma / Ephedra torreyana – Artemisia bigelovii Woodland Pinus edulis – Juniperus osteosperma / Shepherdia rotundifolia Woodland	1 : many
15b	W-PJOP	Pinyon-Juniper / Brittle Prickly Pear Woodland	Pinus edulis - Juniperus osteosperma / Opuntia fragilis Woodland	1 : 1
15d	W-PJSP	Pinyon-Juniper / Sparse Understory Woodland	Pinus edulis - Juniperus osteosperma / Artemisia pygmaea Woodland Pinus edulis - Juniperus osteosperma / Atriplex spp. Woodland Pinus edulis - Juniperus osteosperma / Cushion Plant Woodland Pinus edulis - Juniperus osteosperma / Ephedra viridis Woodland Pinus edulis - Juniperus osteosperma / Petradoria pumila Woodland Pinus edulis - Juniperus osteosperma / Sparse Understory Woodland	1 : many
15e	W-PJWS	Pinyon-Juniper / Sagebrush Woodland Complex	Juniperus osteosperma / Artemisia tridentata ssp. tridentata Woodland Juniperus osteosperma / Artemisia tridentata ssp. wyomingensis Woodland Pinus edulis - Juniperus spp. / Artemisia tridentata (ssp. wyomingensis, ssp. vaseyana) Woodland	1 : many
15f	W-PJBS	Pinyon-Juniper / Black Sagebrush Woodland	Pinus edulis - Juniperus osteosperma / Artemisia nova Woodland	1 : 1
16a	W-PJMM	Pinyon-Juniper / Mountain Mahogany and Gambel Oak Woodland	Pinus edulis - Juniperus spp. / Cercocarpus montanus - Mixed Shrubs Woodland Pinus edulis - Juniperus spp. / Quercus gambelii Woodland	1 : many
17	W-PJBB	Pinyon-Juniper / Blackbrush Woodland	Pinus edulis - Juniperus osteosperma / Coleogyne ramosissima Woodland	1 : 1
Colorado Plateau Pinyon-Juniper Woodland (CES304.767)				
Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818)				
16e	W-PJOM	Pinyon-Juniper / Oak and Manzanita Woodland	Pinus edulis - Juniperus osteosperma / Arctostaphylos patula Woodland Pinus edulis - Juniperus osteosperma / Quercus havardii var. tuckeri Woodland Pinus edulis - Juniperus spp. / Quercus gambelii Woodland Quercus gambelii / Sparse Understory Shrubland	1 : many
Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)				
19	S-LLMM	Little-leaf Mountain Mahogany Slickrock Sparse Vegetation	Cercocarpus intricatus Slickrock Sparse Vegetation	1 : 1
26d	W-HACK	Netleaf Hackberry Slickrock Canyon	Celtis laevigata var. reticulata Slickrock Canyon Woodland	1 : 1

Table 9. Map classes used in the final (post-AA) CARE vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. CARE 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
		Woodland		
27	C-FINP	Slickrock Fin Pocket	Slickrock Fin Pocket	1 : 1
Colorado Plateau Pinyon-Juniper Shrubland (CES304.766)				
19c	W-PJBC	Pinyon-Juniper / Blackbrush – Cliffrose – Tucker Oak Wooded Shrubland	Juniperus osteosperma - (Pinus edulis) / Coleogyne ramosissima - Purshia stansburiana - Quercus havardii var. tuckeri Wooded Shrubland	1 : 1
Multiple Ecological Systems: Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765) Colorado Plateau Pinyon-Juniper Woodland (CES304.767) Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)				
40	S-TALM	Talus Mixed Shrubland Complex	Atriplex canescens - Ephedra viridis Talus Shrubland Chrysothamnus viscidiflorus Talus Shrubland Pinus edulis - Juniperus osteosperma / Ephedra viridis Woodland Amelanchier utahensis Shrubland	1 : many
Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818)				
13b	S-GOSB	Gambel Oak / Serviceberry Shrubland	Quercus gambelii / Amelanchier utahensis Shrubland	1 : 1
Multiple Ecological Systems: Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785) Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)				
13f	S-MSSN	Mountain Sagebrush – Snowberry Shrubland Complex	Artemisia tridentata ssp. vaseyana / Poa fendleriana Shrubland Symphoricarpos oreophilus Shrubland	1 : many
Great Basin Semi-Desert Chaparral (CES304.001)				
41	S-MANZ	Greenleaf Manzanita Shrubland	Arctostaphylos patula Shrubland	1 : 1
Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)				
11c	S-ARTR	Big Sagebrush Shrubland Complex	Artemisia tridentata - (Ericameria nauseosa) / Bromus tectorum Semi-natural Shrubland Artemisia tridentata / Achnatherum hymenoides Shrubland Artemisia tridentata ssp. tridentata / Pleuraphis jamesii Shrubland Artemisia tridentata ssp. tridentata / Sporobolus airoides Shrubland Artemisia tridentata ssp. wyomingensis / (Agropyron cristatum, Psathyrostachys juncea) Seeded Grasses Semi-natural Shrubland Artemisia tridentata ssp. wyomingensis / Disturbed Understory Semi-natural Shrubland	1 : many

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Map Class #	Map Class Code	Map Class Name	Description or Associations Assigned to Map Class	Relation
13d	S-WYSA	Wyoming Sagebrush / Blue Grama Shrubland	<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> / <i>Bouteloua gracilis</i> Shrubland	1 : 1
Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)				
13h	S-ETGG	Torrey Mormon Tea / Blue Grama – Galleta Shrubland	<i>Ephedra torreyana</i> / <i>Bouteloua gracilis</i> - <i>Pleuraphis jamesii</i> Shrubland	1 : 1
13z	S-RURA	Rubber Rabbitbrush / Blue Grama Shrub Herbaceous Vegetation	<i>Ericameria nauseosa</i> / <i>Bouteloua gracilis</i> Shrub Herbaceous Vegetation	1 : 1
18c	S-GRSP	Spiny Hopsage Shrubland	<i>Grayia spinosa</i> Shrubland	1 : 1
Southern Colorado Plateau Sand Shrubland (CES304.793)				
13x	S-EVGC	Green Mormon Tea / Galleta – Cheatgrass Shrubland Complex	<i>Ephedra viridis</i> / <i>Bromus tectorum</i> Semi-natural Shrubland <i>Ephedra viridis</i> / <i>Pleuraphis jamesii</i> Shrubland	1 : many
13y	S-EVRN	Green Mormon Tea / Indian Ricegrass – Needle and Thread Shrubland	<i>Ephedra viridis</i> / (<i>Achnatherum hymenoides</i> , <i>Hesperostipa comata</i>) Shrubland	1 : 1
Inter-Mountain Basins Active and Stabilized Dune (CES304.775)				
10a	S-QUHA	Tucker Oak Shrubland	<i>Quercus havardii</i> var. <i>tuckeri</i> Shrubland	1 : 1
Multiple Ecological Systems: Inter-Mountain Basins Active and Stabilized Dune (CES304.775) Southern Colorado Plateau Sand Shrubland (CES304.793)				
9	S-ARFI	Sand Sage Shrubland Complex	<i>Eriogonum leptocladon</i> / <i>Muhlenbergia pungens</i> Shrubland <i>Poliomintha incana</i> - <i>Artemisia filifolia</i> - <i>Vancleavea stylosa</i> Shrubland <i>Artemisia filifolia</i> Colorado Plateau Shrubland	1 : many
Colorado Plateau Blackbrush-Mormon-tea Shrubland (CES304.763)				
10	S-BLAC	Blackbrush Shrubland Complex	<i>Coleogyne ramosissima</i> / <i>Pleuraphis jamesii</i> Shrubland <i>Coleogyne ramosissima</i> Shrubland	1: many
19d	S-BCTO	Blackbrush – Cliffrose – Tucker Oak Shrubland	<i>Coleogyne ramosissima</i> - <i>Purshia stansburiana</i> - <i>Quercus havardii</i> var. <i>tuckeri</i> Shrubland	1 : 1
Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762)				

Table 9. Map classes used in the final (post-AA) CARE vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. CARE 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
12a	H-ROME	Fringed Sagebrush – Lichens Rocky Mesa Herbaceous Vegetation	Artemisia frigida - (Bouteloua gracilis, Achnatherum hymenoides, Poa secunda) - Lichens Rocky Mesa Dwarf-shrubland	1 : 1
12c	S-ARPO	Black Sagebrush / Muttongrass Shrubland	Artemisia nova / Poa fendleriana Shrubland	1 : 1
13e	S-BSCU	Black Sagebrush – Bitterbrush / Muttongrass Shrubland	Artemisia nova - Purshia tridentata / Poa fendleriana Shrubland	1 : 1
Multiple Ecological Systems: Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762) Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)				
13	S-MXDD	Mixed Desert Shrubland Complex	Artemisia bigelovii Shrubland Ephedra torreyana - Artemisia bigelovii Sparse Vegetation	1 : many
Multiple Ecological Systems: Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765) Inter-Mountain Basins Active and Stabilized Dune (CES304.775) Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)				
13a	S-EPTO	Torrey Mormon Tea Shrubland Complex	Ephedra torreyana Sparse Vegetation Eriogonum leptocladon Sparse Vegetation Ephedra torreyana / Achnatherum hymenoides - Pleuraphis jamesii Shrubland	1 : many
Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)				
6	S-ATCO	Shadscale Shrubland Complex	Atriplex confertifolia - Krascheninnikovia lanata Shrubland Atriplex confertifolia / Achnatherum hymenoides Shrubland Atriplex confertifolia / Pleuraphis jamesii Shrubland Atriplex confertifolia Great Basin Shrubland	1 : many
Inter-Mountain Basins Shale Badland (CES304.789)				
4	S-MATS	Saltbush Badlands Shrubland Complex	Atriplex corrugata Dwarf-shrubland Atriplex gardneri / Achnatherum hymenoides Dwarf-shrubland Atriplex gardneri / Pleuraphis jamesii Dwarf-shrubland Atriplex gardneri / Xylorhiza venusta Dwarf-shrubland Atriplex gardneri Dwarf-shrubland Ephedra torreyana - (Atriplex spp.) / Nonvascular Gypsum Sparse Vegetation Zuckia brandegeei Sparse Vegetation	1 : many
4a	S-BUCK	Crispleaf Buckwheat Badlands Sparse Vegetation	Eriogonum corymbosum Badlands Sparse Vegetation	1 : 1
5	S-GYPS	Gypsum Badlands Sparse Vegetation	Ephedra torreyana – (Atriplex spp.) / Non-vascular Gypsum Sparse Vegetation	1 : 1

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Map Class #	Map Class Code	Map Class Name	Description or Associations Assigned to Map Class	Relation
8a	H-LESA	Salina Wildrye Shale Sparse Grassland	Leymus salinus Shale Sparse Vegetation	1 : 1
Inter-Mountain Basins Wash (CES304.781)				
12b	S-MESI	Mesic Canyon Bottom Shrubland Complex	Atriplex canescens Desert Wash Shrubland Ericameria nauseosa Desert Wash Shrubland Fallugia paradoxa Desert Wash Shrubland Fraxinus anomala Woodland Mesic Canyon Bottom Shrubland	1 : many
Multiple Ecological Systems: Inter-Mountain Basins Greasewood Flat (CES304.780) Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784) Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788) Inter-Mountain Basins Wash (CES304.781) Southern Colorado Plateau Sand Shrubland (CES304.793)				
11	S-WASH	Desert Wash Shrubland Mosaic	Ericameria nauseosa / Sporobolus airoides Shrubland Sarcobatus vermiculatus / Artemisia tridentata Shrubland Atriplex canescens / Bouteloua gracilis Shrubland Atriplex canescens / Sporobolus airoides Shrubland Atriplex canescens Shrubland Atriplex canescens / Pleuraphis jamesii Shrubland Ericameria nauseosa / Bromus tectorum Semi-natural Shrubland Gutierrezia sarothrae / Sporobolus airoides - Pleuraphis jamesii Shrub Herbaceous Vegetation Krascheninnikovia lanata / Pleuraphis jamesii Dwarf-shrubland Krascheninnikovia lanata Dwarf-shrubland Ericameria nauseosa Desert Wash Shrubland Ericameria nauseosa Sand Deposit Sparse Shrubland	1 : many
Multiple Ecological Systems: Inter-Mountain Basins Greasewood Flat (CES304.780) Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784) Inter-Mountain Basins Semi-Desert Grassland (CES304.787)				
11a	S-BLGR	Black Greasewood Shrubland Complex	Sarcobatus vermiculatus / Atriplex confertifolia - (Picrothamnus desertorum, Suaeda moquinii) Shrubland Sarcobatus vermiculatus / Distichlis spicata Shrubland Sarcobatus vermiculatus / Sporobolus airoides Shrubland Sarcobatus vermiculatus Disturbed Shrubland Atriplex confertifolia - Sarcobatus vermiculatus Shrubland Bromus tectorum Semi-natural Herbaceous Vegetation	1 : many
Inter-Mountain Basins Semi-Desert Grassland (CES304.787)				
8b	H-BGPL	Black Grama – Galleta Herbaceous Vegetation	Bouteloua eriopoda - Pleuraphis jamesii Herbaceous Vegetation	1 : 1

Table 9. Map classes used in the final (post-AA) CARE vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. CARE 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:				
Inter-Mountain Basins Semi-Desert Shrub-Steppe				
Inter-Mountain Basins Semi-Desert Grassland				
Inter-Mountain Basins Active and Stabilized Dune				
8	H-GRAS	Mixed Grasslands Complex	Muhlenbergia pungens Herbaceous Vegetation Achnatherum hymenoides Colorado Plateau Herbaceous Vegetation Bouteloua gracilis - Hesperostipa comata Herbaceous Vegetation Bouteloua gracilis - Pleuraphis jamesii Herbaceous Vegetation Hesperostipa comata Great Basin Herbaceous Vegetation Pleuraphis jamesii - Sporobolus airoides Herbaceous Vegetation Pleuraphis jamesii Herbaceous Vegetation Sporobolus airoides Southern Plains Herbaceous Vegetation Sporobolus flexuosus Herbaceous Alliance Achnatherum hymenoides Shrub Herbaceous Alliance	1 : many
Rocky Mountain Subalpine-Montane Riparian Woodland (CES306.833)				
35	W-BSRD	Blue Spruce / Red-Osier Dogwood Woodland	Picea pungens / Cornus sericea Woodland	1 : 1
North American Warm Desert Riparian Woodland and Shrubland (CES302.753)				
64	S-TARU	Tamarisk Temporarily Flooded Shrubland	Tamarix spp. Temporarily Flooded Semi-natural Shrubland	1 : 1
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)				
24	W-POFR	Fremont Cottonwood Woodland Complex	Populus fremontii / Ericameria nauseosa Woodland Populus fremontii - Salix gooddingii Woodland Populus fremontii / Acer negundo Forest Populus fremontii / Mesic Forbs Woodland Populus fremontii / Mesic Graminoids Woodland Populus fremontii / Salix exigua Forest	1 : many
24a	W-POAN	Narrowleaf Cottonwood Woodland	Populus angustifolia / Rhus trilobata Woodland	1 : 1
26b	S-COSE	Red-osier Dogwood Shrubland	Cornus sericea Shrubland	1 : 1
26c	S-BEOC	River Birch Shrubland	Betula occidentalis Shrubland	1 : 1
30	W-BOEL	Box Elder Woodland Complex	Acer negundo / Rhus trilobata Woodland Acer negundo - Ostrya knowltonii Woodland Acer negundo / Quercus gambelii Woodland	1 : many
32	S-WILL	Willow Shrubland Complex	Rhus trilobata Intermittently Flooded Shrubland Salix exigua / Barren Shrubland Salix exigua / Mesic Graminoids Shrubland Salix gooddingii Temporarily Flooded Woodland Alliance	1 : many

Table 9. Map classes used in the final (post-AA) CARE vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. CARE 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
Colorado Plateau Hanging Garden (CES304.764)				
31	H-HANG	Hanging Gardens Herbaceous Vegetation	Aquilegia micrantha - Mimulus eastwoodiae Herbaceous Vegetation	1 : 1
Multiple Ecological Systems: Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765) North American Arid West Emergent Marsh (CES300.729)				
25	H-SEEP	Springs and Seeps Mosaic	Waterpocket Community Eleocharis palustris Herbaceous Vegetation Juncus balticus Herbaceous Vegetation Phragmites australis Western North America Temperate Semi-natural Herbaceous Vegetation Schoenoplectus pungens Herbaceous Vegetation Typha (latifolia, angustifolia) Western Herbaceous Vegetation	1 : many
Not Assigned To An Ecological System				
1	S-BENT	Bentonite Badlands	Atriplex spp. Extreme Sparse Shrubland	1 : 1
8c	H-POFE	Muttongrass / Non-vascular Herbaceous Vegetation	Poa fendleriana / Non-vascular Herbaceous Vegetation	1 : 1
34	C-TINJ	Tinajas	Mapped from field notes only; no assigned associations	1 : many
36	C-MXDW	Wet Meadow Herbaceous Vegetation	Wet Meadow Herbaceous Vegetation	1 : 1
43	H-CUSH	Sparse Cushion Plant Herbaceous Vegetation	Sparse Cushion Plant Herbaceous Vegetation	1 : 1
65	H-HAGL	Halogeton Semi-Natural Herbaceous Vegetation	Halogeton glomeratus Semi-natural Herbaceous Vegetation	1 : 1
Non-Vegetated and Anderson Land Use Map Classes:				
60	L-ORCH	Orchards	Areas near Fruita and Notom cultivated for fruit trees	N/A
63	L-ABAN	Abandoned Fields	Areas near historic homesteads where the ground was broken for agriculture, that have since been abandoned. Most now support exotic and/or annual weeds	N/A
66	L-RESI	Residential Developments	NPS and private residential buildings and associated parking and storage areas in the park and the environs	N/A
67	L-FACI	NPS Facilities	NPS administrative buildings and associated infrastructure, such as visitor centers, maintenance yards, parking areas, and sewage ponds.	N/A
71	G-MUDC	Mudstone Cliffs	Unvegetated outcrops of shale bedrock	N/A
72	G-TALU	Bare Talus/Slides	Slopes covered by loose rock derived from upslope outcrops or cliffs	N/A

Table 9. Map classes used in the final (post-AA) CARE vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. CARE 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
73	G-SAND	Unvegetated Sand	Active dune fields and sand sheets	N/A
74	G-SLIC	Unvegetated Sandstone	Barren sandstone slickrock and cliffs	N/A
75	L-MINE	Mines, Quarries, Mine tailings	Areas disturbed by mining for gravel, uranium, or other locatable or leasable minerals	N/A
76	L-POND	Stock ponds	Small catchments along minor drainages designed to hold runoff for livestock use or groundwater amendment	N/A
76a	L-DTCH	Ditches	Linear features created for the conveyance of water from a stream to agricultural fields or orchards. Includes checkdams to control erosion	N/A
77	G-WASH	Barren wash channel	Expanses of unvegetated sand within intermittent drainage channels.	N/A
77a	G-STRM	Perennial stream	Drainages with visible water	N/A
78	L-ROAD	Roads	Highways, paved park roads and major (graded) dirt park roads	N/A
79	L-CULT	Cultivated fields	Areas near Fruita and Notom cultivated for annual crops.	N/A

Map Class Descriptions

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

- a summary of the ecological concept of the map class. Summaries of map classes consisting of multiple plant associations include an explanation of why associations were grouped. 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 (if available)
- statistics and accuracy assessment results

Map Polygons

The CARE vegetation map consists of 20,987 polygons totaling 146,754 hectares (362,637 acres). Average polygon size is 7.0 ha (17.3 acres). Lands within the park make up 98,650 ha (243,768 acres) or 67.2% of the total project area. Of the total, 18,633 polygons (88.8%) represent natural or semi-natural vegetation map classes covering 91.6% of the mapping project area. Map classes representing non-vegetated rock outcrops, roads, facilities and water account for the remaining 2,354 polygons (11.2% of polygons and 8.4% of the 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 Pinyon-Juniper / Mesic Shrubs Woodland Complex (W-PJME) with 5,122 polygons covering 28.7% of the mapping area. The largest average polygon size belongs to Torrey Mormon Tea Shrubland Complex (S-EPTO) at 44.3 ha (109 acres) per polygon.

Tinajas (map class C-TINJ) at CARE are very small features scattered throughout areas of exposed sandstone bedrock. Many are too small to distinguish on aerial imagery and all are much smaller than the minimum mapping unit. None were sampled in the field and this type is based entirely on field notes provided by the park botanist. Tinajas were therefore mapped as a point layer based on field observations. Several other map classes include both point and polygon features (Appendix J).

Figure 36a is an example of a map of the vegetation of CARE created from the GIS spatial database. Because we used a geodatabase to store and organize spatial information, there is far more data in the spatial database than can be conveyed in a two-dimensional map. Maps can be produced with vegetation polygons labeled in many different ways at different levels of resolution. Table 10 provides summary statistics for CARE vegetation map polygons.

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

Map Code	Map Class Common Name	Polygons			Area (hectares)		
		Park	Environs	Total Area*	Park	Environs	Total Area*
Rocky Mountain Aspen Forest and Woodland (CES306.813)							
W-ASPE	Aspen / Snowberry Forest	22	0	56	56	0	164
	<i>Subtotal</i>	<i>0</i>	<i>56</i>	<i>56</i>	<i>0</i>	<i>164</i>	<i>164</i>
Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)							
W-DFME	Douglas-fir Montane Woodland Complex	46	58	104	206	116	321
	<i>Subtotal</i>	<i>46</i>	<i>58</i>	<i>104</i>	<i>206</i>	<i>115</i>	<i>321</i>
Multiple Ecological Systems:							
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)							
Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)							
Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)							
W-DOFI	Douglas-fir Canyon Woodland Complex	76	34	110	147	53	200
	<i>Subtotal</i>	<i>76</i>	<i>34</i>	<i>110</i>	<i>147</i>	<i>53</i>	<i>200</i>
Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland (CES306.819)							
W-PILO	Bristlecone Pine Woodland	12	8	20	22	26	48
	<i>Subtotal</i>	<i>12</i>	<i>8</i>	<i>20</i>	<i>22</i>	<i>26</i>	<i>48</i>
Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)							
W-PPQG	Ponderosa Pine / Gambel Oak Woodland	7	15	22	14	27	41
	<i>Subtotal</i>	<i>7</i>	<i>15</i>	<i>22</i>	<i>14</i>	<i>27</i>	<i>41</i>
Multiple Ecological Systems:							
Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)							
Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)							
W-PPGM	Ponderosa Pine / Greenleaf Manzanita Woodland	63	38	101	110	82	192

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

Map Code	Map Class Common Name	Polygons			Area (hectares)		
		Park	Environs	Total Area*	Park	Environs	Total Area*
W-POPI	Ponderosa Pine Woodland Complex	32	175	207	92	601	693
	<i>Subtotal</i>	<i>95</i>	<i>213</i>	<i>308</i>	<i>202</i>	<i>683</i>	<i>885</i>
Multiple Ecological Systems: Colorado Plateau Pinyon-Juniper Woodland (CES304.767) Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland (CES304.772)							
W-CELE	Curlleaf Mountain Mahogany Woodland Complex	8	9	17	42	64	106
	<i>Subtotal</i>	<i>8</i>	<i>9</i>	<i>17</i>	<i>42</i>	<i>64</i>	<i>106</i>
Multiple Ecological Systems: Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765) Colorado Plateau Pinyon-Juniper Shrubland (CES304.766) Colorado Plateau Pinyon-Juniper Woodland (CES304.767)							
W-PJME	Pinyon-Juniper / Mesic Shrubs Woodland Complex	3220	1902	5122	27446	14751	42197
	<i>Subtotal</i>	<i>3220</i>	<i>1902</i>	<i>5122</i>	<i>27446</i>	<i>14751</i>	<i>42197</i>
Colorado Plateau Pinyon-Juniper Woodland (CES304.767)							
W-PJMG	Pinyon-Juniper / Mixed Grass Woodland Complex	655	228	883	2968	1022	3989
W-PJCH	Pinyon-Juniper / Cheatgrass Semi-natural Woodland	3	0	3	2	0	2
W-PJPJ	Pinyon-Juniper / Russian Wildrye Semi-natural Woodland	0	1	1	0	1	1
W-PJXE	Pinyon-Juniper / Xeric Shrubs Woodland Complex	992	562	1554	4830	2626	7456
W-PJOP	Pinyon-Juniper / Brittle Prickly Pear Woodland	40	5	45	139	11	151
W-PJSP	Pinyon-Juniper / Sparse Understory Woodland	304	201	505	1453	1460	2913
W-PJWS	Pinyon-Juniper / Sagebrush Woodland Complex	152	291	443	321	814	1135
W-PJBS	Pinyon-Juniper / Black Sagebrush Woodland	3	45	48	4	326	330
W-PJMM	Pinyon-Juniper / Mountain Mahogany and Gambel Oak Woodland	288	195	483	2182	860	3041

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

Map Code	Map Class Common Name	Polygons			Area (hectares)		
		Park	Environs	Total Area*	Park	Environs	Total Area*
W-PJBB	Pinyon-Juniper / Blackbrush Woodland	32	73	105	104	614	718
	<i>Subtotal</i>	2469	1601	4070	12003	7734	19736
Multiple Ecological Systems:							
Colorado Plateau Pinyon-Juniper Woodland (CES304.767)							
Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818)							
W-PJOM	Pinyon-Juniper / Oak and Manzanita Woodland	224	47	271	400	93	493
	<i>Subtotal</i>	224	47	271	400	93	493
Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)							
S-LLMM	Little-leaf Mountain Mahogany Slickrock Sparse Vegetation	1330	247	1577	10264	501	10765
W-HACK	Netleaf Hackberry Slickrock Canyon Woodland	30	2	32	29	1	30
C-FINP	Slickrock Fin Pocket	222	30	252	211	26	236
	<i>Subtotal</i>	1582	279	1861	10504	528	11031
Colorado Plateau Pinyon-Juniper Shrubland (CES304.766)							
W-PJBC	Pinyon-Juniper / Blackbrush – Cliffrose – Tucker Oak Wooded Shrubland	18	109	127	33	417	450
	<i>Subtotal</i>	18	109	127	33	417	450
Multiple Ecological Systems:							
Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)							
Colorado Plateau Pinyon-Juniper Woodland (CES304.767)							
Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)							
S-TALM	Talus Mixed Shrubland Complex	372	118	490	2754	416	3169
	<i>Subtotal</i>	372	118	490	2754	416	3169
Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818)							
S-GOSB	Gambel Oak / Serviceberry Shrubland	15	23	38	67	102	168

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

Map Code	Map Class Common Name	Polygons			Area (hectares)		
		Park	Environs	Total Area*	Park	Environs	Total Area*
<i>Subtotal</i>		15	23	38	67	101	168
Multiple Ecological Systems:							
Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785)							
Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)							
S-MSSN	Mountain Sagebrush – Snowberry Shrubland Complex	0	25	25	0	74	74
<i>Subtotal</i>		0	25	25	0	74	74
Great Basin Semi-Desert Chaparral (CES304.001)							
S-MANZ	Greenleaf Manzanita Shrubland	2	0	2	18	0	18
<i>Subtotal</i>		2	0	2	18	0	18
Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)							
S-ARTR	Big Sagebrush Shrubland Complex	160	185	345	696	1330	2025
S-WYSA	Wyoming Sagebrush / Blue Grama Shrubland	14	8	22	96	69	164
<i>Subtotal</i>		174	193	367	792	1399	2189
Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)							
S-ETGG	Torrey Mormon Tea / Blue Grama – Galleta Shrubland	3	0	3	82	0	82
S-RURA	Rubber Rabbitbrush / Blue Grama Shrub Herbaceous Vegetation	3	4	7	68	126	193
S-GRSP	Spiny Hopsage Shrubland	1	1	2	3	<1	3
<i>Subtotal</i>		7	5	12	153	126	278
Southern Colorado Plateau Sand Shrubland (CES304.793)							
S-EVGC	Green Mormon Tea / Galleta – Cheatgrass Shrubland Complex	23	83	106	18	922	939
S-EVRN	Green Mormon Tea / Indian Ricegrass – Needle and Thread Shrubland	12	12	24	146	73	219

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

Map Code	Map Class Common Name	Polygons			Area (hectares)		
		Park	Environs	Total Area*	Park	Environs	Total Area*
<i>Subtotal</i>		35	95	130	164	995	1158
Inter-Mountain Basins Active and Stabilized Dune (CES304.775)							
S-QUHA	Tucker Oak Shrubland	13	2	15	34	3	36
<i>Subtotal</i>		13	2	15	34	2	36
Multiple Ecological Systems: Inter-Mountain Basins Active and Stabilized Dune (CES304.775) Southern Colorado Plateau Sand Shrubland (CES304.793)							
S-ARFI	Sand Sage Shrubland Complex	60	2	62	401	7	408
<i>Subtotal</i>		60	2	62	401	7	408
Colorado Plateau Blackbrush-Mormon-tea Shrubland (CES304.763)							
S-BLAC	Blackbrush Shrubland Complex	125	145	270	1002	1609	2611
S-BCTO	Blackbrush – Cliffrose – Tucker Oak Shrubland	0	6	6	0	19	19
<i>Subtotal</i>		125	151	276	1002	1628	2630
Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762)							
H-ROME	Fringed Sagebrush – Lichens Rocky Mesa Herbaceous Vegetation	0	9	9	0	24	24
S-ARPO	Black Sagebrush / Muttongrass Shrubland	0	29	29	0	52	52
S-BSCU	Black Sagebrush – Bitterbrush / Muttongrass Shrubland	2	36	38	3	149	152
<i>Subtotal</i>		2	74	76	3	225	228
Multiple Ecological Systems: Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762) Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)							
S-MXDD	Mixed Desert Shrubland Complex	759	370	1129	9941	3566	13507

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

Map Code	Map Class Common Name	Polygons			Area (hectares)		
		Park	Environs	Total Area*	Park	Environs	Total Area*
<i>Subtotal</i>		759	370	1129	9941	3566	13507
Multiple Ecological Systems:							
Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)							
Inter-Mountain Basins Active and Stabilized Dune (CES304.775)							
Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)							
S-EPTO	Torrey Mormon Tea Shrubland Complex	67	76	143	2496	3835	6331
<i>Subtotal</i>		67	76	143	2496	3835	6331
Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)							
S-ATCO	Shadscale Shrubland Complex	417	218	635	6051	2798	8849
<i>Subtotal</i>		417	218	635	6051	2798	8849
Inter-Mountain Basins Shale Badland (CES304.789)							
S-MATS	Saltbush Badlands Shrubland Complex	306	143	449	3642	1771	5412
S-BUCK	Crispleaf Buckwheat Badlands Sparse Vegetation	19	2	21	193	7	200
S-GYPS	Gypsum Badlands Sparse Vegetation	168	46	214	4288	500	4788
H-LESA	Salina Wildrye Shale Sparse Grassland	1	9	10	1	31	33
<i>Subtotal</i>		494	200	694	8124	2309	10433
Inter-Mountain Basins Wash (CES304.781)							
S-MESI	Mesic Canyon Bottom Shrubland Complex	145	20	165	295	26	321
<i>Subtotal</i>		145	20	165	295	26	321
Multiple Ecological Systems:							
Inter-Mountain Basins Greasewood Flat (CES304.780)							
Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)							
Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)							
Inter-Mountain Basins Wash (CES304.781)							
Southern Colorado Plateau Sand Shrubland (CES304.793)							

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

Map Code	Map Class Common Name	Polygons			Area (hectares)		
		Park	Environs	Total Area*	Park	Environs	Total Area*
S-WASH	Desert Wash Shrubland Mosaic	235	178	413	714	460	1175
	<i>Subtotal</i>	235	178	413	714	461	1175
Multiple Ecological Systems:							
Inter-Mountain Basins Greasewood Flat (CES304.780)							
Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)							
Inter-Mountain Basins Semi-Desert Grassland (CES304.787)							
H-HAGL	Halogeton Semi-Natural Herbaceous Vegetation	1	0	1	1	0	1
S-BLGR	Black Greasewood Shrubland Complex	214	70	284	1545	562	2107
	<i>Subtotal</i>	215	70	285	1546	562	2108
Inter-Mountain Basins Semi-Desert Grassland (CES304.787)							
H-BGPL	Black Grama – Galleta Herbaceous Vegetation	1	0	1	16	0	16
H-POFE	Muttongrass / Non-vascular Herbaceous Vegetation	0	1	1	0	5	5
	<i>Subtotal</i>	1	1	1	16	5	21
Multiple Ecological Systems:							
Inter-Mountain Basins Semi-Desert Shrub-Steppe							
Inter-Mountain Basins Semi-Desert Grassland							
Inter-Mountain Basins Active and Stabilized Dune							
H-GRAS	Mixed Grasslands Complex	566	217	783	3147	1406	4553
	<i>Subtotal</i>	566	217	783	3147	1406	4553
Rocky Mountain Subalpine-Montane Riparian Woodland (CES306.833)							
W-BSRD	Blue Spruce / Red-Osier Dogwood Woodland	2	1	3	6	1	7
	<i>Subtotal</i>	2	1	3	6	1	7
North American Warm Desert Riparian Woodland and Shrubland (CES302.753)							
S-TARU	Tamarisk Temporarily Flooded Shrubland	199	86	285	105	228	334

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

Map Code	Map Class Common Name	Polygons			Area (hectares)		
		Park	Environs	Total Area*	Park	Environs	Total Area*
<i>Subtotal</i>		199	86	285	105	229	334
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)							
W-POFR	Fremont Cottonwood Woodland Complex	187	90	277	254	109	364
W-POAN	Narrowleaf Cottonwood Woodland	0	3	3	0	6	6
S-COSE	Red-osier Dogwood Shrubland	1	0	1	<1	0	<1
S-BEOC	River Birch Shrubland	1	5	6	9	10	20
W-BOEL	Box Elder Woodland Complex	6	0	6	12	0	12
S-WILL	Willow Shrubland Complex	24	20	44	35	19	55
<i>Subtotal</i>		219	118	337	310	144	457
Colorado Plateau Hanging Garden (CES304.764)							
H-HANG	Hanging Gardens Herbaceous Vegetation	1	0	1	<1	0	<1
<i>Subtotal</i>		1	0	1	<1	0	<1
Multiple Ecological Systems: Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765) North American Arid West Emergent Marsh (CES300.729)							
H-SEEP	Springs and Seeps Mosaic	41	36	77	13	10	23
<i>Subtotal</i>		41	36	77	13	10	23
Not Assigned to an Ecological System							
S-BENT	Bentonite Badlands	91	78	169	404	882	1285
C-TINJ	Tinajas (Points only, no polygons)	N/A	N/A	N/A	N/A	N/A	N/A
C-MXDW	Wet Meadow Herbaceous Vegetation	0	5	5	0	2	2
H-CUSH	Sparse Cushion Plant Herbaceous Vegetation	77	2	79	210	3	213

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

Map Code	Map Class Common Name	Polygons			Area (hectares)		
		Park	Environs	Total Area*	Park	Environs	Total Area*
<i>Subtotal</i>		168	85	253	614	887	1500
UNVEGETATED AND ANDERSON LAND USE MAP CLASSES							
L-ORCH	Orchards	19	2	21	14	3	18
L-ABAN	Abandoned Fields	6	5	11	16	7	23
L-RESI	Residential Developments	2	4	6	3	1	4
L-FACI	NPS Facilities	13	0	13	11	0	11
G-MUDC	Mudstone Cliffs	80	7	87	427	37	464
G-TALU	Bare Talus/Slides	165	85	250	1146	465	1611
G-SAND	Unvegetated Sand	2	1	3	2	0	2
G-SLIC	Unvegetated Sandstone	1032	159	1191	6986	1490	8476
L-MINE	Mines, Quarries, Mine tailings	4	6	10	1	9	10
L-POND	Stock ponds	391	30	421	16	6	22
L-DTCH	Ditches	2	9	11	<1	6	6
G-WASH	Barren Wash Channel	83	24	107	104	36	140
G-STRM	Perennial Stream	17	7	24	25	14	39
L-ROAD	Roads	15	10	25	109	47	156
L-CULT	Cultivated fields	10	11	21	10	113	123
<i>Subtotal</i>		1841	360	2201	8870	2234	11105
Total All Map Classes		13932	7055	20987	98651	48103	146754

* Note: Total polygon area may differ from the full mapping project area because of cumulative rounding error.

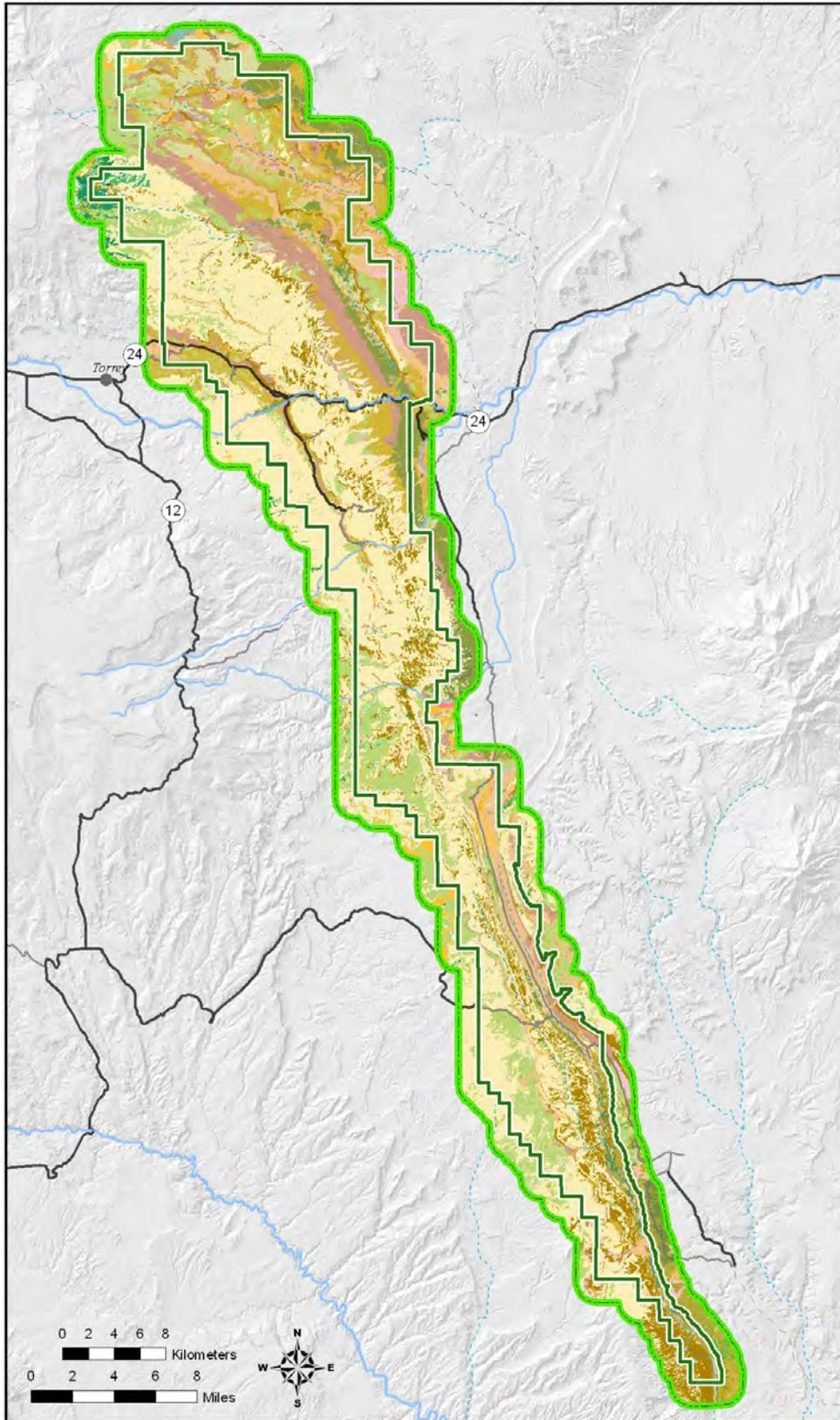


Figure 36a. The CARE vegetation map based on ecological system groups of map classes.

Ecological Systems for Capitol Reef National Park

-  Rocky Mountain Aspen Forest and Woodland
-  Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland
-  Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland
-  Southern Rocky Mountain Ponderosa Pine Woodland
-  Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland
-  Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland
-  Colorado Plateau Pinyon-Juniper Shrubland
-  Colorado Plateau Pinyon-Juniper Woodland
-  Colorado Plateau Mixed Bedrock Canyon and Tableland
-  Rocky Mountain Gambel Oak-Mixed Montane Shrubland
-  Rocky Mountain Lower Montane-Foothill Shrubland
-  Great Basin Semi-Desert Chaparral
-  Inter-Mountain Basins Montane Sagebrush Steppe
-  Inter-Mountain Basins Big Sagebrush Shrubland
-  Colorado Plateau Mixed Low Sagebrush Shrubland
-  Colorado Plateau Blackbrush-Mormon-tea Shrubland
-  Inter-Mountain Basins Semi-Desert Shrub-Steppe
-  Southern Colorado Plateau Sand Shrubland
-  Inter-Mountain Basins Active and Stabilized Dune
-  Inter-Mountain Basins Greasewood Flat
-  Inter-Mountain Basins Mixed Salt Desert Scrub
-  Inter-Mountain Basins Shale Badland
-  Inter-Mountain Basins Wash
-  Inter-Mountain Basins Semi-Desert Grassland
-  Rocky Mountain Subalpine-Montane Riparian Woodland
-  Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland
-  North American Warm Desert Riparian Woodland and Shrubland
-  North American Arid West Emergent Marsh
-  Colorado Plateau Hanging Garden
-  Natural Features of Special Interest
-  Unvegetated Geologic Exposures
-  Developed Areas
-  Open Water
-  Vegetation Mapping Project Boundary
-  Capitol Reef National Park Boundary

Figure 36b. The CARE vegetation map legend.

Discussion

Mapping vegetation within the parks of the Colorado Plateau, including CARE, is made more challenging by the massive, sheer cliffs that are a common feature of the Plateau. The cliffs make field access difficult, confound the generation of slope and aspect data, and create problematic shadows on the aerial and orthophotography. In addition to requiring the application of special techniques to overcome these challenges, the mapping process revealed opportunities for future improvement, which are discussed below.

Things that worked well: Field data and local descriptions of the associations provided by the ecologists were extremely important ancillary data sources used by the cartographers to delineate map classes. High-quality plot and observation point data, as well as 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 CARE, high quality orthophotography allowed confident manual interpretation and was a solid source for deriving physiognomic classes and tree coverage densities. The geologic data were detailed and had high horizontal accuracy, both of which are important in GIS applications.

On-screen digitizing of map polygons was a successful technique in mapping this park, for several reasons. First, it eliminated map scale as an issue, since interpretation was made on orthoimagery, not on Mylar overlays on uncorrected aerial photography. Second, it saved a great deal of time, as it eliminated the need to scan the Mylar overlays, orthorectify and warp them to the orthoimagery, clean up the linework digitally, and re-attribute the polygons. Eliminating these steps also improved accuracy by removing two potential sources of transcription error.

Areas for Improvement: One area that posed difficulties for mapping in this project was shadows cast by cliffs in the project area. The shadowing affected interpretation of the canyon walls and floors and posed difficulty in extracting derived data such as tree density. Photointerpretation efforts could have been better informed by collecting either additional observation points or by acquiring additional training site data within shadowed areas. The aerial photos were flown late in the season (September) and flightlines were oriented due north-south, not along the axis of the Waterpocket Fold. Both of these facts increased the amount of shadowing in canyons.

The analysis and interpretation of vegetation data from CARE was complicated by the differences between the 2003-2004 and legacy data sets, by lack of replication in many types, and by the high level of variation in understory components. This variety often was not correlated with edaphic or climatic factors, but rather was likely due to historical disturbance regimes and stochastic events. It also probably artificially increased the number of associations identified within the park. With more data, it may have been possible to recognize some plots as variants of existing associations rather than as new associations. The random factors make it difficult to analyze the data with traditional vegetation classification methods. The legacy data were also of limited use to the photointerpreters, as the exact location of most plots was unknown.

Accuracy Assessment

Methods

Introduction

Accuracy assessment (AA) is a test of how well polygon map class attributes represent vegetation on the ground. The AA compares field observations of pre-selected points 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 the area within the CARE boundary; mapped lands 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 (TNC et al. 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.

Of the original set of vegetated map classes, 27 were excluded from the accuracy assessment, either because they were mapped only where encountered in the field, or because they were believed to occur only in the environs. Seventeen land-use and geologic map classes (L-XXXX, G-XXXX) were excluded because they are essentially unvegetated.

Accuracy assessment sampling points were selected for each vegetation map class using guidelines A through E. The primary set of AA evaluation sites included 1,319 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 12.5 m (41 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 12.5 m buffer worked in most situations; however, for small or linear polygons the buffer was reduced or eliminated. Sheer cliffs and steep talus were excluded from the AA point selection pool due to poor or dangerous access. Location (UTM) coordinates for all AA points were downloaded to 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 CARE during the summer of 2005. 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 m² centered on the AA point coordinates (Appendix B). Environmental data collected in the field included elevation, slope, aspect, topographic position, landform, unvegetated surface elements, and descriptive comments. Vegetation data included leaf type and physiognomic class, as well as height and canopy cover for the dominant species in each stratum. The illustrated field key was used to identify the plant association that best described the plot. In most cases, only one plant association name was recorded. When vegetation relationships were less clear, a secondary or tertiary plant association name was also recorded. Plant associations occurring within 50 m of the AA point boundary were also recorded. One or more 35 mm color slides were taken at each AA point to provide visual documentation of the site.

The field team collected data at 1,313 AA points (Figure 37). AA point data were manually entered into the plots database and a thorough quality assessment/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 catalogued in the same database as the classification plot photographs.

Data Analysis

All 1,313 AA data points collected in 2005 were used in the data analysis. The field data were converted into a spatial data layer with coordinates and attributes. The first step in the AA analysis intersected the AA point data with the map polygon data. The primary, secondary, and tertiary plant association names 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. Sixty-two points were classified as vegetation types belonging to map classes that were not accuracy assessed, because they were “mapped where encountered”. Polygons containing these points were re-labeled and the 62 points were removed from the analysis.

The results of the initial analysis were arrayed in a preliminary contingency table in which producer’s and user’s accuracy were calculated for each map class. Producer’s accuracy is computed 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 the project ecologist met to analyze the map errors revealed in the preliminary contingency table. 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 position error, questionable field determinations, edge error, and inclusions (small patches of atypical 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 solutions for raising map class accuracy formulated (Appendix I).

In January 2006, a meeting was held among the 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 11). 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 86 vegetation, geology, and land-use map classes.

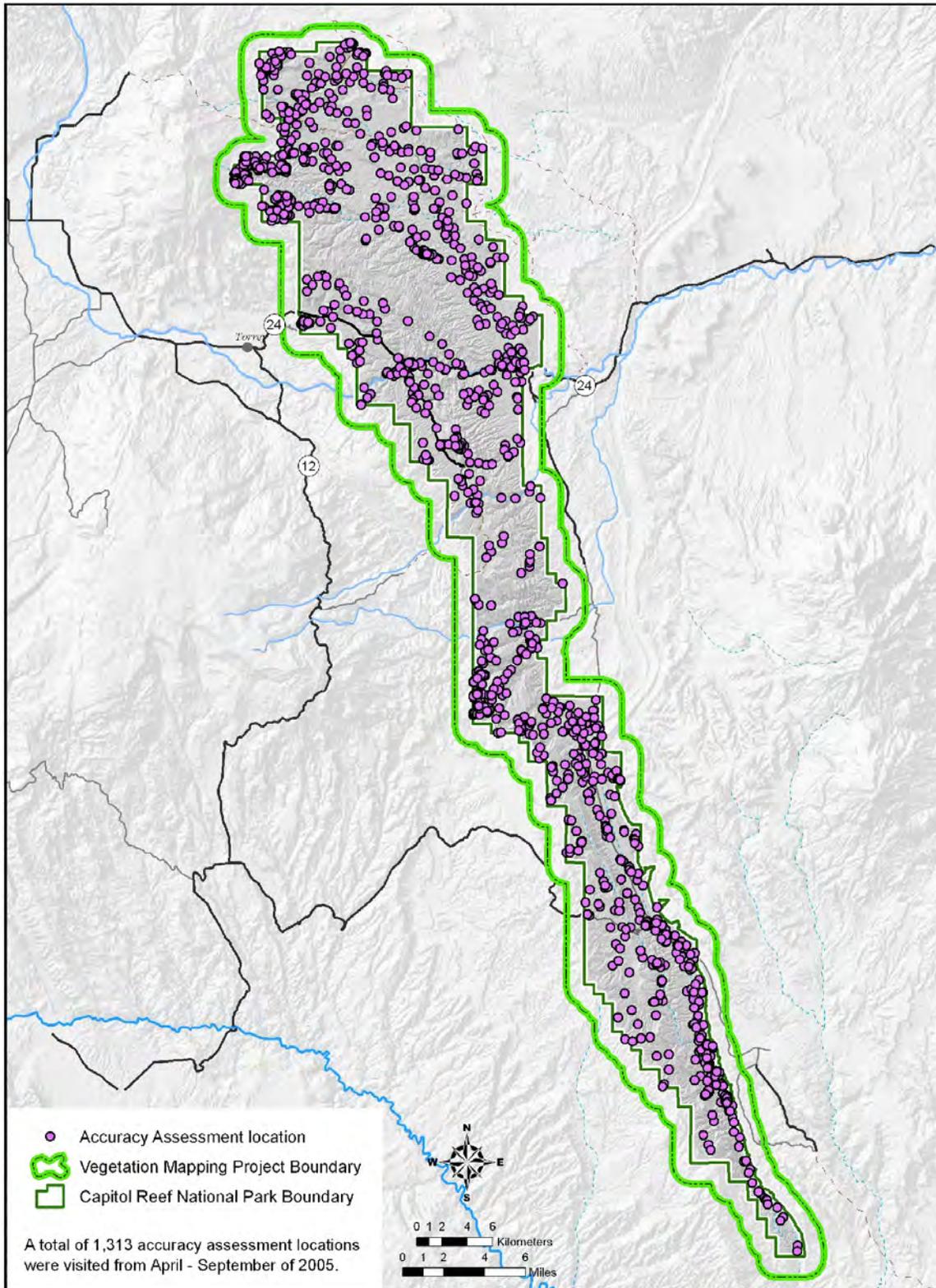


Figure 37. Location of accuracy assessment points sampled within CARE. The accuracy of the map outside of the park boundary was not assessed.

Table 11. Final contingency table for CARE. This table represents the 44 map classes retained following accuracy assessment and revision whose accuracy was assessed¹. Five AA points were classified as types that were mapped only where encountered; polygon labels were therefore changed to match the field call. 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 77% (Kappa statistic = 70%). User's and producer's accuracy values for each map class appear in Tables 12 and 13.

Map Unit	4	4a	5	6	8	8b	9	10	10a	11	11a	11c	12b	12d	13	13a	13b	13d	13e	13h	13x	13y	13z	14	15	15b	15d	15e	16	16a	16e	17	19	19c	20	21	23a	23c	24	32	33	33a	40	64	TOT	% corr					
4	34			10	1						1				1										1																		1	49	69%						
4a	3	18														1																															22	82%			
5	1		24												4	1									1																						31	77%			
6	4			27	1										2	1								1	2																				1	39	69%				
8	2			3	24					1	1																																			31	77%				
8b						0																																								0	0%				
9							18	2		2												3												1												26	69%				
10								25							1										1																						27	93%			
10a							1		3																					1						1										6	50%				
11		3			7		1			69						1							2	2												1										81	77%				
11a					1		1				25		1			2																															34	74%			
11c											4	18	1																																			26	69%		
12b										1				24													1																					2	30	80%	
12d														3											1		1																					5	60%		
13	2	1	1		3										49										3		1																					60	82%		
13a		1	4	3	1											21																																30	70%		
13b																	14	1										6	1																				22	64%	
13d																		23																															23	100%	
13e																			2																														2	100%	
13h						2															15				2																							1	20	75%	
13x																																																	1	100%	
13y					2		3	1															16																									22	73%		
13z										2														18																									20	90%	
14					1																				40	1	3	5		2																		52	77%		
15						1																			2	62				4																			69	90%	
15b																									1		24	1		4																				30	80%
15d				2																					10	2	6	65		1	5																			91	71%
15e																									1	1		2	24	1	1																		30	80%	
16																									4	5		2		46																		1	58	79%	
16a																									1		6	2	4	3	45																		61	74%	
16e							1						2														1			7	3	36	1	1															1	53	68%

Table 11. Final contingency table for CARE. This table represents the 44 map classes retained following accuracy assessment and revision whose accuracy was assessed¹. Five AA points were classified as types that were mapped only where encountered; polygon labels were therefore changed to match the field call. 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 77% (Kappa statistic = 70%). User's and producer's accuracy values for each map class appear in Tables 12 and 13.

Map Unit	4	4a	5	6	8	8b	9	10	10a	11	11a	11c	12b	12d	13	13a	13b	13d	13e	13h	13x	13y	13z	14	15	15b	15d	15e	16	16a	16e	17	19	19c	20	21	23a	23c	24	32	33	33a	40	64	TOT	% corr	
17								1										1						1								15											19	79%			
19					1								1											1									15											18	83%		
19c																																	5											5	100%		
20																												1						4										5	80%		
21														1														1								26	2			1				33	79%		
23a																									1			10						4	1	18								34	53%		
23c																												3	5	2											1			28	54%		
24										1		1																														1	1	34	88%		
32										2																																		5	40%		
33																																												31	90%		
33a																																											5	100%			
40																													1															9	90%		
64										2			3																															2	80%		
Total	46	23	29	45	42	3	25	29	3	80	31	19	32	4	57	27	14	25	2	15	1	19	20	66	81	40	79	36	86	59	40	18	16	7	8	27	25	15	35	2	29	6	17	2	30		
% corr	74%	78%	83%	60%	57%	0%	72%	86%	100%	86%	81%	95%	75%	75%	86%	78%	100%	92%	100%	100%	100%	84%	90%	61%	77%	60%	82%	67%	53%	76%	90%	83%	94%	71%	50%	96%	72%	100%	86%	100%	97%	83%	53%	96%		1308	

¹Vegetation map classes 1, 8a, 8c, 12a, 12c, 13f, 14b, 14c, 15f, 18c, 19d, 22, 24a, 25, 26b, 26c, 26d, 27, 30, 31, 34, 35, 36, 41, 43, 63, and 65 were not accuracy assessed. No geologic or land use map classes were accuracy assessed.

Results and Discussion

The map classes shown in tables and figures in this document represent those that remained or were created following adjustment of map classes to improve CARE map class accuracy. Final overall map accuracy is 77% (Kappa correction = 70%). Individual map class producer's and user's accuracy values are given with their 90% confidence intervals. The width of each confidence interval is affected by sample size. Individual map class accuracy ranges from 0% to 100% (Table 12 and Table 13).

Table 12. Final CARE 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)
S-BLAC	10	Blackbrush Shrubland Complex	93% ± 9%	86% ± 10%
S-MXDD	13	Mixed Desert Shrubland Complex	82% ± 9%	86% ± 8%
S-WYSA	13d	Wyoming Sagebrush / Blue Grama Shrubland	100%	92% ± 9%
S-BSCU	13e	Black Sagebrush – Bitterbrush / Muttongrass Shrubland	100%	100%
S-EVGC	13x	Green Mormon Tea / Galleta – Cheatgrass Shrubland Complex	100%	100%
S-RURA	13z	Rubber Rabbitbrush / Blue Grama Shrub Herbaceous Vegetation	90% ± 11%	90% ± 11%
S-LLMM	19	Little-leaf Mountain Mahogany Slickrock Sparse Vegetation	83% ± 14%	94% ± 10%
W-POFR	24	Fremont Cottonwood Woodland Complex	88% ± 9%	86% ± 10%
W-POPI	33	Ponderosa Pine Woodland Complex	90% ± 9%	97% ± 6%
W-PPQG	33a	Blue Spruce / Red-Osier Dogwood Woodland	100%	83% ± 25%
S-TARU	64	Tamarisk Temporarily Flooded Shrubland	80% ± 12%	96% ± 6%

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

Map Class Code	Map Class Number	Map Class Name	Producer's Accuracy (±90% CI)	User's Accuracy (±90% CI)	Confused with Map Class #
S-BUCK	4a	Crispleaf Buckwheat Badlands Sparse Vegetation	82% ± 14%	78% ± 14%	4, 11
S-GYPS	5	Gypsum Badlands Sparse Vegetation	77% ± 8%	83% ± 8%	13, 13a
S-QUHA	10a	Tucker's Oak Shrubland	50% ± 34%	100%	9
S-WASH	11	Desert Wash Shrubland Mosaic	77% ± 8%	86% ± 8%	8, 64
S-BLGR	11a	Black Greasewood Shrubland	74% ± 13%	81% ± 12%	11c, 13a

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

Map Class Code	Map Class Number	Map Class Name	Producer's Accuracy ($\pm 90\%$ CI)	User's Accuracy ($\pm 90\%$ CI)	Confused with Map Class #
		Complex			
S-ARTR	11c	Big Sagebrush Shrubland Complex	69% \pm 15%	95% \pm 9%	11a
S-MESI	12b	Mesic Canyon Bottom Shrubland Complex	80% \pm 12%	75% \pm 13%	16e, 64
S-GOSB	13b	Gambel Oak / Serviceberry Shrubland	64% \pm 17%	100%	15e
S-ETGG	13h	Torrey Mormon Tea / Blue Grama – Galleta Shrubland	75% \pm 16%	100%	8b, 14
S-EVRN	13y	Green Mormon Tea / Indian Ricegrass – Needle-and-Thread Shrubland	73% \pm 15%	84% \pm 14%	8, 9
W-PJXE	15	Pinyon-Juniper / Xeric Shrubs Woodland Complex	90% \pm 6%	77% \pm 7%	13, 16
W-PJOP	15b	Pinyon-Juniper / Brittle Prickly Pear Woodland	80% \pm 12%	60% \pm 13%	15d, 16, 16a
W-PJSP	15d	Pinyon-Juniper / Sparse Understory Woodland	71% \pm 8%	82% \pm 7%	14, 15b, 16a
W-PJWS	15e	Pinyon-Juniper / Sagebrush Woodland Complex	80% \pm 12%	67% \pm 13%	13b, 16a
W-PJOM	16e	Pinyon-Juniper / Oak and Manzanita Woodland	68% \pm 10%	90% \pm 8%	16, 16a
W-PJBB	17	Pinyon-Juniper / Blackbrush Woodland	79% \pm 15%	83% \pm 15%	10
W-PJBC	19c	Pinyon-Juniper / Blackbrush – Cliffrose – Tucker Oak Wooded Shrubland	100%	71% \pm 29%	10a
W-PILO	20	Bristlecone Pine Woodland	80% \pm 29%	50% \pm 29%	23a
W-PPGM	21	Ponderosa Pine / Greenleaf Manzanita Woodland	79% \pm 11%	96% \pm 6%	16e, 23a
W-DOFI	23c	Douglas-fir Canyon Woodland Complex	54% \pm 15%	100%	16, 16a, 16e
S-WILL	32	Willow Shrubland Complex	40% \pm 36%	100%	11
S-TALM	40	Talus Mixed Shrubland Complex	90% \pm 16%	53% \pm 20%	many

As shown in Table 14, 22 map classes were retained in the final vegetation map for CARE when either user's or producer's accuracy did not meet the 80% program standard. In many cases, the 90% confidence interval includes 80%, so park staff deemed the results to be acceptable. In other cases, park staff accepted lower map class accuracy because the map class was rare in the park and the accuracy was based on only a few points. Park staff wanted the option of correcting these polygons on a case-by-case basis. In the remaining cases, park staff retained map classes with less than 80% accuracy either because the classes were ecologically significant and therefore

they wanted to keep them even with low accuracy, or because the errors were with closely related map classes or were a matter of a few percent cover of a diagnostic species.

Eleven map classes did not achieve the 80% standard for either user's or producer's accuracy (Table 14). Reasons for retaining each map class are detailed below.

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

Map Class Code	Map Class Number	Map Class Name	Producer's Accuracy ($\pm 90\%$ CI)	User's Accuracy ($\pm 90\%$ CI)	Confused with Map Class #
S-MATS	4	Saltbush Badlands Shrubland Complex	69% \pm 10%	74% \pm 11%	4a, 6
S-ATCO	6	Shadscale Shrubland Complex	69% \pm 12%	60% \pm 12%	4, 8, 13a
H-GRAS	8	Mixed Grasslands Complex	77% \pm 13%	57% \pm 13%	6, 11
H-BGPL	8b	Black Grama – Galleta Herbaceous Vegetation	0% 0%		13h
S-ARFI	9	Sand Sage Shrubland Complex	69% \pm 15%	72% \pm 15%	13y
W-CELE	12d	Curl-leaf Mountain Mahogany Woodland Complex	60% \pm 36%	75% \pm 36%	15, 15d
S-EPTO	13a	Torrey Mormon Tea Shrubland Complex	70% \pm 14%	78% \pm 13%	5, 6, 11a
W-PJMG	14	Pinyon-Juniper / Mixed Grass Woodland Complex	77% \pm 10%	61% \pm 9%	15b, 15d, 16
W-PJME	16	Pinyon-Juniper / Mesic Shrubs Woodland Complex	79% \pm 9%	53% \pm 9%	14, 15, 16e
W-PJMM	16a	Pinyon-Juniper / Mountain Mahogany and Gambel Oak Woodland	74% \pm 9%	76% \pm 9%	15b, 15d, 15e, 16, 23c
W-DFME	23a	Douglas-fir Montane Woodland Complex	53% \pm 14%	72% \pm 15%	16, 20, 33

S-MATS (Map Class 4) - Saltbush Badlands Shrubland Complex: This map class was most often confused with the closely related Crispleaf Buckwheat Badlands Sparse Vegetation and Shadscale Shrubland Complex map classes, but park staff retained it because it represents a distinct desert community with significant ecological values.

S-ATCO (Map Class 6) - Shadscale Shrubland Complex: This map class was most often confused with the closely related Crispleaf Buckwheat Badlands Sparse Vegetation and Torrey Mormon Tea Shrubland Complex, as well as with Mixed Grasslands Complex, which have similar signatures. However, accuracy was still relatively high and park staff chose to retain this map class because of its ecological significance.

H-GRAS (Map Class 8) - Mixed Grasslands Complex: Most of the errors in this map class were points that keyed to bottomland or desert shrub-herbaceous types. An omission in the key only allowed these types of AA plots to be classified as shrublands, whereas most would properly have keyed to grasslands with scattered shrubs. Because the differences in most cases were only

a few percent cover of grass separating grasslands and shrublands, park staff accepted less than 80% accuracy in this class. The field key was amended to prevent this error in the future.

H-BGPL (Map Class 8b) - Black Grama – Galleta Herbaceous Vegetation: This map class represents a unique community found only on the top and slopes of Johnson Mesa. Due to an error by the technician generating the AA points, no AA points were assigned to the one large polygon given as this map class. The points called MU8b by AA crews are all close to the MU8b polygon on Johnson Mesa and in similar habitats. Given this scenario, and the importance of this map class to the park's biodiversity, park staff chose to retain the map class.

S-ARFI (Map Class 9) - Sand Sage Shrubland Complex: Most of the confusion for this map class was with the Green Mormon Tea / Indian Ricegrass – Needle-and-Thread Shrubland map class. These map classes have very similar signatures, share similar habitats, and may represent different successional stages of the same community type. For these reasons, and because the accuracy was relatively high, park staff retained these map classes as separate entities.

W-CELE (Map Class 12d) - Curl-leaf Mountain Mahogany Woodland Complex: Accuracy in this map class was low primarily because it is rare within the park and only five AA points were assigned to it. However, the community is ecologically significant; therefore park staff retained this map class and will correct polygons during future field work.

S-EPTO (Map Class 13a) - Torrey Mormon Tea Shrubland Complex: Although it remains in the contingency table, confusion with the Shadscale Shrubland Complex has been reduced by changing the field key so that if a Torrey Mormon-tea community has any *Artemisia bigelovii* or *Atriplex confertifolia*, it cannot be assigned to the Shadscale Shrubland Complex map class. Confusion with the Gypsum Badlands Sparse Vegetation is understandable given the difficulty of discerning ground lichen cover from aerial photography (the vascular component of this map class is also usually dominated by Torrey Mormon-tea). Once corrections were made to the field key, park staff retained it as a separate map class. The confusion with the Black Greasewood Shrubland Complex map class was due to mapper error, but was not considered significant enough to justify combining these map classes.

W-PJMG (Map Class 14) - Pinyon-Juniper / Mixed Grass Woodland Complex: See explanation for Map Class W-PJHE. The primary confusion was with the Pinyon-Juniper / Brittle Prickly Pear Woodland map class; many of the stands with brittle prickly pear dominant in the understory also have a significant grass component. Confusion with the Pinyon-Juniper / Sparse Understory Woodland was mostly due to the fact that larger polygons often contained stands with patchy grass cover and effectively were an inseparable complex of grass-dominated and sparse-understory woodlands. Confusion with the Pinyon-Juniper / Mesic Shrubs Woodland Complex map class occurred mostly in stands with marginal (e.g., close to the 5% cutoff) cover of diagnostic shrubs. Park staff determined these types of errors were acceptable, that the basic map class concept was solid and should be retained as a separate entity.

W-PJME (Map Class 16) - Pinyon-Juniper / Mesic Shrubs Woodland Complex: This map class was among the most common and widespread within the park; because of this abundance, park staff were reluctant to combine it with any of the closely related woodland map classes with

which it was most often confused. Minor changes to the field key should help ensure that in the future, field workers will be able to separate woodlands with a xeric shrub understory more reliably from stands with a mesic shrub understory.

W-PJMM (Map Class 16a) - Pinyon-Juniper / Mountain Mahogany and Gambel Oak

Woodland: Park staff retained this map class because the concept was good and it was ecologically significant within CARE. Most of the confusion is with closely related woodland types, especially stands with scattered Douglas-fir trees.

W-DFME (Map Class 23a) - Douglas-fir Montane Woodland Complex: Confusion with the Pinyon-Juniper / Mesic Shrubs Woodland Complex was generally a matter of pinyon-juniper stands with scattered Douglas-fir being classed one way by the photointerpreter but another way by AA crews collecting plot data. Park staff accepted this type of error and decided to retain the map class. Confusion with the Bristlecone Pine Woodland and Ponderosa Pine Woodland Complex map classes was due to the misclassification (by the photointerpreter) or mis-keying (by the field crews) of stands with a canopy of mixed tall conifer species. Small changes to the field keys should limit this type of error in the future.

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Appendix A

Ecological Systems of Capitol Reef National Park

Introduction

This appendix contains summary descriptions of 29 terrestrial and riparian/wetland ecological system (ES) units (NatureServe 2003b, Comer et al. 2003) occurring at Capitol Reef National Park. Each ecological system represents one or more National Vegetation Classification (NVC) plant associations or alliances (Table 6 within the main report). Map classes were also crosswalked to ES units (Table 9 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.

UPLAND ECOLOGICAL SYSTEMS

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, *Symphotrichum 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

CES306.825 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/aspens 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, occurring predominantly in cool ravines and on north-facing slopes.

Subnations: AZ, CO, ID, NM, NV, OR?, 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

CES306.648 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

CES304.790 INTER-MOUNTAIN BASINS SUBALPINE LIMBER-BRISTLECONE PINE WOODLAND

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

Spatial Scale & Pattern: Large Patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Upper Montane; Forest and Woodland; Ridge; Ridge/Summit/Upper Slope; Temperate Continental; Xeric; *Pinus longaeva*, *Pinus flexilis*

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

Range: This system extends from the Mojave Desert and Sierra Nevada across the Great Basin to the central Wasatch and extreme western Uinta mountains.

Subnations: CA, NV, UT

CES304.767 COLORADO PLATEAU PINYON-JUNIPER WOODLAND

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

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Mesa; Ridge/Summit/Upper Slope; Sedimentary Rock; Temperate Xeric; Aridic; *Pinus edulis*, *Juniperus osteosperma*

Concept Summary: This ecological system occurs in dry mountain slopes, mesas, plateaus, and ridges of the Colorado Plateau region including the Western Slope of Colorado to the Wasatch Range, south to the Mogollon Rim and the northwestern corner of New Mexico. It is typically found at lower elevations (1500-2440 m). Severe climatic events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to relatively narrow altitudinal belts on mountainsides. Soils supporting this system vary in texture ranging from stony, cobbly, gravelly sandy loams to clay loam or clay. *Pinus edulis* and/or *Juniperus osteosperma* dominate the tree canopy. In northern Arizona and northwestern New Mexico, *Juniperus monosperma* and hybrids of *Juniperus* spp. may dominate or codominate the tree canopy. *Juniperus scopulorum* may codominate or replace *Juniperus osteosperma* at higher elevations. Understory layers are variable and may be dominated by

shrubs, graminoids, or be absent. Associated species include *Arctostaphylos patula*, *Artemisia tridentata*, *Cercocarpus intricatus*, *Cercocarpus montanus*, *Coleogyne ramosissima*, *Purshia stansburiana*, *Purshia tridentata*, *Quercus gambelii*, *Bouteloua gracilis*, *Pleuraphis jamesii*, or *Poa fendleriana*. This system occurs at higher elevations than Great Basin Pinyon-Juniper Woodland (CES304.773) and Colorado Plateau shrubland systems.

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

Subnations: AZ, CO, NM, UT

CES304.772 INTER-MOUNTAIN BASINS CURL-LEAF MOUNTAIN MAHOGANY WOODLAND AND SHRUBLAND

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

Spatial Scale & Pattern: Large Patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Aridic; *Cercocarpus ledifolius*

Concept Summary: This ecological system occurs in hills and mountain ranges of the Intermountain West basins from the eastern foothills of the Sierra Nevada northeast to the foothills of the Bighorn Mountains. It typically occurs from 600 m to over 2650 m in elevation on rocky outcrops or escarpments and forms small- to large-patch stands in forested areas. Most stands occur as shrublands on ridges and steep rimrock slopes, but they may be composed of small trees in steppe areas. Scattered junipers or pines may also occur. This system includes both woodlands and shrublands dominated by *Cercocarpus ledifolius*. *Artemisia tridentata* ssp. *vaseyana*, *Purshia tridentata*, with species of *Arctostaphylos*, *Ribes*, or *Symphoricarpos* are often present. Undergrowth is often very sparse and dominated by bunch grasses, usually *Pseudoroegneria spicata* and *Festuca idahoensis*. *Cercocarpus ledifolius* is a slow-growing, drought-tolerant species that generally does not resprout after burning and needs the protection from fire that rocky sites provide.

Range: This system occurs in hills and mountain ranges of the Intermountain West from the eastern foothills of the Sierra Nevada northeast to the foothills of the Bighorn Mountains.

Subnations: CA, CO, ID, MT, NV, OR, UT, WY

CES304.766 COLORADO PLATEAU PINYON-JUNIPER SHRUBLAND

Division 304 (Inter-Mountain Basins); Shrubland

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Lowland [Foothill]; Mesa; Ridge/Summit/Upper Slope; Sedimentary Rock; Temperate Xeric; Aridic; *Pinus edulis*, *Juniperus osteosperma*

Concept Summary: This ecological system is characteristic of the rocky mesatops and slopes on the Colorado Plateau and west slope of Colorado, but these stunted tree shrublands may extend further upslope along the low-elevation margins of taller pinyon-juniper woodlands. Sites

are drier than Colorado Plateau Pinyon-Juniper Woodland (CES304.767). Substrates are shallow/rocky soils at lower elevations (1200-2000 m). Sparse examples of the system grade into Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765). The vegetation is dominated by dwarfed (usually <3 m tall) *Pinus edulis* and/or *Juniperus osteosperma* trees forming tall shrublands in the region along low-elevation margins of pinyon-juniper woodlands. Other shrubs, if present, include *Artemisia nova*, *Artemisia tridentata* ssp. *wyomingensis*, *Chrysothamnus viscidiflorus*, or *Coleogyne ramosissima*. The herbaceous layer is sparse to moderately dense and typically composed of xeric graminoids.

Range: Rocky mesa tops and slopes on the Colorado Plateau.

Subnations: AZ, CO, NM, UT

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

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

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; Intermediate 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

CES304.763 COLORADO PLATEAU BLACKBRUSH-MORMON TEA SHRUBLAND
Division 304 (Inter-Mountain Basins); Shrubland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Lowland [Foothill]; Shrubland; Temperate Xeric; Aridic

Concept Summary: This ecological system occurs in the Colorado Plateau on benchlands, colluvial slopes, pediments or bajadas. Elevation ranges from 560-1650 m. Substrates are shallow, typically calcareous, non-saline and gravelly or sandy soils over sandstone or limestone bedrock, caliche or limestone alluvium. It also occurs in deeper soils on sandy plains where it may have invaded desert grasslands. The vegetation is characterized by extensive open shrublands dominated by *Coleogyne ramosissima* often with *Ephedra viridis*, *Ephedra torreyana*, or *Grayia spinosa*. Sandy portions may include *Artemisia filifolia* as codominant. The herbaceous layer is sparse and composed of graminoids such as *Achnatherum hymenoides*, *Pleuraphis jamesii*, or *Sporobolus cryptandrus*.

Range: Occurs in the Colorado Plateau on benchlands, colluvial slopes, pediments or bajadas. Elevation ranges from 560-1600 m.

Subnations: AZ, CO, NM, UT

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

CES304.785 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 tridentata* 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

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

CES304.001 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, UT

CES304.793 SOUTHERN COLORADO PLATEAU SAND SHRUBLAND

Division 304 (Inter-Mountain Basins); Shrubland

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

Concept Summary: This large-patch ecological system is found on the south-central Colorado Plateau in northeastern Arizona extending into southern and central Utah. It occurs on windswept mesas, broad basins and plains at low to moderate elevations (1300-1800 m). Substrates are stabilized sandheets or shallow to moderately deep sandy soils that may form small hummocks or small coppice dunes. This semi-arid, open shrubland is typically dominated by short shrubs (10-30% cover) with a sparse graminoid layer. The woody layer is often a mixture of shrubs and dwarf-shrubs. Characteristic species include *Ephedra cutleri*, *Ephedra torreyana*, *Ephedra viridis*, and *Artemisia filifolia*. *Coleogyne ramosissima* is typically not present. *Poliomintha incana*, *Parryella filifolia*, *Quercus havardii* var. *tuckeri*, or *Ericameria nauseosa* may be present to dominant locally. *Ephedra cutleri* and *Ephedra viridis* often assume a distinctive matty growth form. Characteristic grasses include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Hesperostipa comata*, and *Pleuraphis jamesii*. The general aspect of occurrences is an open low shrubland but may include small blowouts and dunes. Occasionally grasses may be moderately abundant locally and form a distinct layer. Disturbance may be important in maintaining the woody component. Eolian processes are evident, such as pediceled plants, occasional blowouts or small dunes, but the generally higher vegetative cover and less prominent geomorphic features distinguish this system from Inter-Mountain Basins Active and Stabilized Dune (CES304.775).

Range: This system occurs in sandy plains and mesas on the south-central Colorado Plateau in northeastern Arizona extending into southern and central Utah.

Subnations: AZ, CO, NM, UT

CES304.775 INTER-MOUNTAIN ACTIVE AND STABILIZED DUNE

Division 304 (Inter-Mountain Basins); Barren

Spatial Scale & Pattern: Large Patch

Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland

Diagnostic Classifiers: Dune; Temperate Continental; Sand Soil Texture, Aridic, W-Landscape/High Intensity

Concept Summary: This ecological system occurs in basins, valleys and plains of the Intermountain West. It is composed of a mosaic of migrating, bare dunes; anchored dunes with

sparse to moderately dense vegetation (<10-30% canopy cover); and stabilized dunes. The system is defined by the presence of migrating dunes or, where the dunes are entirely anchored or stabilized, evidence that the substrate is eolian and not residual, that the vegetation is early- or mid-seral, and that the substrate is likely to become actively migrating again with disturbance or increased aridity. In the Colorado Plateau, many small active and partially vegetated dunes occur along some of the larger washes and playas (where sand is blown out of wash and forms dunes) and some larger dunes such as Coral Pink Dunes in southwestern Utah. Substrates are usually eolian sand, but small dunes composed of silt and clay downwind from playas in the Wyoming Basins (which usually support greasewood vegetation) also are included here. Species occupying these environments are often adapted to shifting, coarse-textured substrates (usually quartz sand) and form patchy or open grasslands, shrublands or steppe, and occasionally woodlands. Vegetation varies and may be composed of *Achnatherum hymenoides*, *Artemisia filifolia*, *Artemisia tridentata* ssp. *tridentata*, *Atriplex canescens*, *Ephedra* spp., *Chrysothamnus viscidiflorus*, *Coleogyne ramosissima*, *Ericameria nauseosa*, *Hesperostipa comata*, *Leymus flavescens*, *Muhlenbergia pungens*, *Psoralidium lanceolatum*, *Purshia tridentata*, *Redfieldia flexuosa*, *Sporobolus airoides*, *Sarcobatus vermiculatus*, *Tetradymia tetrameres*, or *Tiquilia* spp. Herbaceous species such as *Redfieldia flexuosa*, *Achnatherum hymenoides*, and *Psoralidium lanceolatum* are characteristic of early-seral vegetation through much of this system's range. Shrubs are dominant in later stages of succession.

Comments: Rules are needed for deciding whether shrub or shrub-steppe vegetation on stabilized dunes should be considered part of this active and stabilized dune system, or part of another system. The areas include Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784), Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777), and Inter-Mountain Basins Big Sagebrush Steppe (CES304.778) on sand, and Inter-Mountain Basins Greasewood Flat (CES304.780) on clay and silt.

Range: This system occurs in intermountain basins of the western U.S. including southwestern Montana in the Centennial Valley.

Subnations: AZ, CO, ID, MT, NM, 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

CES304.780 INTER-MOUNTAIN BASINS GREASEWOOD FLAT

Division 304 (Inter-Mountain Basins); Mixed Upland and Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Diagnostic Classifiers: Lowland; Shrubland; Toeslope/Valley Bottom; Alkaline Soil; Deep Soil; Xeromorphic Shrub

Concept Summary: This ecological system occurs throughout the intermountain basins of the western U.S. and extends onto the western Great Plains. It typically occurs on stream terraces and flats associated with drainages or it may form rings around sparsely vegetated playas. Sites typically have saline soils, a shallow water table and flood intermittently, but remain dry for most growing seasons. The water table remains high enough to maintain vegetation, despite salt accumulations. This system usually occurs as a mosaic of multiple communities, with open to moderately dense shrublands dominated or codominated by *Sarcobatus vermiculatus*. *Atriplex canescens*, *Atriplex confertifolia*, or *Krascheninnikovia lanata* may be present to codominant. Occurrences are often surrounded by mixed salt desert scrub. The herbaceous layer, if present, is usually dominated by graminoids. There may be inclusions of *Sporobolus airoides*, *Distichlis spicata* (where water remains ponded the longest), or *Eleocharis palustris* herbaceous types.

Range: Occurs throughout much of the western U.S. in Intermountain basins and extends onto the western Great Plains.

Subnations: AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY

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

CES304.789 INTER-MOUNTAIN BASINS SHALE BADLAND

Division 304 (Inter-Mountain Basins); Barren

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (<10% vasc.); Upland

Diagnostic Classifiers: Lowland; Badlands; Alkaline Soil; Shale and Mudstone; Silt Soil Texture; Clay Soil Texture

Concept Summary: This widespread system of the intermountain western U.S. is composed of barren and sparsely vegetated substrates (<10% plant cover) typically derived from marine shales but also from siltstones and mudstones (clay). Landforms are typically rounded hills and plains that form a rolling topography. The harsh soil properties and high rate of erosion and deposition are driving environmental variables supporting sparse dwarf-shrubs, e.g., *Atriplex corrugata*, *Atriplex gardneri*, *Artemisia pedatifida*, and herbaceous vegetation.

Range: This system is found in the intermountain western U.S. It is confirmed by Oregon and Washington review to not occur in either of those states.

Subnations: AZ, CA, CO, ID, MT, NM, NV, UT, WY

CES304.787 INTER-MOUNTAIN BASINS SEMI-DESERT GRASSLAND

Division 304 (Inter-Mountain Basins); Herbaceous

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Lowland Foothill; Herbaceous; Temperate Xeric; Alkaline Soil; Aridic; Graminoid

Concept Summary: This widespread ecological system occurs throughout the intermountain western U.S. on dry plains and mesas, at approximately 1450 to 2320 m (4750-7610 feet) elevation. These grasslands occur in lowland and upland areas and may occupy swales, playas, mesatops, plateau parks, alluvial flats, and plains, but sites are typically xeric. Substrates are often well-drained sandy or loamy-textured soils derived from sedimentary parent materials but are quite variable and may include fine-textured soils derived from igneous and metamorphic rocks. When they occur near foothill grasslands they will be at lower elevations. The dominant perennial bunch grasses and shrubs within this system are all very drought-resistant plants. These grasslands are typically dominated or by *Achnatherum hymenoides*, *Aristida* spp., *Bouteloua gracilis*, *Hesperostipa comata*, *Muhlenbergia* sp., or *Pleuraphis jamesii* and may include

scattered shrubs and dwarf-shrubs of species of *Artemisia*, *Atriplex*, *Coleogyne*, *Ephedra*, *Gutierrezia*, or *Krascheninnikovia lanata*.

Range: Occurs throughout the Intermountain western U.S. on dry plains and mesas, at approximately 1450 to 2320 m (4750-7610 feet) in elevation.

Subnations: AZ, CA, CO, ID, MT?, NM, NV, OR, UT, WA, WY

RIPARIAN AND WETLAND ECOLOGICAL SYSTEMS

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

Spatial Scale & Pattern: Linear

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Montane, Upper Montane; Forest and Woodland; Riverine / Alluvial; Short (<5 yrs) Flooding Interval; Subalpine/Montane Riparian Shrubland

Concept Summary: This riparian woodland system is comprised of seasonally flooded forests and woodlands found at montane to subalpine elevations of the Rocky Mountain cordillera, from southern New Mexico north into Montana, and west into Intermountain basins and the Colorado Plateau. It occurs throughout the interior of British Columbia and the eastern slopes of the Cascade Mountains. This system contains the conifer and aspen woodlands that line montane streams. These are communities tolerant of periodic flooding and high water tables. Snowmelt moisture in this system may create shallow water tables or seeps for a portion of the growing season. Stands typically occur at elevations between 1500 and 3300 m (4920-10,830 feet), farther north elevation ranges between 900 and 2000 m. This is confined to specific riparian environments occurring on floodplains or terraces of rivers and streams, in V-shaped, narrow valleys and canyons (where there is cold-air drainage). Less frequently, occurrences are found in moderate-wide valley bottoms on large floodplains along broad, meandering rivers, and on pond or lake margins. Dominant tree species vary across the latitudinal range, although it usually includes *Abies lasiocarpa* and/or *Picea engelmannii*; other important species include *Pseudotsuga menziesii*, *Picea pungens*, *Populus tremuloides*, and *Juniperus scopulorum*. Non-dominant trees may include *Alnus incana*, *Abies concolor*, *Abies grandis*, *Pinus contorta*, *Populus angustifolia*, *Populus balsamifera* ssp. *trichocarpa*, and *Juniperus osteosperma*.

Range: This system is found at montane to subalpine elevations of the Rocky Mountain cordillera, from southern New Mexico north into Montana, Alberta and British Columbia, and west into the Intermountain region and the Colorado Plateau.

Subnations: AB, AZ, BC, CO, ID, MT, NM, NV, OR, SD, UT, WA, WY

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

CES302.753 NORTH AMERICAN WARM DESERT RIPARIAN WOODLAND AND SHRUBLAND

Division 302 (North American Warm Desert); Woody Wetland

Spatial Scale & Pattern: Linear

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Lowland; Forest and Woodland; Shrubland; Tropical/Subtropical Xeric; Temperate Xeric; Riverine / Alluvial

Concept Summary: This ecological system consists of low-elevation (<1200 m) riparian corridors along medium to large perennial streams in canyons and the desert valleys of the southwestern United States and adjacent Mexico. The vegetation is a mix of riparian woodlands and shrublands. Dominant trees include *Acer negundo*, *Fraxinus velutina*, *Populus fremontii*, *Salix gooddingii*, *Salix lasiolepis*, *Celtis laevigata* var. *reticulata*, and *Juglans major*. Shrub dominants include *Salix geyeriana*, *Shepherdia argentea*, and *Salix exigua*. Vegetation depends on periodic flooding and sediment scour and/or rise in the water table.

Range: Canyons and desert valleys of the southwestern United States and adjacent Mexico.

Subnations: AZ, CA, MXBC, MXCH, MXSO, NM, NV, TX

CES300.729 NORTH AMERICAN ARID WEST EMERGENT MARSH

Division 300 (North American Continental); Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Herbaceous; Depressional [Lakeshore, Pond]; Mineral: W/ A-Horizon >10 cm; Aquatic Herb; Graminoid; Deep (>15 cm) Water; Saturated Soil

Concept Summary: This widespread ecological system occurs throughout much of the arid and semi-arid regions of western North America, typically surrounded by savanna, shrub steppe, steppe, or desert vegetation. Natural marshes may occur in depressions in the landscape (e.g., kettle ponds), as fringes around lakes, and along slow-flowing streams and rivers. Marshes are frequently or continually inundated, with water depths up to 2 m. Water levels may be stable, or may fluctuate 1 m or more over the course of the growing season. Water chemistry may include some alkaline situations, but the alkalinity is highly variable even within the same complex of wetlands. Marsh soils have characteristics typical of long periods of anaerobic conditions (e.g., gley colors, high organic content, redoximorphic features). The vegetation is characterized by herbaceous plants that are adapted to saturated soil conditions. Common emergent and floating vegetation includes species of *Scirpus* and/or *Schoenoplectus*, *Typha*, *Juncus*, *Potamogeton*, *Polygonum*, *Nuphar*, and *Phalaris*. This system may also include areas of relatively deep water with floating-leaved plants (*Potamogeton*, *Lemna*, and *Brasenia*) and submergent and floating plants (*Myriophyllum*, *Ceratophyllum*, and *Elodea*).

Comments: This ecological system occurs in the arid and semi-arid regions of western North America, in semipermanently flooded habitats within a relatively dry landscape.

Range: Occurs throughout much of the arid and semi-arid regions of western North America.

Subnations: AZ, CA, CO, ID, MT, ND, NE, NM, NV, OK, OR, SD, TX, UT, WA, WY

CES304.764 COLORADO PLATEAU HANGING GARDEN

Division 304 (Inter-Mountain Basins); Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Montane, Lower Montane; Cliff; Sedimentary Rock; Temperate Xeric; Seepage-Fed Sloping; Forb; Fern; Graminoid; Saturated Soil

Concept Summary: Hanging gardens in the Colorado Plateau region are surrounded by an arid environment and associated with canyon country. These highly localized environments include canyons with perennial seeps forming pocketed wetlands and draping vegetation across wet cliff faces. Three main garden types exist: alcove, terrace, or windowblind. Each is determined by the nature of the geological formation and the presence or absence of joint systems. They tend to occur on all exposures, but they are always shaded for much of each day. Temperature and humidity are stable compared to surrounding habitats. Most hanging gardens are dominated by herbaceous plants, a number of which are endemic to this region. Common species include *Adiantum capillus-veneris*, *Adiantum pedatum*, *Mimulus eastwoodiae*, *Mimulus guttatus*, *Sullivantia hapemanii*, *Cirsium rydbergii*, and several species of *Aquilegia*.

Range: Colorado Plateau.

Subnations: AZ, CO, NV?, UT

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 Capitol Reef National Park. Three types of data were collected: vegetation plot, observation point, 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.

Appendix B.1. Plot and Observation Point Field Sampling Manual

FIELD SAMPLING AT CAPITOL REEF NATIONAL PARK

A Basic Guide for Field Work

This document is intended to give you general instructions and guidelines for conducting your field work at Capitol Reef National Park. Detailed, field-by-field coding conventions for the primary form you'll be completing in the field (the Plot Survey form) are provided in the 'cheat sheet' at the back of this guide. You will also be taking Observation Points on a form reduced from and similar to the Plot Survey form, it will be provided in the field. An Accuracy Assessment Point form—another form reduced from and similar to the Plot Survey form, will also be provided in the field.

OVERVIEW

The data that you collect this year will be used to create a relatively fine-scale delineation of vegetation pattern in this Northern Colorado Plateau Network (NCPN) park and its environs. The range of habitats and the corresponding diversity of vegetation types, found in this park are complex. The understanding of finer-scale, ecologically distinct vegetation types that you will help create may be used by the park to plan appropriate management activities, monitor the results of these activities, track long-term changes in vegetation, direct searches for rare species, model fire behavior, and portray the wealth of natural diversity on park lands to the public.

Establishing a field sampling strategy that captures sufficient data on all the distinct vegetation types in Capitol Reef National Park, an area that is diverse and rugged, is a challenge. To make the sampling as efficient as possible, the key environmental variables thought to be driving vegetation pattern were identified. These included factors such as geology, soils, aspect, elevation, and land use/fire history (see TNC 1998).

Initially, sampling will be conducted using a gradsect analysis supported by aerial photographs, geology maps, and topographic maps in addition to overlays of the three data sources to adequately and thoroughly sample the vegetation using standard vegetation plots and ancillary observation points. A classification based on this sampling will result in interpretation of aerial photos to produce a vegetation map that will be assessed for accuracy the following field season. The photo interpreters will supply digital orthophotos with polygons delineated for accuracy assessment work. A combination of manual and electronic delineation and digitizing approaches, as well as on-screen and automated photo interpretation techniques, will be used for Capitol Reef National Park to delineate polygons and label the vegetation types. The vegetation "types" the photo interpreters will choose to name their polygons are those included in the preliminary classification of the parks vegetation created using the U.S. National Vegetation Classification System (Grossman et al. 1998).

The field crew will evaluate the field data, assign a preliminary vegetation type based on a list of potential vegetation types developed from the existing literature, and update the tally of vegetation types by number of plots collected. The goal is to use your time as efficiently as possible: we are trying our best to augment and expand legacy data collected by earlier researchers.

GETTING THERE

You will have a Digital Ortho Quarter Quad (DOQQ) print and a copy of the 1:12,000-scale aerial photography to guide you. You and your partner will navigate towards each selected gradsect polygon

and selected photo-signatures using your Park road and trail map, USGS 7.5 mm. topographic map, the DOQQ, and/or GPS. The DOQQ's will have roads and trails highlighted on them to help you as well.

Before you leave...check that you have all the materials needed to complete your field work (Please see the checklist and ‘considerations for mission planning’ at the end of this document to help you).

Every single morning...check your GPS receiver to make sure it is set to NAD 83.

Along the way...look around. The goal of this field work is to augment an existing database of vegetation types that occur in Capitol Reef National Park. If, on the way to one vegetation type, 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. In this Park, these undescribed vegetation types are more likely various pinyon – juniper woodland understories or shrublands. You will be better able to recognize these undescribed vegetation types as the season progresses and you become more familiar with the vegetation types and how they can look on the ground.

ONCE THERE

Establishing a Plot

1) Figure out where to place your plot. This 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 signature as a whole. In other words, avoid areas where the vegetation appears to be transitioning from one type to another (ecotones) and areas with anomalous or heterogeneous structure or species composition. Look at *all* the vegetation strata to determine if the area is structurally and floristically uniform and generally try to place your plots at least 30 m from what you see as the ‘boundary’ between this vegetation type and any neighboring, distinctly different types. During the training period this step will be emphasized and discussed in detail. However, the rule-of-thumb is to conduct a reconnaissance of the plot area if time and topography allows.

Note: In cases where a signature is very heterogeneous, more than one plot or a plot and observation points may be needed. Again, look around, use that human perception.

2) Using your GPS (Global Positioning System) receiver, record the UTM (Universal Transverse Mercator) coordinates in the center of the plot under the Field UTM X and Field UTM Y on the field form. Also mark and label the location of the plot on a USGS 7.5 min. topographic map and/or on an aerial photo. If you cannot obtain a GPS reading, estimate UTM's from the USGS topographic map and note on the form that you had to resort to this method. Plots may be circular, rectangular or square. Note shape and dimensions on the field form. If the plot is rectangular or square, record the azimuth of the long side (any side if square) to help relocate the plot. It may make more sense to establish rectangular plots in linear vegetation types (e.g. riparian or ridgeline types). Standard plot sizes should be as follows:

If you're in a ...	You should usually make your plot...	Giving you a plot area of...
Forest (i.e., trees have their crowns overlapping, usually forming 60-100% cover)	11.3 m radius OR 20 m x 20 m	400 m ² 400 m ²
Woodland (i.e., open stands of trees with crowns usually not touching. Canopy tree cover is 25-60% OR exceeds shrub, dwarf-shrub, herb, and nonvascular cover).	11.3 m radius OR 20 m x 20 m	400 m ² 400 m ²
Shrubland (i.e., shrubs greater than 0.5 m tall are	11.3 m radius OR	400 m ²

If you're in a ...	You should usually make your plot...	Giving you a plot area of...
dominant, usually forming more than 25% cover OR exceeding tree, dwarf shrub, herb, and nonvascular cover)	20 m x 20 m	400 m ²
Dwarf-shrubland (heath) (i.e., Shrubs less than 0.5 m tall are dominant, usually forming more than 25% cover OR exceeding tree, shrub, herb, and nonvascular cover).	5.65 m radius OR 10 m x 10 m	100 m ² 100 m ²
Herbaceous (i.e., Herbs dominant usually forming more than 25 percent cover OR exceeding tree, shrub, dwarf-shrub, and nonvascular cover).	5.65 m radius OR 10 m x 10 m	100 m ² 100 m ²
Nonvascular (i.e., nonvascular cover dominant usually forming more than 25% cover).	2.82 m radius OR 5 m x 5 m	25 m ² 25 m ²

Note: You can deviate from the standard plot *shapes* where that makes sense, but the total plot *area* encompassed by the boundaries should be as listed above for each major class of vegetation. For example, forested riparian vegetation may be sampled in a more linear 10 x 40 m (400 m²) plot; herbaceous riparian or ridgeline vegetation in a 2 x 50 m (100m²) plot. You may also increase the size of the plot to the next standard size if necessary to sample the heterogeneity of the vegetation. Forests, woodlands and shrublands can be increased to 1000 m². Please make a note on plot form.

3) Once the plot is established, it is generally a good time to fill out the **Identifiers/Locators** part of your Plot Survey Form (see the cheat sheet) and take the plot photos.

Taking photographs

Two color photos will be taken of each plot using slide film. The purpose is to obtain a good representation of the vegetation of the plot, not individual species. A piece of paper (or a chalk board or dry erase board) should be placed in the plot, with the plot number recorded on it, so that the photo includes the plot number. Preprinted plot numbers could be printed or copied onto colored paper (white has such strong contrast as to be unreadable in the photo) and attached to the back of a clipboard. This saves having to write plot numbers in the field. Take the photograph looking across the contour if plot is steep. Record roll #, frame # and azimuth on plot form.

Data Collection

Environmental Description

See the coding instructions at the end of this document for guidance on the specific fields.

Vegetation Description

For guidance on the specific fields on the second page of the form, see the coding instructions.

As you begin to collect the species, DBH (diameter at breast height – 4.5'), and cover information, keep these rules in mind they will speed your data collection considerably:

1) Except in very diverse plots, don't spend more than **20 minutes** looking for new and different species to record. Remember that these plot data are to be used to classify the overall vegetation of the Park, not to make a complete species list for it. And 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. For diverse plots with over 25 taxa you may take up to 30 minutes on the listing process.

2) If you can't identify a plant to species, record it on your form as "unknown species 1," "unknown species 2," "*Carex* unknown sp. I", etc. Record associated cover class and other data for the unknown as you would for any other species. Then do one of two things:

If you need the species identified right away because it appears to be dominant or diagnostic (you're seeing it all over the place or you're seeing much more in this particular vegetation type than in others), take a sample of the species with as much of the plant as possible, especially intact sexual parts (flowers and fruits), if present. Place the sample in a baggie, and label the baggie (or specimen) with the plot code and the name you gave it on the data form.

If you don't need the plant keyed right away, press it. Mark the pressed specimen with the plot code and the name you gave it on the data form.

Store specimens in a cool, dry place. Bagged specimens will keep fresh longer in the refrigerator or ice chest until pressed or identified. You can, of course, key some of these out yourself if you want to, but don't let plant keying get in the way of your primary responsibility: field data *collection*. No one expects you to identify every plant but you should make an effort to learn at least the common species that keep recurring in plots. A quick prioritization of what to key and what to press may be made based on the recurrence of the species in samples and on the cover-class estimate of the species in a particular plot. If the species has a high cover value (>1%) it is more of a priority to identify. Field crews should mark the specimen tag with its cover class estimate as well as its unique identifying number.

Observation Point Form

When you have sampled one particular vegetation type thoroughly, but want to further define its distribution or when you encounter small but unique vegetation patches that are below the minimum mapping unit in size (<1.5 ha), record the site on an Observation Point form. This is an abbreviated Plot Survey form and usually takes about 15 minutes to fill in the data. The major difference is that an Observation Point is unbounded and includes an area roughly equal to that of the minimum mapping unit (20 m radius around the observer) or it encompasses the entirety of a small but unique vegetation patch. The data fields are the same as those on the Plot Survey form, so use the above instructions. Minor differences in the Observation Point form from the Plot Survey form include the elimination of some data fields, more general cover classes for ground cover estimates, and only the dominant or diagnostic species are recorded. Also, only one photo is taken to record the Observation Point plant community.

We hope you find your field season on the Colorado Plateau enjoyable and rewarding. Good luck!

LITERATURE CITED

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- The Nature Conservancy [TNC]. 1998. An environmentally-driven approach to vegetation sampling and mapping at Yosemite National Park. Report prepared for the U.S. Department of the Interior, National Biological Survey and National Park Service. The Nature Conservancy, Arlington, Virginia.

INSTRUCTIONS FOR FILLING OUT FIELDS IN THE PLOT AND OBSERVATION POINT SURVEY FORMS

PLOT DESCRIPTION

Plot Code

Code indicating the specific plot within the vegetation polygon. For the 2004 field season, the codes will be in the following format "PARK ACRONYM.XXX" (i.e., "Capitol Reef National Park = CARE.XXX"). Begin with CARE.001 and go from there. If another team is working, decide with them which plot numbers each team will use to identify the data they gather. For example, if a second team is working one week at Capitol Reef National Park and approximately 100 plots have already been collected, they may sample plots CARE.125 through CARE.150.

Provisional Community Name

Using the provisional classification of the parks with which you've been provided, assign the name of the vegetation type that most closely resembles this type. Enter the finest level of the classification possible. In fact, *none* of the names may be a good fit; you may have found a new type. If that is the case, create a provisional name with the dominant and diagnostic species. The 'provisional community name' that is assigned will be used to update the tally of types x number of plots needed.

State UT

Park Name CARE

Park Site Name

Provisional name assigned by field worker that describes where the data were collected. It should represent an identifiable feature on a topographic or park map.

Quad Name

Appropriate name/scale from survey map used; use 7.5-minute quadrangle if possible.

Quad Code

Code of quadrangle map.

Field UTM X

Use GPS, but if you can't obtain a GPS reading, estimate coordinates from a topographic map and note on the form that this method was used.

Field UTM Y

Use GPS, but if you can't obtain a GPS reading, estimate coordinates from a topographic map and note on the form that this method was used.

GPS Error

Note the error in the GPS reading off the unit.

Survey Date

Date the survey was taken; year, month, day.

Surveyors

Names of surveyors, with principal surveyor (usually the Lead Ecologist) listed first.

Directions to Plot

Precise directions to the site using a landmark (e.g., a named point on the topographic map, a major highway, using park naming conventions for roads) readily locatable on a 7.5 minute topographic or park 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 as closely as possible to the 0.1 mile and use compass directions. Give additional directions to the plot within the site. Do not take more than a couple of minutes to fill this out.

Plot Length and Plot Width

Enter diameter for circular plots and width and length dimensions for square or rectangular plots. Choose the appropriate plot size based on the following:

Vegetation Class	Standard Plot Dimensions	PLOT AREA
Forest	11.3 m radius or 20 m x 20 m	400 m ²
Woodland	11.3 m radius or 20 m x 20 m	400 m ²
Shrubland	11.3 m radius or 20 m x 20 m	400 m ²
Dwarf-shrubland	5.65 m radius or 10 m x 10m	100 m ²
Herbaceous	5.65 m radius or 10 m x 10 m	100 m ²
Nonvascular	2.82 m radius or 5 m x 5 m	25 m ²

Plot Photos/ Roll Number/Frame Numbers

Indicate (Y or N) if photos of the plot have been taken at the time of sampling, and the roll and frame numbers of any photos. Also record azimuth of the photo if not taken in the standard direction.

Plot Permanent (if/when applicable)

Check off that the plot has been permanently marked.

Plot Representativeness

Does this plot represent the variability of the photo signature? If not, were additional plots taken? Note additional species not seen in the plot in the space provided. Note: we distinguish in this section the plot's ability to represent the stand or polygon you are sampling as one component and the ability of this sample to represent the range of variability of the association in the entire mapping area. The former comment may be ascertained by reconnaissance of the stand. The latter comment comes only after some familiarity with the vegetation type throughout the mapping area and may be left blank if you have no opinion.

ENVIRONMENTAL DESCRIPTION

Elevation

Elevation of the plot. Specify whether in feet or meters (this will depend on the units used on the GPS or on the topographic map being used). In general, we have determined that the reading you obtain from a topographic map, provided you are certain where you are, is more accurate than the average reading from the GPS unit. Thus, please attempt to estimate your elevation with the topographic map.

Slope

Measure the slope in degrees using a clinometer.

Aspect

Measure the slope aspect using a compass (be sure to correct for the magnetic declination). Note: all compasses should be pre-set to an average declination for the park and thus, readings from the compasses carried by the field crews may be directly noted.

Topographic Position

Topographic position of the plot. Choose one:

INTERFLUVE (crest, summit, ridge). Linear top of ridge, hill, or mountain; the elevated area between two fluves (drainageways) that sheds water to the drainageways.

HIGH SLOPE (shoulder slope, upper slope, convex creep slope). Geomorphic component that forms 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). Level top of a plateau.

MIDSLOPE (transportational midslope, middle slope). Intermediate slope position.

BACKSLOPE (dipslope). Subset of midslopes that are steep, linear, and may include cliff segments.

STEP IN SLOPE (ledge, terraeette). Nearly level shelf interrupting a steep slope 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, commonly gentle and linear and characterized by alluvial deposition.

LOW LEVEL (terrace). Valley floor or shoreline representing the former position of an alluvial plain, lake, or shore.

CHANNEL WALL (bank). Sloping side of a channel.

CHANNEL BED (narrow valley bottom, gully, arroyo, wash). Bed of single or braided watercourse commonly barren of vegetation and formed of modern alluvium.

BASIN FLOOR (depression). Nearly level to gently sloping, bottom surface of a basin.

Landform

Enter the landform that describes the site where the plot was taken. Note on the code sheet the landform choices are listed at different scales. Thus, one can select more than one for plot if appropriate (e.g., mountain could be macro and ridge could be meso scale). You can develop your own list for CARE. Please be consistent so we can analyze by landform. Appendix is a landform glossary.

Surficial Geology

Note the geologic substrate influencing the plant community (bedrock or surficial materials). Accurately recording the geology at the plot is especially important if the plot is on an inclusion in the type on the geology map. The list below provides types from the CARE geology map.

Capitol Reef National Park Geology Map Units (in chronological order, youngest to oldest)

Geology Unknown	Obscured by soil
Quaternary	Aeolian sands
	Alluvial deposits
	Rock glacier deposits
	Terrace gravel deposits
	Older Alluvium (pre Holocene)
	Talus / Colluvium / Landslides
	Glacial till deposits
Tertiary	Intrusive igneous
	Flagstaff Limestone
Mesozoic	Mesaverde Formation
	Mancos shale - Undifferentiated
	Masuk Member - Mancos Shale
	Blue Gate Shale Member - Mancos Shale
	Ferron Sandstone Member - Mancos Shale
	Tununk Shale Member - Mancos Shale
	Dakota Sandstone
	Cedar Mountain Formation
	Morrison Formation - undifferentiated
	Brushy Basin Shale Member - Morrison Formation
	Salt Wash Member - Morrison Formation
	Tidwell Member - Morrison Formation
	Summerville Formation
	Curtis Formation
	Entrada Sandstone
	Carmel Formation
	Navajo Sandstone
Kayenta Formation	
Wingate Sandstone	
Chinle Formation	
Moenkopi Formation	
Kaibab Limestone	
Paleozoic	Cutler Group Undivided

Cowardin System

If the system is a wetland, check off the name of the USFWS system which best describes its hydrology and landform. Indicate “upland” if the system is not a wetland.

Assess the hydrologic regime of the plot using these descriptions (adapted from Cowardin et al. 1979).

SEMI-PERMANENTLY 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. Includes Cowardin’s Intermittently Exposed and Semipermanently Flooded modifiers.

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. Includes Cowardin’s Seasonal, Seasonal-Saturated, and Seasonal-Well Drained modifiers.

SATURATED - Surface water is seldom present, but substrate is saturated to surface for extended periods during the growing season. Equivalent to Cowardin’s Saturated modifier.

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. Equivalent to Cowardin’s Temporary modifier.

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. Equivalent to Cowardin’s Intermittently Flooded modifier.

PERMANENTLY FLOODED - Water covers the land surface at all times of the year in all years. Equivalent to Cowardin’s “permanently flooded.”

UNKNOWN - The water regime of the area is not known. The unit is simply described as a non-tidal wetland.

Environmental Comments

Enter any additional noteworthy comments on the environmental setting. This field can be used to describe site history such as fire events (date since last fire or evidence of severity) as well as other disturbance or reproduction factors.

Unvegetated Surface

Estimate the approximate percentage of the *total* surface area covered by each category. Only include categories with over 5 percent cover.

Soil Texture

Using the key below, assess average soil texture.

Simplified Key to Soil Texture (Brewer and McCann 1982)

A1	Soil does not remain in a ball when squeezed	sand
A2	Soil remains in a ball when squeezed	B
B1	Squeeze the ball between your thumb and forefinger, attempting to make a ribbon that you push up over your finger. Soil makes no ribbon	loamy sand
B2	Soil makes a ribbon; may be very short.....	C
C1	Ribbon extends less than 1 inch before breaking.....	D
C2	Ribbon extends 1 inch or more before breaking.....	E
D1	Add excess water to small amount of soil Soil feels at least slightly gritty.....	loam or sandy loam
D2	Soil feels smooth.....	silt loam
E1	Soil makes a ribbon that breaks when 1 to 2 inches long; Cracks if bent into a ring.....	F
E2	Soil makes a ribbon 2+ inches long; does not crack when bent into a ring	G
F1	Add excess water to small amount of soil; Soil feels at least slightly gritty.....	sandy clay loam or clay loam
F2	Soil feels smooth.....	silty clay loam or silt
G1	Add excess water to a small amount of soil; Soil feels at least slightly gritty.....	sandy clay or clay
G2	Soil feels smooth.....	silty clay

Soil Drainage

The 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. It is recognized that 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. It is further recognized that soil profile morphology, for example mottling, normally, but not always, reflects soil moisture status. Although soil morphology may be a valuable field indication of moisture status, it should not be the overriding criterion. Soil drainage classes cannot be based solely on the presence or absence of mottling. Topographic position and vegetation as well as soil morphology are useful field criteria for assessing soil moisture status.

RAPIDLY DRAINED - The soil moisture content seldom exceeds field capacity in any horizon except immediately after water addition. Soils are free from any evidence of gleying throughout the profile. Rapidly drained soils are commonly coarse textured or soils on steep slopes.

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.

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 thick and dark.

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 Ac 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 strongly gleyed. Except in high-chroma parent materials the B & 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.

VEGETATION DESCRIPTION

Leaf Phenology

Select the value which best describes the leaf phenology of the dominant stratum. The dominant stratum is the uppermost stratum that contains at least 10% cover.

EVERGREEN - Greater than 75% of the total woody cover is never without green foliage.

COLD DECIDUOUS - Greater than 75% of the total woody cover sheds its foliage in connection with an unfavorable season mainly characterized by winter frost.

MIXED EVERGREEN - COLD DECIDUOUS - Evergreen and deciduous species generally contribute 25-75% of the total woody cover. Evergreen and cold-deciduous species admixed.

PERENNIAL - Herbaceous vegetation composed of more than 50% perennial species.

ANNUAL - Herbaceous vegetation composed of more than 50% annual species.

Leaf Type

Select one value which best describes the leaf form of the dominant stratum. The dominant stratum is the uppermost stratum that contains at least 10% cover.

BROAD-LEAVED - Woody vegetation primarily broad-leaved (generally contributes greater than 50 percent of the total woody cover).

NEEDLE-LEAVED - Woody vegetation primarily needle-leaved (generally contributes greater than 50 percent cover).

MICROPHYLLOUS - Woody cover primarily microphyllous.

GRAMINOID - Herbaceous vegetation composed of more than 50 percent graminoid/stipe leaf species.

FORB (BROAD-LEAF-HERBACEOUS) - Herbaceous vegetation composed of more than 50% broad-leaf forb species.

PTERIDOPHYTE - Herbaceous vegetation composed of more than 50 percent species with frond or frond-like leaves.

Physiognomic Class

Choose one:

FOREST: Trees with their crowns overlapping (generally forming 60-100% cover).

WOODLAND: Open stands of trees with crowns not usually touching (generally forming 25-60% cover). Canopy tree cover may be less than 25% 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 25% cover). Shrub cover may be less than 25% where it exceeds tree, dwarf-shrub, herb, and nonvascular cover, respectively. Vegetation dominated by woody vines is generally treated in this class.

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 25% cover). Dwarf-shrub cover may be less than 25% where it exceeds tree, shrub, herb, and nonvascular cover, respectively.

HERBACEOUS: Herbs (graminoids, forbs, and ferns) dominant (generally forming at least 25% cover; trees, shrubs, and dwarf-shrubs generally with less than 25% cover). Herb cover may be less than 25% where it exceeds tree, shrub, dwarf-shrub, and nonvascular cover, respectively.

NONVASCULAR: Nonvascular cover (bryophytes, non-crustose lichens, and algae) dominant

(generally forming at least 25% cover). Nonvascular cover may be less than 25% where it exceeds tree, shrub, dwarf-shrub, and herb cover, respectively.

SPARSE VEGETATION: Abiotic substrate features dominant. Vegetation is scattered to nearly absent and generally restricted to areas of concentrated resources (total vegetation cover is typically less than 25% and greater than 0%).

Strata/Lifeform, Height, Cover, Diagnostic Species

Visually divide the community into vegetation layers (strata). Indicate the average height class of the stratum in the first column, using the Height Scale on the form. Enter the average percent cover class of the whole stratum in the second column, using the Cover Scale on the form. Height and Cover classes are also listed below.

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.

Herbaceous layers are: Ht = total, H1 = Graminoids (grass, sedge, rush), H2 = Forbs (Dicot herbaceous), H3 = Ferns and Fern allies, and H4 = tree seedlings. List the dominant species in each stratum. If a species present is known to be diagnostic of a particular vegetation type, list these as well, marking them with an asterisk.

Cover Scale for Strata		Height Scale for Strata	
T	<1%	01	<0.5 m
P	1-5%	02	0.5-1 m
1	5-15%	03	1-2 m
2	15-25%	04	2-5 m
3	25-35%	05	5-10 m
4	35-45%	06	10-15 m
5	45-55%	07	15-20 m
6	55-65%	08	20-35 m
7	65-75%	09	35-50 m
8	75-85%	10	>50 m
9	85-95%		
10	95+		

Animal Use Evidence

Comment on any evidence of use of the plot/polygon by non-domestic animals (i.e., tracks, scat, gopher or prairie dog mounds, etc.). Notes on domestic animals should be made in the field below.

Natural and Anthropogenic Disturbance

Comment on any evidence of natural or anthropogenic disturbance and specify the source.

Other Comments

Any other comments.

Species/DBH/Percent Cover Table

Starting with the uppermost stratum, list all the species present and cover class (using the 12 point scale) and percent cover of each species in that particular stratum. Indicate strata in the left-hand columns. If in the tree layer (single-stemmed woody plants, generally 5 m in height or greater at maturity), note in the "T" column if T1 (emergent tree), T2 (tree canopy), or T3 (tree sub-canopy). If in the shrub layer, note in the "S", column if S1 (tall shrub, > 2m), S2 (short shrub, <2m), or S3 (dwarf-shrub <0.5m). If in the ground layer, note in the "G" column if H1 (herbaceous - graminoid), H2 (herbaceous - forb), H3 (herbaceous - fern), H4 (tree seedlings) N (nonvascular other than ferns), V (vine/liana), or F (epiphyte).

*For plots with trees, estimate cover of seedlings, saplings, mature (all others), and total cover for each tree species. Use a separate line for each and assign the most appropriate strata class (by height). Seedlings are generally less than 1.5 m, but that may vary by species.

Also record the DBH (in cm) of all trees above 5 cm diameter. Separate the measurements with a comma. For plots with very high tree density DBH measurements will be done in a subplot. If the number of trees with a DBH greater than 5 cm is more than about 25, divide the plot into quarters and measure the DBH of trees in the southeast quadrant, or the quadrant nearest southeast. CLEARLY NOTE on the form that this is what you've done.

Appendix B.2. Accuracy Assessment Point Field Sampling Manual Accuracy Assessment Field Manual – 2005

Capitol Reef National Park, Dinosaur National Monument, Curecanti National Recreation Area

This manual documents accuracy assessment (AA) data collection procedures for Capitol Reef National Park (CARE), Dinosaur National Monument (DINO), and Curecanti National Recreation Area (CURE). This project is directed by the Northern Colorado Plateau Network (NCPN) with assistance from engineering environmental Management, Inc. (E2M) and NatureServe.

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 works well to classify vegetation to association
- 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 A POINT

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).

At each AA point the investigator will key the vegetation to plant association within half a hectare around each point. If a map unit key is available (e.g. DINO) then the investigator will also key the same area to map class.

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 may be easiest. If the polygon is smaller than the MMU, evaluate the whole polygon

Along the way... Identify the mapping 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 ones 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 need to clearly describe in the comments fields the situation and be clear about what is represented within and outside the polygon targeted for sampling.

AA POINT FORM INSTRUCTIONS – 2005

This section documents field-by-field instructions for AA point data collection and guides completing the AA Point Data Form. Upon arrival at an AA point location, the field investigator will take a waypoint with the GPS unit. Please make sure the GPS unit is set for NAD83, and that the WAAS is on. If a Trimble unit is used, then several data fields will be collected electronically in the GPS data dictionary as well as manually recorded on the forms. Manual recording of data serves as a backup in case of GPS failure. Park specific cheatsheets are provided at the end of this section to assist with field workers with data collection.

IDENTIFIERS / LOCATORS SECTION

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. Four letter park codes for this project are as follows: CARE, DINO, or CURE. For example, an AA point at Capitol Reef would be CARE_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.

Quad name, County, State

Enter information for the area in which AA point occurs. This will be done in the office.

Park Site Name

This is best determined from the topographic map. Select a nearby feature that is an obvious waypoint, such as the name of a canyon, road, arch, etc. This name does not need to be unique. If a number of AA points are sampled in a small area the same site name may be used for all of them.

Survey Date

Enter the date the AA point was sampled. Please use the format Month – Day – Year.

Surveyor(s)

Full last name(s) of the field team member(s) collecting data. First initial optional.

AA Point Shape

Select one of the following choices to describe plot shape: circular or other. In the case of other please provide comments in the classification comments field below.

GPS file

This field only needs to be completed if a GPS unit other than Trimble GeoXM is being used. For instance, if a Garmin unit is being used then enter the name given to the waypoint when the AA point was marked in the GPS unit. It is helpful to assign a name that incorporates the AA point number.

Field UTMX, Field UTM Y

Record the UTM easting and northing that was saved as a waypoint in the GPS. Please double check to make sure the easting is six digits and the northing is seven digits.

In deep canyon country it is often difficult to obtain a GPS reading (the GPS has to be able to ‘see’ at least three or four satellites). If it is not possible to get a GPS reading in the point, or if the PDOP is greater than 8 (or EPE is greater than ± 50 m), first try to get a signal from a higher point outside (but still

close to) the point. If that fails then estimate the UTM coordinates from the topo map, and manually enter these UTM's into the GPS unit.

Use a map that is in NAD 83 if at all possible, since the project standard is the NAD83 datum. However, USGS 7.5 minute maps 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.

Coordinates derived from NAD27 topographic map?

If coordinates are derived from a NAD27 USGS topographic map please check this box on the field form.

To ensure that all AA points show up in the right place, please use this procedure when estimating UTM coordinates from a NAD27 topo map:

1. Locate the AA point as accurately as possible on the topo map, using triangulation if possible.
2. Use the topo map, straightedge, pencil and a transparent overlay grid to obtain UTM coordinates in NAD27 (done carefully, one 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 the GPS unit to the NAD27 datum.
4. Create a new waypoint, give it the AA point code, and enter the UTM coordinates that were recorded.
5. Update the settings in the GPS unit to the NAD83 datum. This will convert the NAD27 coordinates to NAD83 without screwing up the coordinates already in the 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 it is done then the more likely it is that the rounding error will change the coordinates of other (non-topo-derived) points. This can be done back in the office during datasheet review and data entry.

GPS Unit

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

GPS Error

Note the PDOP (or "Estimated Position Error" (EPE), if a Garmin unit is being used) displayed on the GPS unit. The lower the number the more accurate the reading.

3D Differential?

3D differential is obtained when the 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 location coordinates are as accurate as possible. It is in geosynchronous orbit, so if the southern sky is visible, one will usually 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 the field investigator resorted to estimating the AA point location UTM's on the topo map, note that in this field. If the usual GPS croaked and an old Magellan had to be borrowed from a friend, note that. Also, if the investigator had to leave the point to get a reading from a high point, record that here, along with the compass bearing and distance of the GPS location from the point center (unless offset function was used on the Trimble GeoXM- in that case, enter "point offset.")

Camera

Circle the appropriate camera name and model, or enter it next to “other” if it is not on the datasheet.

Taking photographs

Take two color slides of each AA point. 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 "CARE 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 a photograph.

CARE AA 241 →NW

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

For each photo taken at the AA point record the following: *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 (SE→NW) and any other comments to clarify contents of the photo.

ASSOCIATION INFORMATION SECTION

Primary Name, Secondary Name, Tertiary Name

Fill out this section last, after all the vegetation information has been collected. 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 other 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 crew encountered a new vegetation type and applied a name not in the field key, then 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 Vegetation Associations Within 50 m

List other associations that are within 50m of the outside border of the AA point being evaluated.

Representativeness of AA point

Because the 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 association to the description in the key (Good, Fair, Poor). Please describe briefly any difficulty experienced in using the plant association key in the *Field Key Log* pages in the back of the field key. It would also be helpful to have specific suggestions on how to make the key work better. The field key log will ask you for a reference to the AA point number where the problem was encountered and a description of what didn’t work and your suggestions. This is extremely important! It will provide information for improving the key for the final report.

ENVIRONMENTAL DESCRIPTION SECTION

Elevation

Elevation of the AA point. If a Trimble GeoXM is being used, use the GPS unit to record elevation in meters. If a different GPS unit is being used then estimate the elevation from the topographic map. Specify on the data sheet whether the measurement is in feet or meters, and whether it was obtained from a GPS unit or a map.

Slope

Measure the slope in degrees using a clinometer. The degree scale is the left-hand scale when looking through the clinometer. If the slope varies at the point then estimate an average. If the point is on a ridgetop or in a dune field, enter “variable.” Further information may be provided in the Environmental Comments section.

Aspect

Measure aspect in degrees using a compass (set for local magnetic declination, which is given in the lower left hand corner of every USGS topo map). If the slope is flat, enter “n/a” for aspect. If the point wraps around different aspects on a slope, enter “variable” and describe further in the Environmental Comments section.

Topographic Position

This is the position of the point on its related landform. Determining this requires the investigator to think of the landform in cross-section, which is roughly diagramed on the back of the cheat sheet. One of the terms listed below **must** be used:

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 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 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, lake, or shore.

Landform

Enter the landforms that best describe the site where the AA point is located. Referring to the topo map for the landscape context may help the investigator determine 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, the AA point may be on a ledge on the rim of a canyon. A suggested list of landforms and definitions is provided in Appendix A. *Note: The topographic position selected above should relate to the scale of the landform chosen here.*

Surficial Geology

List the primary geologic substrate where the AA point plant community occurs. A list of geologic types is provided on park specific cheatsheets at the end of this document. The geology map should help, but if one is unable to decipher the geology at all or a geology map is not available at the point, then provide a general description (e.g., coarse sandstone, green shale, aeolian sands or obscured by soils).

Environmental Comments

Enter any 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 good job. Information from this field is used to prepare local descriptions of the plant communities, and to help assign AA points to associations not previously recorded in the park.

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

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 plant dominated AA points.

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 *A. canescens*, all *Chrysothamnus* except *C. 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 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 is seen at the AA point when looking across at the vegetation. The following definitions can be used as guidelines, but may not always apply in desert locales. 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.

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.

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 mostly occupied by grasses and/or forbs.

Wooded Herbaceous. Trees forming approximately equal cover with a grass or forb component.

Herbaceous. Perennial or annual 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 5-7% and greater than 2%. Badlands or sand dunes supporting communities of annual plants should be included in this category, regardless of cover.

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 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 *gareti*, *corrugate*, *gardnerii* (which are dwarf).

S3 Dwarf Shrub. <0.5 meters tall. For example, *Opuntia polycantha*.

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 mature trees, 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 thing 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

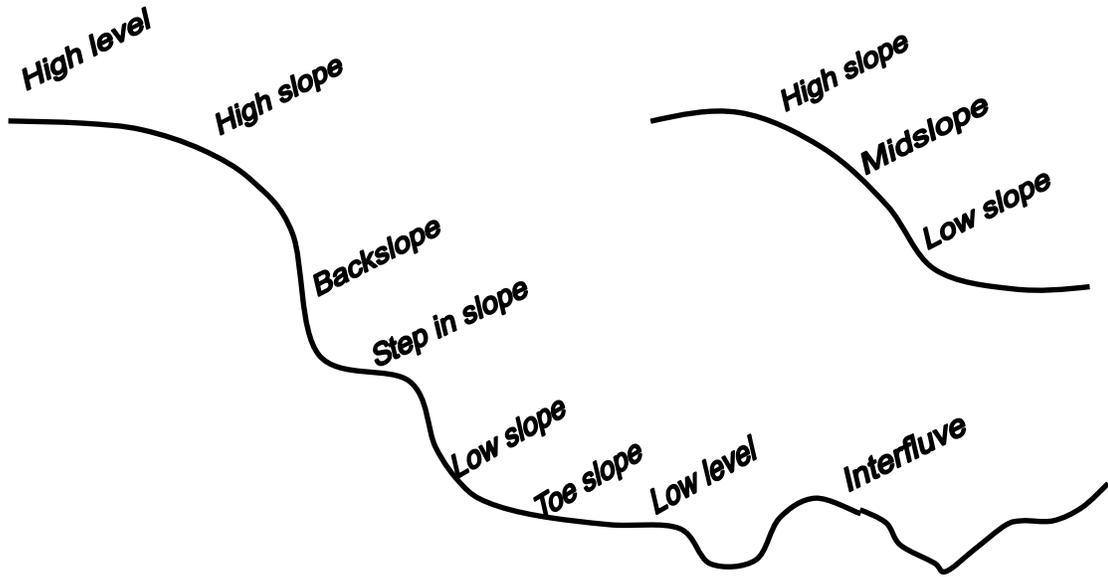
Cover Class. For each plant species use the cover class codes listed below to estimate overall canopy cover for each species listed on the form.

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.

TOPOGRAPHIC POSITION - CHEAT SHEET



EXTRA-CURRICULAR INSTRUCTIONS - 2005

The Northern Colorado Plateau Network Inventory and Monitoring Program is engaged in 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 best possible. Completion of the comments field would be most appreciated.

If the spring community is sizeable enough please consider conducting a regular vegetation , 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 or GeoXM GPS unit)

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 in the data dictionary in the Trimble GeoXM GPS unit- “Weed” feature) 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 last year near Upheaval Dome. 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 working in an infested area, please make sure that field crew members are not carrying seeds or other propagules 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.

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 s, 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. Park Service crews will enter all data collected during the project.

NCPN staff are developing quality assessment and control procedures to help ensure that data collected are consistent, accurate and complete.

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 each park where work is being conducted. 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.

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.

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
 - b. Communicate with the other team member(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 points 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 AA points 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?

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
- Key to the map units of DINO (DINO only)
- 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 A: Landform Glossary

(<http://soils.usda.gov/technical/handbook/contents/part629glossary1.html>)

alluvial cone - A semi-conical type of alluvial fan with very steep slopes; it is higher, narrower, and steeper (e.g., > 40% slopes) than a fan, and composed of coarser, and thicker layers of material deposited by a combination of alluvial episodes and to a much lesser degree, landslides (e.g., debris flow).

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 flat (a) (colloquial: western US) A level, graded, alluvial surface in bolsons and semi-bolsons which commonly does not manifest traceable channels, terraces or floodplain levels. (b) (**not preferred**) A general term for a small flood plain bordering a river, on which alluvium is deposited during floods.

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.

alluvial plain remnant - An erosional remnant of an alluvial plain which retains the surface form and alluvial deposits of its origin but was not emplaced by, and commonly does not grade to a present-day stream or drainage network.

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.

anticline - (a) A unit of folded strata that is convex upward and whose core contains the stratigraphically oldest rocks, and occurs at the earth's surface. In a single anticline, beds forming the opposing limbs of the fold dip away from its axial plane. (b) A fold, at any depth, generally convex upward whose core contains the stratigraphically older rocks.

arroyo - (colloquial: southwest A.) The channel of a flat-floored, ephemeral stream, commonly with very steep to vertical banks cut in unconsolidated material; sometimes called a wash. It is usually dry but can be transformed into a temporary watercourse or torrent after heavy rain within the watershed. Where arroyos intersect zones of ground-water discharge, they are better classed as intermittent stream channels.

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.

backswamp - A flood-plain landform. Extensive, marshy or swampy, depressed areas of flood plains between natural levees and valley sides or terraces.

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.

ballena - (colloquial: western US.) A fan remnant having a distinctively-rounded surface of fan alluvium. The ballena's broadly-rounded shoulders meet from either side to form a narrow summit and merge smoothly with concave sideslopes and then concave, short pediments which form smoothly-rounded drainageways between adjacent ballenas. A partial ballena is a fan remnant large enough to retain some relict fan surface on a remnant summit.

ballon - (colloquial: western US). A rounded, dome-shaped hill, formed by erosion or uplift.

bar - A general term for a ridge-like accumulation of sand, gravel, or other alluvial material formed in the channel, along the banks, or at the mouth of a stream where a decrease in velocity induces deposition; e.g. a channel bar or a meander bar. A generic term for any of various elongate offshore ridges, banks, or mounds of sand, gravel, or other unconsolidated material submerged at least at high tide, and built up by the action of waves or currents, especially at the mouth of a river or estuary, or at a slight distance offshore from the beach.

barchan dune - A crescent-shaped dune with tips extending leeward (downwind), making this side concave and the windward (upwind) side convex. Barchan dunes tend to be arranged in chains extending in the dominant wind direction.

base slope - A geomorphic component of hills consisting of the concave to linear slope (perpendicular to the contour) which, regardless of the lateral shape is an area that forms an apron or wedge at the bottom of a hillside dominated by colluvial and slope wash processes and sediments (e.g., colluvium and slope alluvium). Distal base slope sediments commonly grade to, or interfinger with, alluvial fills, or gradually thin to form pediment over residuum.

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.

basin floor - A general term for the nearly level, lower-most part of intermontane basins (i.e. bolsons, semi-bolsons). The floor includes all alluvial, eolian, and erosional landforms below the piedmont slope.

basin-floor remnant - (colloquial: western US) A flat erosional remnant of any former landform of a basin floor that has been dissected following the incision of an axial stream.

bench - (not preferred) refer to structural bench.

beveled base - The lower portion of a canyon wall or escarpment marked by a sharp reduction in slope gradient from the precipitous cliff above, and characteristically composed of thinly mantled colluvium (e.g. < 1 m) and / or carapaced with a thin surficial mantle of large rock fragments from above, which overly residuum of less resistant rock (e.g., shale) whose thin strata intermittently outcrop at the surface; a zone of erosion and transport common in the canyonlands of the semi-arid, southwestern US.

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 kilometers in diameter.

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.

bolson - (colloquial: western US.) A landscape term for an internally drained (closed) intermontane basin into which drainages from surrounding mountains converge inward toward a central depression. Bolsons are often tectonically depressed areas and, according to Peterson, include alluvial flat, alluvial plain, beach plain, barrier beach, lake plain, sand sheets, dunes, and playa. The piedmont slope includes slopes of erosional origin adjoining the mountain front (pediments) and complex construction surfaces (fans). A semi-bolson is an externally drained (open) bolson. Synonym - intermontane basin.

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.

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 steep slopes and talus or 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.

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. **canyon bench** - One of a series of relatively narrow, flat landforms occurring along a canyon wall and caused by differential erosion of alternating strong and weak horizontal strata; a type of structural bench.

canyonlands - A deeply and extensively dissected landscape composed predominantly of relatively narrow, steep-walled valleys with small flood plains or valley floors; commonly with considerable outcrops of hard bedrock on steep slopes, ledges, or cliffs, and with broader summits or interfluves than found in badlands. Sideslopes exhibit extensive erosion, active back-wearing, and sparse vegetation.

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.

cinder cone - A conical hill formed by the accumulation of cinders and other pyroclastics, normally basaltic or andesitic composition. Slopes generally exceed 20 percent.

cliff - Any high, very steep to perpendicular or overhanging face of rock or earth; a precipice.

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.

closed depression - A generic name for an enclosed area that has no surface drainage outlet and from which water escapes only by evaporation or subsurface drainage; an area of low ground indicated on a topographic map by a hachured contour line forming a closed loop.

collapse sinkhole - A type of sinkhole that is formed by collapse of a cave within the underlying soluble bedrock (e.g., limestone, gypsum, salt).

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.

complex landslide - A category of mass movement processes, associated sediments (complex landslide deposit) or resultant landforms characterized by a composite of several mass movement processes none of which dominates or leaves a prevailing landform. Numerous types of complex landslides can be specified by naming the constituent processes evident (e.g. a complex earth spread - earth flow landslide).

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*.

cuesta - An asymmetric, homoclinal ridge capped by resistant rock layers of slight to moderate dip (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.

cuesta valley - A low relief, low angle, asymmetrical depression which lies parallel to the strike of underlying strata; a type of strike valley. It's formed by the differential erosion of weaker strata interbedded with more resistant bedrock. It may or may not contain a local drainage network and commonly lies above and is not connected to the regional drainage system.

debris fall - The process, associated sediments (debris fall deposit) or resultant landform characterized by a rapid type of *fall* involving the relatively free, downslope movement or collapse of detached, unconsolidated material which falls freely through the air (lacks an underlying slip face); sediments have substantial proportions of both fine earth and coarse fragments; common along undercut stream banks.

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.

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.

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.

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.

dike - A tabular igneous intrusion that cuts across the bedding or foliation of the country rock.

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 talus, and favors the accumulation of fine sediments and organic materials.

ditch - An open and usually unlined channel or trench excavated to convey water for drainage or irrigation 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.

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, parana 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 streams by the sand. See dune lake.

earthflow - The process, 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 not, behaves as a viscous fluid when moving.

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.

eolian sands - Sand-sized, clastic material transported and deposited primarily by wind, commonly in the form of a dune or a sand sheet.

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.

eroded fan remnant - All, or a portion of an alluvial fan that is much more extensively eroded and dissected than a fan remnant; sometimes called an *erosional fan remnant*. It consists primarily of a) eroded and highly dissected sides (*eroded fan-remnant sideslopes*) dominated by hillslope positions (shoulder, backslope, etc.), and b) to a lesser extent an intact, relatively planar, relict alluvial fan "summit" area best described as a tread.

eroded fan-remnant sideslope - A rough margin of an *eroded fan remnant* highly dissected by ravines and gullies that can be just a fringe or make up a large part of an eroded alluvial fan; its bounding escarpments, originally formed by inset channels, have become highly dissected and irregular such that terrace components (tread and riser) have been consumed or modified and replaced by hillslope positions and components (shoulder, backslope, footslope, etc.); sometimes referred to as *fan remnant sideslopes*.

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.

fan - (a) A gently sloping, fan-shaped mass of detritus forming a section of a low-angle cone commonly at a place where there is a notable decrease in gradient; specifically an alluvial fan.

fan apron - A sheet-like mantle of relatively young alluvium and soils covering part of an older fan piedmont (and occasionally alluvial fan) surface, commonly thicker and further down slope (e.g., mid-fan or mid-fan piedmont) than a fan collar. It somewhere buries an older soil that can be traced to the edge of the fan apron where the older soil emerges as the land surface, or relict soil. No buried soils should occur within a fan-apron mantle itself.

fan collar - A landform comprised of a thin, short, relatively young mantle of alluvium along the very upper margin (near the proximal end or apex) of a major alluvial fan. The young mantle somewhere buries an older soil that can be traced to the edge of the collar where the older soil emerges at the land surface as a relict soil.

fan remnant - A general term for landforms that are the remaining parts of older fan-landforms, such as alluvial fans, fan aprons, inset fans, and fan skirts, that either have been dissected (erosional fan-remnants) or partially buried (nonburied fan-remnants). An erosional fan remnant must have a relatively flat summit that is a relict fan-surface. A nonburied fan-remnant is a relict surface in its entirety.

fan skirt - The zone of smooth, laterally-coalescing, small alluvial fans that issue from gullies cut into the fan piedmont of a basin or that are coalescing extensions of the inset fans of the fan piedmont, and that merge with the basin floor at their toeslopes. These are generally younger fans which onlap older fan surfaces.

fault-line scarp - A steep slope or cliff formed by differential erosion along a fault line, as by the more rapid erosion of soft rock on one side of a fault as compared to more resistant rock on the other side; e.g. the east face of the Sierra Nevada in California.

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.

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. (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.

footslope - The hillslope profile position that forms the concave surface at the base of a hillslope. It is a transition zone between upslope sites of erosion and transport (shoulder, backslope) and downslope sites of deposition (toeslope).

free face - A geomorphic component of hills and mountains consisting of an outcrop of bare rock that sheds rock fragments and other sediments to, and commonly stands more steeply than the angle of repose

of, the colluvial slope immediately below; most commonly found on shoulder and backslope positions, and can comprise part or all of a nose slope or side slope.

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.

graben - An elongate trough or basin bounded on both sides by high-angle, normal faults that dip towards the interior of the trough. It is a structural form, it may be geomorphically expressed as a rift valley.

gravel pit - A depression, ditch or pit excavated to furnish gravel for roads or other construction purposes; a type of borrow pit.

ground soil - Any soil at the present-day land surface and actively undergoing pedogenesis,

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. = Ravine.

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).

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.

head slope - A geomorphic component of hills consisting of a laterally concave area of a hillside, especially at the head of a drainageway, resulting in converging overland water flow (e.g. sheet wash); head slopes are dominated by colluvium and slope wash sediments (e.g., slope alluvium); contour lines form concave curves. Slope complexity (downslope shape) can range from simple to complex. Headslopes are comparatively moister portions of hillslopes and tend to accumulate sediments (e.g., cummulic profiles) where they are not directly contributing materials to channel flow.

headwall - A steep slope at the head of a valley; e.g. the rock cliff at the back of a cirque.

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.

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.

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.

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).

hoodoo - A 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.

horst - An elongate block that is bounded on both sides by normal faults that dip away from the interior of the horst. It is a structural form and may or may not be expressed geomorphically.

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.

impact crater - a) A generally circular or elliptical depression formed by hypervelocity impact of an experimental projectile or ordinance into earthy or rock material. b) (not recommended - use meteorite crater) A generally circular crater formed by the impact of an interplanetary body (projectile) on a planetary surface.

inset fan - (colloquial; western US) The flood plain of an ephemeral stream that is confined between fan remnants, ballenas, basin-floor remnants, or closely-opposed fan toeslopes of a basin.

interdune - The relatively flat surface, whether sand-free or sand-covered, between dunes. GG

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.

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.

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.

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.

knoll - A small, low, rounded hill rising above adjacent landforms.

lake - An inland body of permanent standing water, fresh or saline, occupying a depression, generally of appreciable size (larger than a pond) and too deep to permit vegetation (excluding subaqueous vegetation) to take not completely across the expanse of water.

lakebed - (a) The flat to gently undulating ground underlain or composed of fine-grained sediments deposited in a former lake. (b) The bottom of a lake; a lake basin.

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*.

ledge - (a) A narrow shelf 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.

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.

longitudinal dune - A long, narrow sand dune, usually symmetrical in cross profile, oriented parallel to the prevailing wind direction ; it is wider and steeper on the windward side but tapers to a point on the lee side. It commonly forms behind an obstacle in an area where sand is abundant and the wind is strong and constant. Such dunes can be a few meters high and up to 100 km long.

low hill - A generic name for an elevated, generally rounded land surface with low local relief, rising between 30 meters (100 ft.) to as much as 90 m (approx. 300 ft.) above surrounding lowlands.

lowland - (a) A generic, imprecise term for low-lying land or an extensive region of low-lying land, especially near a coast and including the extended plains or country lying not far above tide level. (b) (not preferred) A generic, imprecise term for a landscape of low, comparatively level ground of a region or local area, in contrast with the adjacent higher country. (c) (not recommended - use valley, bolson, etc.) A generic term for a large valley.

marsh - Periodically wet or continually flooded areas with the surface not deeply submerged. Covered dominantly with sedges, cattails, rushes, or other hydrophytic plants.

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. (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.

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. (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.

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.

open depression - A generic name for any enclosed or low area that has a surface drainage outlet whereby surface water can leave the enclosure; an area of lower ground indicated on a topographic map by contour lines forming an incomplete loop or basin indicating at least one surface exit.

overbank deposit - Fine-grained sediments (silt and clay) deposited from suspension on a flood plain by floodwaters that cannot be contained within the stream channel.

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.

oxbow lake - The crescent-shaped, often ephemeral body of standing water situated by the side of a stream in the abandoned channel (oxbow) of a meander after the stream formed a neck cutoff and the ends of the original bend were silted up.

parabolic dune - A sand dune with a long, scoop-shaped form, convex in the downwind direction so that its horns point upwind, whose ground plan approximates the form of a parabola.

peak - Sharp or rugged upward extension of a ridge chain, usually at the junction of two or more ridges; the prominent highest point of a summit area.

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.

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.

piedmont - (adjective) Lying or formed at the base of a mountain or mountain range; e.g., a piedmont terrace or a piedmont pediment. (noun) An area, plain, slope, glacier, or other feature at the base of a mountain; e.g., a foothill or a bajada. In the United States, the Piedmont is a low plateau extending from New Jersey to Alabama and lying east of the Appalachian Mountains.

piedmont slope - (colloquial - western US) The dominant gentle slope at the foot of a mountain; generally used in terms of intermontane-basin terrain in arid to subhumid regions. Main components include: (a) An erosional surface on bedrock adjacent to the receding mountain front (pediment, rock pediment); (b) A constructional surface comprising individual alluvial fans and interfan valleys, also near the mountain front; and (c) A distal complex of coalescent fans (bajada), and alluvial slopes without fan form. Piedmont slopes grade to basin-floor depressions with alluvial and temporary lake plains or to surfaces associated with through drainage (e.g., axial streams).

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.

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.

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 migration of the channel toward the outer bank.

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.

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.

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.

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.

river - (a) A general term for a natural, freshwater surface stream of considerable volume and generally with a permanent base flow, moving in a defined channel toward a larger river, lake, or sea.

river valley - an elongate depression of the Earth's surface carved by a river during its development.

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.

rock pediment - An erosion surface of low relief, cut directly into and across bedrock and composed of either bare rock or thinly veneered pediment or residuum (e.g. < 1.5 m) over bedrock; it occurs along the flanks of mountain fronts, or at the base of mountains or high hills. Its surface grades to the backwearing mountain slopes or hillslopes above, and generally grades down to and merges with a lower-lying alluvial plain, piedmont slope or valley floor below.

rotational slide - The process, associated sediments (rotational landslide deposit) or resultant landforms characterized by an extremely slow to moderately rapid type of slide, composed of comparatively dry and largely soil-rock materials, portions of which remain largely intact and in which movement occurs along a well-defined, concave shear surface and resulting in a backward rotation of the displaced mass. The landform may be single, successive (repeated up and down slope), or multiple (as the number of slide components increase).

rubble - An accumulation of loose angular rock fragments, commonly overlying outcropping rock; the unconsolidated equivalent of a breccia.

saddle - A low point on a ridge or interfluvium, generally a divide (pass, col) between the heads of streams flowing in opposite directions.

sandhills - A region of semi-stabilized sand dunes or sandy hills, either covered with vegetation or bare, as in north-central Nebraska and the midlands of the Carolinas.

sand plain - (a) A sand-covered plain which may originate by deflation of sand dunes, and whose lower limit of erosion is governed by the ground-water level. Also spelled *sandplain*. (b) (not preferred - refer to *sandy* outwash plain) A small outwash plain composed chiefly of sand deposited by meltwater streams flowing from a glacier.

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.

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.

scarp slope - The relatively steeper face of a cuesta, facing in a direction opposite to the dip of the strata.

scree - A collective term for an accumulation of coarse rock debris mantling a slope. Scree is not a synonym of talus, as scree includes loose, coarse fragment material on slopes without cliffs.

scree slope - A portion of a hillside or mountain mantled by scree and lacking an upslope rockfall source.

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.

shrub-coppice dune - A small, streamlined dune that forms around brush and clump vegetation.

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. The slope bounding a drainageway and lying between the drainageway and the adjacent interfluvium. It is generally linear along the slope width.

slide - (a) Mass movement processes, associated sediments (slide deposit) or resultant landforms (e.g., rotational, translational, and snow slide) characterized by a failure of earth, snow, or rock under shear stress along one or several surfaces that are either visible or may reasonably be inferred. The moving mass may or may not be greatly deformed, and movement may be rotational (rotational slide) or planar (translational slide). A slide can result from lateral erosion, lateral pressure, weight of overlying material, accumulation of moisture, earthquakes, expansion owing to freeze-thaw of water in cracks, regional tilting, undermining, fire, and human agencies. (b) The track of bare rock or furrowed earth left by a slide. (c) The mass of material moved by or deposited by a slide.

slip face - The steeply sloping surface of a dune, standing at or near the angle of repose of loose sand, and advancing downwind by a succession of slides wherever that angle is exceeded.

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 alluvium - Sediment gradually transported down mountain or hill slopes primarily by non-channel alluvial processes (i.e., slope wash processes) and characterized by particle sorting. Lateral particle sorting is evident on long slopes. In a profile sequence, sediments may be distinguished by differences in

size and/or specific gravity of coarse fragments and may be separated by stone lines. Sorting of pebbles or cobbles and burnished peds distinguish these materials from unsorted colluvial deposits.

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*.

slot canyon - A long, narrow, deep and tortuous channel or drainageway with sheer rock walls eroded into sandstone or other sedimentary rocks, especially in the semi-arid western US (e.g. Colorado Plateau); subject to flash flood events; depth to width ratios exceed 10:1 over most of its length and can approach 100:1; commonly containing unique ecological communities distinct from the adjacent, drier uplands.

strath terrace - A type of stream terrace, formed as an erosional surface cut on bedrock and thinly mantled with stream deposits (alluvium).

stream - (a) A body of running water that moves under gravity to progressively lower levels, in a relatively narrow but clearly defined channel on the ground surface, in a subterranean cavern, or beneath or in a glacier. It is a mixture of water and dissolved, suspended, or entrained matter. (b) A term used in quantitative geomorphology interchangeably with channel.

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 (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.

strike valley - A subsequent valley eroded in, and developed parallel to the strike of, underlying weak strata; such as a cuesta; a valley that often, but not necessarily contains a strike valley.

structural bench - A platform-like, nearly level to gently inclined erosional surface developed on resistant strata in areas where valleys are cut in alternating strong and weak layers with an essentially horizontal attitude. Structural benches are bedrock controlled, and in contrast to stream terraces, have no geomorphic implication of former, partial erosion cycles and base-level controls, nor do they represent a stage of flood-plain development following an episode of valley trenching.

summit - (a) The topographically highest position of a hillslope profile with a nearly level (planar or only slightly convex) surface. (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 interfluvial 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; (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.

syncline - (a) A unit of folded strata that is concave upward whose core contains the stratigraphically younger rocks, and occurs at the earth's surface. In a single syncline, beds forming the opposing limbs of the fold dip toward its axial plane. (b) A fold, at any depth, generally concave upward whose core contains the stratigraphically younger rocks.

tableland - A term for a broad upland with an extensive, nearly level or undulating summit area and steep side slopes descending to surrounding lowlands.

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.

talus cone - A small, steep, cone-shaped landform at the base of a cliff or escarpment, that heads in a relatively small declivity or ravine, and composed of poorly sorted rock and soil debris that has accumulated primarily by episodic rockfall or, to a lesser degree, by slope wash. Not to be confused with an *alluvial cone*; a similar feature but of fluvial origin, composed of better stratified and more sorted material, and that tapers up into a more extensive drainageway.

talus slope - a portion of a hillslope or mountainslope mantled by talus and lying below a rock source.

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 level. Practically, terraces are considered to be generally flat alluvial areas above the 100 yr. flood stage.

terraces - Small, irregular step-like forms on steep hillslopes, especially in pasture, formed by creep or erosion of surficial materials that may be induced or enhanced by trampling of livestock such as sheep or cattle. Synonyms (not preferred) - catstep, sheep or cattle track.

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.

translational slide - A category of mass movement processes, associated sediments (translational slide deposit) or resultant landforms characterized by the extremely slow to moderately rapid downslope displacement of comparatively dry soil-rock material on a surface (slip face) that is roughly parallel to the general ground surface, in contrast to falls, topples, and rotational slides. The term includes such diverse *slide* types as translational debris slides, translational earth slide, translational rock slide, block glides, and slab or flake slides.

transverse dune - A very asymmetric sand dune elongated perpendicular to the prevailing wind direction, having a gentle windward slope and a steep leeward slope standing at or near the angle of repose of sand; it generally forms in areas of sparse vegetation.

valley - An elongate, relatively large, externally drained depression of the Earth's surface that is primarily developed by stream erosion or glacial activity.

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.

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.

zibar - A small, low-relief sand dune that lacks discernible slip faces and commonly occurs on sand sheets, in interdune areas, or in corridors between larger dunes. Zibar spacing can range from 50-400 m with local relief < 10 m. Unlike coppice dunes, zibars are unrelated to deposition around vegetation. Generally dominated by coarser sands.

Appendix B.3. Example of a Vegetation Plot Data Form

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

Plot Code CARE 468 BPU Code 513/147
 Provisional Community Name Pinus edulis - Juniperus osteosperma Woodland
 State UT Park Name CAPITOL REEF NP Park Site Name Brinkerhoff Spring
 Quad Name Bitter Creek Divide Quad Code 3711-H1 Aerial Photo # 41
 GPS file name P468C Field UTM X 490031 m E Field UTM Y 4202895 m N
 DATUM NAD83 UTM Zone: 12 Error +/- 5 m 3D Differential? Y/(N)
 Comments/GPS device used: Garmin etrex summit

Survey Date 5/24/03 Surveyors B. Smith, D. Niosi
 Directions to Plot
From Brinkerhoff Spring, head ~ 250 to N/NE @ base of cliffs
 Plot Permanent: NO

Plot length(m) _____ Azimuth _____ Plot Photos (y/n) _____ Roll # 6C Frame # 16, 17, 18
 Plot width(m) _____ Diameter if circle 22.6 Digital camera frame # _____
 Photo Comments: _____ Cryptogamic Soils Photos (y/n) _____ Roll # _____ Frame # _____
 Digital camera frame # _____

Plot representativeness (discuss plot placement and explain non-representativeness)
 a. Representativeness of association compared with occurrences outside park (if known):
 b. Representativeness of plot in stand: very good; plot has W, N, S facing aspects, which is representative of all interfluvial in polygon

ENVIRONMENTAL DESCRIPTION

Elevation: 6720 ft/m (circle one) Slope: 10 deg. Aspect: 288 deg.
 Topographic Position (see cheat sheet) High slope
 Landform (see cheat sheet) Interfluvial / Colluvial Slope
 Surficial Geology (see cheat sheet/map) Chico Formation

<input checked="" type="checkbox"/> Upland	<input type="checkbox"/> Palustrine	<input type="checkbox"/> Permanently Flooded	<input type="checkbox"/> Unknown	<input type="checkbox"/> Temporarily Flooded
<input type="checkbox"/> Riverine	<input type="checkbox"/> Lacustrine	<input type="checkbox"/> Semipermanently Flooded	<input type="checkbox"/> Seasonally Flooded	<input type="checkbox"/> Intermittently Flooded

Environmental Comments (factors controlling community/plant distribution, seral stage, fire history etc):
Active erosion from cliffs above surrounding drainages

Ground Cover: (please estimate to the nearest percentage. Sum = 100%)
16 Bare soil 25 Large rocks (>10 cm)
 _____ Bedrock <1 Lichen (on rock)
 _____ Sand (0.1-2 mm) dune/alluvium 15 Wood (>1 cm)
<1 Moss (on rock) 35 Small rocks (0.2-10 cm)
 _____ Other (describe): _____ Water
15 Litter / duff (dead) _____ Cryptogam (total soil
8 Litter / duff (live basal area) l lichen, moss, cyanobact.)

Soil Texture (see cheat sheet):
 _____ sand _____ loamy sand sandy loam _____ loam
 _____ silt loam _____ silt _____ clay loam _____ silty clay
 _____ sandy clay _____ clay _____ peat _____ muck

Soil Drainage:
 Rapidly drained _____ Well drained
 _____ Moderately well drained _____ Somewhat poorly drained
 _____ Poorly drained _____ Very poorly drained

VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	Leaf Type (of dominant stratum)	Physiognomic Class	Height Scale for Strata	Cover Scale for Strata
Trees and Shrubs	<input type="checkbox"/> Broad-leaved	<input type="checkbox"/> Forest	01 <0.5 m	T 0-1%
<input checked="" type="checkbox"/> Evergreen	<input checked="" type="checkbox"/> Needle-leaved	<input checked="" type="checkbox"/> Woodland	02 0.5-1m	P >1-5%
<input type="checkbox"/> Cold-deciduous	<input type="checkbox"/> Microphyllous	<input type="checkbox"/> Shrubland	03 1-2 m	1 >5-15%
<input type="checkbox"/> Mixed evergreen-cold-deciduous	<input type="checkbox"/> Graminoid	<input type="checkbox"/> Dwarf Shrubland	04 2-5 m	2 >15-25%
	<input type="checkbox"/> Forb	<input type="checkbox"/> Shrub Herbaceous	05 5-10 m	3 >25-35%
	<input type="checkbox"/> Pteridophyte	<input type="checkbox"/> Herbaceous	06 10-15 m	4 >35-45%
Herbs	<input type="checkbox"/> Non-vascular	<input type="checkbox"/> Nonvascular	07 15-20 m	5 >45-55%
<input type="checkbox"/> Annual	<input type="checkbox"/> Mixed (describe)	<input type="checkbox"/> Sparsely Vegetated	08 20-35 m	6 >55-65%
<input type="checkbox"/> Perennial			09 35 - 50 m	7 >65-75%
			10 >50 m	8 >75-85%
				9 >85-95%
				10 > 95%

	Height Class	Cover Class	Dominant Species (mark Diagnostic species with *)
T1 Emergent			
T2 Canopy	D4	D1	PINE DU, JUNO DT
T3 Sub-canopy			
S1 Tall shrub			
S2 Short Shrub	D2	I	SHEROT
S3 Dwarf-shrub	D1	P	BUTSAR, ERICOR, SHEROT
Ht Herbaceous			
H1 Graminoids	D1	P	STIHYM, HILJAM
H2 Forbs	D1	P	Various
H3 Ferns			
H4 Tree seedlings	D1	T	PINE DU
N Non-vascular			
V Vine/liana			
E Epiphyte			

Animal Use Evidence (including scat, browse, burrows, bedding sites, etc)
 Ant hill in center of plot; cliff swallows

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

Other Comments/Continuation from previous sections. Describe surrounding communities and how they relate to the plot.
 This plot is very similar to surrounding communities on these colluvial interfluvies below the cliff.

Plot Code: CARE. 468

Species/percent cover: Starting with the uppermost stratum, list all species with % cover for each species in the stratum. For each tree species estimate seedling, sapling and total cover indicating stratum. List species outside the plot at the end of the table and designate with a 0 in Cover Class column.

Stratum	Species Name	Cover		Species Name	Cover		Species Name	Cover		TOTALS
		Class	Stratum		Class	Stratum		Class	Stratum	
T2	<i>Pinus edulis</i> 10	P	H1	<i>Stipa hymenoides</i>	P					
	<i>Juniperus</i>	T		<i>Hesperis matronalis</i>	T					
	<i>Asclepias</i>									T1 =
S2	<i>Shepherdia</i>	P								T2 = 1
	<i>rotundifolia</i>		H2	<i>Hymenocallis</i>	T					T3 =
	<i>Eriogonum</i>	T		<i>filifolius</i>						S1 =
	<i>Corymbosum</i>			<i>Machaeranthera</i>	T					S2 = 1
	<i>Amelanchier</i>	T		<i>glandulodes</i>						S3 = P
	<i>Utahensis</i>			<i>Arenaria fendleri?</i>	T					H1 = P
	<i>Chrysothamnus</i>	T		<i>Caryocarpus (per)</i>	T					H2 = P
	<i>Nauseosus</i>			<i>vegetativa</i>						H3 =
S3	<i>Gutierrezia</i>	T								H4 =
	<i>Suaeda</i>									N =
	<i>Eriogonum</i>	T								V =
	<i>Corymbosum</i>		H4	<i>Pinus edulis</i>						E =
	<i>Shepherdia</i>	T								
	<i>rotundifolia</i>									

Cover Class	Strata:
Scale:	T1 = Emergent
T = >0-1%	T2 = Canopy
P = >1-5%	T3 = Subcanopy
1 = >5-15%	S1 = Tall Shrub
2 = >15-25%	S2 = Short Shrub
3 = >25-35%	S3 = Dwarf Shrub
4 = >35-45%	H1 = Graminoid
5 = >45-55%	H2 = Forb
6 = >55-65%	H3 = Fern
7 = >65-75%	H4 = Tree seedling
8 = >75-85%	N = Nonvascular
9 = >85-95%	V = Vine/liana
10 = >95%	E = Epiphyte

VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	Leaf Type (of dominant stratum)	Physiognomic Class	Height Scale for Strata	Cover Scale for Strata
Trees and Shrubs	<input type="checkbox"/> Broad-leaved	<input type="checkbox"/> Forest	01 <0.5 m	T 0-1%
<input checked="" type="checkbox"/> Evergreen	<input checked="" type="checkbox"/> Needle-leaved	<input checked="" type="checkbox"/> Woodland	02 0.5-1m	P >1-5%
<input type="checkbox"/> Cold-deciduous	<input type="checkbox"/> Microphyllous	<input type="checkbox"/> Shrubland	03 1-2 m	1 >5-15%
<input type="checkbox"/> Mixed evergreen-cold-deciduous	<input type="checkbox"/> Graminoid	<input type="checkbox"/> Dwarf Shrubland	04 2-5 m	2 >15-25%
	<input type="checkbox"/> Forb	<input type="checkbox"/> Shrub Herbaceous	05 5-10 m	3 >25-35%
	<input type="checkbox"/> Pteridophyte	<input type="checkbox"/> Herbaceous	06 10-15 m	4 >35-45%
Herbs	<input type="checkbox"/> Non-vascular	<input type="checkbox"/> Nonvascular	07 15-20 m	5 >45-55%
<input type="checkbox"/> Annual	<input type="checkbox"/> Mixed (describe)	<input type="checkbox"/> Sparsely Vegetated	08 20-35 m	6 >55-65%
<input type="checkbox"/> Perennial			09 35 - 50 m	7 >65-75%
			10 >50 m	8 >75-85%
				9 >85-95%
				10 > 95%

	Height Class	Cover Class	Dominant Species (mark Diagnostic species with *)
T1 Emergent			
T2 Canopy	D4	D1	PINEDU, JUNDT
T3 Sub-canopy			
S1 Tall shrub			
S2 Short Shrub	D2	I	SHEROT
S3 Dwarf-shrub	D1	P	BUTSA, ERICOR, SHEROT
Ht Herbaceous			
H1 Graminoids	D1	P	STIHYM, HILJAM
H2 Forbs	D1	P	Various
H3 Ferns			
H4 Tree seedlings	D1	T	PINEDU
N Non-vascular			
V Vine/liana			
E Epiphyte			

Animal Use Evidence (including scat, browse, burrows, bedding sites, etc)
 Ant hill in center of plot; cliff swallows

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

Other Comments/Continuation from previous sections. Describe surrounding communities and how they relate to the plot.
 This plot is very similar to surrounding communities on these colluvial interfluvies below the cliff.

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

CARE
~~CAPITOL REEF~~ NATIONAL PARK VEGETATION MAPPING PROGRAM: OBSERVATION SURVEY FORM 2004

SURVEY AND SITE INFORMATION

Plot Code (Please Circle One): ~~CANY~~ CARE 9703 BPU Code: NONE County: WAYNE

Type of Observation (Please Circle One): VEG/OBS SPRING/HANGING GARDEN OTHER (Specify) _____

State UT Site Name BILLINGS PASS Location (Please Circle One): Park Environs

Quad Name FLAT TOP Aerial Photo # NONE

GPS file name 9703 Field UTM X 462747 m E Field UTM Y 4255238 m N
 Datum NAD 83 Zone: 12S GPS Unit: Trimble XM / Garmin Flat PDOP: 2.98 3D Differential? Y / N
 GPS Comments: Error: +/- _____ m (Flat Garmin only)

Survey Date 07 20 04 Surveyors: B. CONDIE, S. TOPP Size of Area: ONE ACRE

Plot Photos (Y / N) Camera Name and Model: OLYMPUS
 Photo Type: Plot Roll: A14 Frame#: 8 Photographer: TOPP Comments: → NE
 Photo Type: _____ Roll: _____ Frame#: _____ Photographer: _____ Comments: _____
 Photo Type: _____ Roll: _____ Frame#: _____ Photographer: _____ Comments: _____

ENVIRONMENTAL DESCRIPTION

Elevation: 2803 ft/m From: GPS/Map (circle one) Slope: 2 deg. Aspect: 48 deg.
 Topographic Position (see cheat sheet) HIGH LEVEL
 Landform (see cheat sheet) RIDGE TOP
 Surficial Geology (see cheat sheet/map) VOLCANIC BOULDERS

<input checked="" type="checkbox"/> Upland	Cowardin System <input type="checkbox"/> Palustrine	Hydrology <input type="checkbox"/> Permanently Flooded <input type="checkbox"/> Seasonally Flooded <input type="checkbox"/> Semipermanently Flooded	<input type="checkbox"/> Unknown <input type="checkbox"/> Seasonally Flooded <input type="checkbox"/> Saturated	<input type="checkbox"/> Temporarily Flooded <input type="checkbox"/> Intermittently Flooded
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Environmental Comments: THIS POLYGON IS NOT A TRANSITION AREA BUT AN AREA CONTAINING TWO DIFFERENT COMMUNITIES. THIS CONVEX RIDGE TOP HAS THIN SOIL WITH MANY EXPOSED ROCKS AND BOULDERS. THE NEARLY FLAT UNSHADED AREA HAS A HIGHER SOLAR BUDGET THAN THE SLAPING AREA, WITH A NORTHERLY ASPECT, SHADED BY THE ASPEN TREES. THIS VEGETATIVE MIX HAS BEEN SAMPLED SEVERAL TIMES. THE HIGH NUMBER OF FORBS & GRASSES ARE NOT LISTED HERE. WE WILL DO ANOTHER PLOT (0727) TO THE NW TO HIGHLIGHT THE ENVIRONMENTAL & VEGETATION CONTRAST W/ THIS POINT.

Unvegetated Surface: (please use cover scale below)
 Bare soil Small rocks (0.2-10cm) Wood (>1cm) Other (describe) ROCK LICHEN
 Bedrock Large rocks (>10cm) Litter / duff

VEGETATION DESCRIPTION

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

2004: APR 17; v1.3 (Observation Form) 1

~~CAPITOL REEF~~ NATIONAL PARK VEGETATION MAPPING PROGRAM: OBSERVATION SURVEY FORM 2004

Provisional Community Name: Artemisia nova / Poa fendleriana Plot Code: CARE CANY-GLCA 9703
Dwarf Shrubland

Stratum Height Class	Stratum Cover Class	Dominant Species (mark Diagnostic species with *)	% Cover
T1 Emergent			
T2 Canopy			
T3 Sub-canopy			
S1 Tall shrub (> 2 m)			
S2 Short Shrub (< 2 m)			
S3 Dwarf Shrub (< 0.5 m)	<u>02</u>	<u>01 * Artemisia nova</u>	<u>11</u>
H Herbaceous	<u>01</u>	<u>Poa fendleriana</u>	<u>2</u>
N Non-vascular			
V Vine/liana			

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%	
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2004: APR 17; v1.3 (Observation Form) 2

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

2005 ACCURACY ASSESSMENT POINT FORM - CAPITOL REEF NATIONAL PARK
NORTHERN COLORADO PLATEAU NETWORK VEGETATION MAPPING PROJECT

IDENTIFIERS/LOCATORS

AA Point Code: CARE_AA_0830 Quad name: The Post County: Garfield
 Park Site Name: Hogback E. of Grand Gulch
 Survey Date: 4/23/05 Surveyor(s): A Tendick

GPS file name: _____ Field UTM X: 502334 m E Field UTM Y: 4187132 m N
 Coordinates from USGS NAD27 Quad Map (if checked enter coordinates under GPS comments)
 GPS Unit: (circle one): Trimble XM Garmin Flat /None/ Other: _____ PDOP: 2.5 3D Differential? yes no
 Datum NAD 83 Zone: _____ Error +/-: _____ m (Flat Garmin only)
 GPS Comments: _____

Camera Name and Model (circle one): Olympus Stylus / Canon Sureshot / Other: Minolta F2

Roll #	Frame #	Photographer	Direction/Comments
<u>ATI</u>	<u>13</u>	<u>Tendick</u>	<u>→NW</u>
<u>ATI</u>	<u>14</u>	<u>" "</u>	<u>→NE</u>

PLANT ASSOCIATION INFORMATION

ASSOCIATIONS AT AA POINT	OTHER ASSOCIATIONS WITHIN 50 M OF AA POINT
Primary Name: <u>PINEDM-JUNOST/COLRAM Woodland</u>	1.
Secondary Name: _____	2.
Primary- New Assoc? <input type="checkbox"/> yes <input checked="" type="checkbox"/> no	Secondary- New Assoc? <input type="checkbox"/> yes <input type="checkbox"/> no
Representativeness of point within polygon: <input checked="" type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor ... of association to description: <input checked="" type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor	
Classification Comments: (complications, uncertainties, explanation of poor representativeness) <u>Association name fits well here, even though P-J cover is so low, but the environmental comments don't mention the mixture of shrubs found in this plot. Plot is a good representation of the P-J/COLRAM communities interspersed throughout polygon with P-J/CERINT woodlands. P-J cover may be a little lower here than is average for the polygon</u>	

ENVIRONMENTAL DESCRIPTION

Elevation: 1,560 m/ft From: GPS/Map (circle one) | Slope: 20° Aspect: 66°
 Topographic Position: High Slope
 Landform: Hogback | Geology: Salt Wash of the Morrison
 Environmental Comments: Fairly steep slope covered with small, cobbly rocks and less bare ground exposed, also scattered large rock chunks (1/2-2 m²). Scattered, old JUNOST skeletons still standing. Plot is near ridgetop. Mixture of shrubs, but most with low cover values.

2005: APRIL 18 AT
5/10

2005 ACCURACY ASSESSMENT POINT FORM - CAPITOL REEF NATIONAL PARK
 NORTHERN COLORADO PLATEAU NETWORK VEGETATION MAPPING PROJECT

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

<u>P</u> Bedrock	<u>02</u> Large rocks (cobbles, boulders > 10 cm)	<u>—</u> Sand (0.1-2 mm)
<u>P</u> Litter, duff	<u>04</u> Small rocks (gravel, 0.2-10 cm)	<u>03</u> Bare soil
<u>P</u> Wood (> 1 cm)		<u>—</u> Other: _____

VEGETATION DESCRIPTION

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

Strata	Height Class	Cover Class	Dominant species (mark any known diagnostic species with a *)	% Cover
T1 Emergent	<u>—</u>	<u>—</u>		
T2 Canopy	<u>04</u>	<u>P</u>	<i>Pinus edulis</i> <i>Juniperus osteosperma</i>	<u>2</u> <u>1</u>
T3 Sub-canopy	<u>—</u>	<u>—</u>		
S1 Tall shrub	<u>—</u>	<u>—</u>		
S2 Short Shrub	<u>01</u>	<u>1b</u>	<i>Coleogyne ramosissima</i> <i>Ephedra torreyana</i> <i>Grayia spinosa</i> <i>Artemisia bigelovii</i>	<u>12</u> <u>1</u> <u>1</u> <u>1</u>
S3 Dwarf-shrub	<u>—</u>	<u>S2</u> <u>COPH</u>	<i>Rhus aromatica</i> var. <i>simplicifolia</i> <i>Chrysothamnus nauseosus</i>	<u>1</u> <u>1</u>
H Herbaceous	<u>01</u>	<u>P</u>	<i>Xyloberiza tortifolia</i> <i>Bromus tectorum</i> <i>Stipa comata</i> <i>Hilaria jamesii</i>	<u>1</u> <u>1</u> <u>1</u> <u>1</u>
H4 Tree Seedlings	<u>—</u>	<u>—</u>		
N Non-vascular	<u>—</u>	<u>—</u>		

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 CARE VegMapDB, have been used for all vegetation mapping projects conducted by NCPN. CARE VegMapDB contains plot, observation point, and accuracy assessment data collected during project field work.

Two database files are required to use CARE VegMapDB:

- *CARE_PlotsAA_XP.mdb*. This “frontend” file contains all queries, forms, reports, associated modules and Visual Basic code.
- *CARE_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 (*CARE_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.

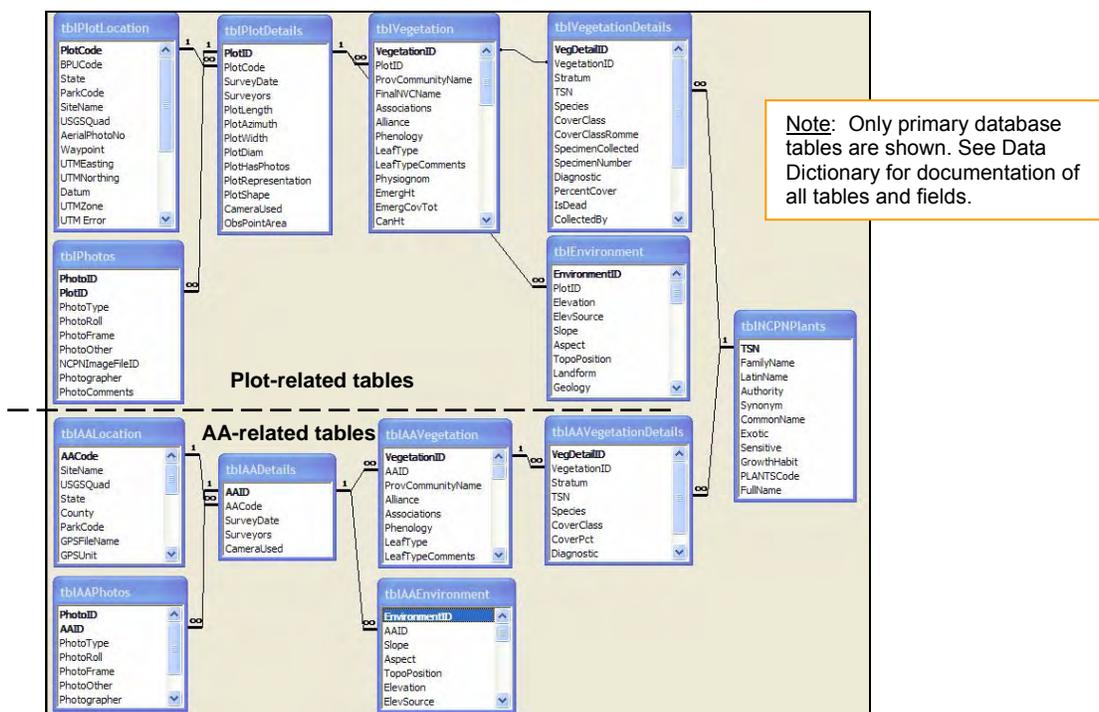


Figure 1. Entity Relationship Diagram for CARE VegMapDB

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: 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
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

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

Field Name	Field Description	Field Type	Field Width
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	dbLong	4
Aspect	Aspect of plot	dbText	50
TopoPosition	Topographic position of plot; value selected from tlkpTopography	dbText	50
Landform	Landform on which plot is located; value selected from tlkpLandform	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
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 ground cover	dbText	3
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 cryptogam 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	dbMemo	0

Field Name	Field Description	Field Type	Field Width
	animals in plot area		
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
LiveBasalArea	Field used at CARE only; estimate to the nearest percentage of live basal area ground cover	dbText	4
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
MossPct	Estimate to the nearest percentage of moss ground cover	dbText	3
DarkCyanobacteria	Estimate to the nearest percentage of dark cyanobacteria ground cover	dbText	3
TotalPct	Calculated total percent of ground cover.	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	Landform value corresponding to plot location; values chosen from tlkpLandform	dbText	50

Table Name: tblFuels

Description: Table containing details on fuels characteristics of plot.

Field Name	Field Description	Field Type	Field Width
FuelsID	Unique record ID	dbLong	4
PlotID	Foreign key; links to tblPlotDetails	dbLong	4
PPDFPhotoGuide	n/a for CARE plots	dbText	3
PJPhotoGuide	n/a for CARE plots	dbText	3
SBPhotoGuide	n/a for CARE plots	dbText	3
PJAgeClass	If plot contains pinyon and/or juniper, enter value that best describes the age class of the stand; values stored in tlkpPJAge	dbText	15
LitterOrigin	n/a for CARE plots	dbText	3
LitterNorth	n/a for CARE plots	dbText	3

Field Name	Field Description	Field Type	Field Width
LitterEast	n/a for CARE plots	dbText	3
LitterSouth	n/a for CARE plots	dbText	3
LitterWest	n/a for CARE plots	dbText	3
DuffOrigin	n/a for CARE plots	dbText	3
DuffNorth	n/a for CARE plots	dbText	3
DuffEast	n/a for CARE plots	dbText	3
DuffSouth	n/a for CARE plots	dbText	3
DuffWest	n/a for CARE plots	dbText	3
IsSubplot	indicate if measurements are for subplot (if plot has >25 trees, one quadrant (subplot) of plot can be measured for fuels	dbBoolean	1

Table Name: tblFuelsDetails

Description: Details on stems, height, crown width, and other attributes of trees within plot.

Field Name	Field Description	Field Type	Field Width
FuelsDetailID	Unique identifier for record	dbLong	4
FuelsID	Foreign key, links to tblFuels	dbLong	4
StemCount	Number of stems measured. Value will be 1 if forest species; >=1 if woodland species.	dbInteger	2
StemDiameter	diameter in cm of stem(s). If stem count =1 for a forest species, diameter represents dbh. If stem count is >1 for a woodland species, diameter represents the average diameter of all stems measured at crown base.	dbDouble	8
TSN	Taxonomic Serial Number - unique taxon identifier assigned by ITIS	dbDouble	8
WoodlandCrownWidth	n/a for CARE plot	dbDouble	8
WoodlandCrownHeight	n/a for CARE plot	dbDouble	8
ForestCrownBaseHeight	n/a for CARE plot	dbDouble	8
ForestCrownHeight	n/a for CARE plot	dbDouble	8
CrownRatio	n/a for CARE plot	dbText	12
StructureStage	n/a for CARE plot	dbText	12
Comments	n/a for CARE plot	dbText	255

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
GenPhotoDate	Date photo taken	dbText	50
GenPhotographer	Name of photographer	dbText	75
GenPhotoParkCode	Park Code	dbText	4
GenPhotoDesc	General description of photo contents	dbText	250
GenPhotoAssocName	Association name	dbText	50
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
ImageFileID	New image file name as indicated in NCPN Photo	dbText	50

Field Name	Field Description	Field Type	Field Width
	Database		
GenPhotoComments	Geneal 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
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
GenSpecLocality	Description of locality where specimen was collected	dbText	250
GenSpecHabitat	Description of habitat where specimen was collected	dbText	250
GenSpecAssocSpec	As sociated 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 identifier	dbLong	4
PlotID	Foreign key, links to tblPlotDetails	dbLong	4
PhotoType	Type of photo being referenced.	dbText	16
PhotoRoll	Reference number for film roll of photo.	dbText	12
PhotoFrame	Frame number of photo within roll.	dbText	50
PhotoOther	Other unique identifier or reference number for digital photo or name of movie file.	dbText	25
NCPNImageFileID	NCPN PhotoDatabase digital image file name.	dbText	50
Photographer	Name of photographer.	dbText	50
PhotoComments	Brief description of photo.	dbText	255

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	dbMemo	0

Field Name	Field Description	Field Type	Field Width
	known)		
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. Numbers before the slash refer to the BPU number, while numbers after the slash are unique identifiers for the plot. N/a means the plot was not in a BPU.	dbText	25
State	State where plot is located	dbText	2
ParkCode	Park unit where plot is located	dbText	4
SiteName	Short, descriptive name of site where plot is located	dbText	100
USGSQuad	USGS quadrangle (1:24K) where plot is located	dbText	50
AerialPhotoNo	Aerial photo number corresponding to plot location	dbText	10
Waypoint	Garmin plot code	dbText	7
UTMEasting	UTM easting of plot	dbDouble	8
UTMNorthing	UTM northing of plot	dbDouble	8
Datum	Datum of UTM coordinates	dbText	10
UTMZone	UTM zone of coordinates	dbText	4
UTM Error	error, in meters, of location data (based on reading from Garmin GPS unit)	dbText	5
PDOP	satellite Precision Dilution of Position (based on reading from Trimble GPS unit)	dbText	50
DiffCorrected	Indicate if coordinates have been differentially corrected	dbText	3
DirectionsToPlot	Precise directions to plot	dbMemo	0
County	County where plot is located.	dbText	50
GPSUnit	Manufacturer and model of GPS unit (e.g., Trimble GeoExplorer 3)	dbText	25
GPSComments	Any brief comments on GPS data collection at plot.	dbText	255
InPark	Select Yes if plot is within park boundaries.	dbBoolean	1
IsObservationPt	Yes if observation point.	dbBoolean	1

Table Name: tblVegetation

Description: Overall vegetation characteristics of a plot or observation point

Field Name	Field Description	Field Type	Field Width
VegetationID	Unique record ID	dbLong	4
PlotID	Foreign key, links to tblPlotDetails	dbLong	4
ProvCommunityName	Community name (provisional) assigned by field crews by following naming protocols as described in field manual and training 04/04.	dbText	120
FinalNVCName	Final name assigned to association by NatureServe	dbText	150
Associations	Association corresponding to provisional community name	dbText	150
Alliance	Alliance corresponding to provisional community name	dbText	150
Phenology	Leaf phenology of the dominant stratum. Field is blank for non-vascular plants	dbText	35

Field Name	Field Description	Field Type	Field Width
LeafType	Leaf form of the dominant stratum.	dbText	20
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 tlkPhysiogClass)	dbText	20
EmergHt	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
EmergCovTot	Height class of emergent stratum (classes are in tlkpHeight)	dbText	4
CanHt	Height class of canopy stratum	dbText	2
CanCovTot	Cover class of canopy stratum	dbText	50
SubHt	Height class of subcanopy stratum	dbText	2
SubCovTot	Cover class of subcanopy stratum	dbText	4
TallShHt	Height class of tall shrub stratum	dbText	2
TallShCovTot	Cover class of tall shrub stratum	dbText	4
ShrubHt	Height class of short shrub stratum	dbText	2
ShrubCovTot	Cover class of short shrub stratum	dbText	4
DwarfHt	Height class of dwarf shrub stratum	dbText	2
DwarfCovTot	Cover class of dwarf shrub stratum	dbText	4
HerbHt	Height class of herbaceous stratum (all H layers)	dbText	2
HerbCovTot	Cover class of herbaceous stratum (all H layers)	dbText	4
GramHt	Height class of graminoid stratum	dbText	2
GramCovTot	Cover class of graminoid stratum	dbText	4
ForbHt	Height class of forb stratum	dbText	2
ForbCovTot	Cover class of forb stratum	dbText	4
FernHt	Height class of fern and fern ally stratum	dbText	2
FernCovTot	Cover class of fern and fern ally stratum	dbText	4
SeedlHt	Height class of seedling stratum	dbText	2
SeedlCovTot	Cover class of seedling stratum	dbText	4
NonvasHt	Height class of nonvascular stratum	dbText	2
NonvasCovTot	Cover class of nonvascular stratum	dbText	4
VineHt	Height class of vine stratum	dbText	2
VineTotCov	Cover class of vine stratum	dbText	4
EpiHt	Height class of epiphyte stratum	dbText	2
EpiTotCov	Cover class of epiphyte stratum	dbText	4
OutsidePlotHt	Height class of species occurring outside plot	dbText	50
OutsidePlotTotCov	Cover class of species occurring outside plot	dbText	50
RommeHt	Romme height class- contains dummy entries so the Romme veg stratas will be picked up in the geodatabase	dbText	2
RommeCovTot	Romme cover class- contains dummy entries so the Romme veg stratas will be picked up in the geodatabase	dbText	4

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 tlkStrata	dbText	2
TSN	Taxonomic Serial Number - unique taxon identifier assigned by ITIS	dbDouble	8
Species	Latin names of species, from tblINCPNPlants	dbText	100

Field Name	Field Description	Field Type	Field Width
CoverClass	Cover class to describe species and strata (from tillkCover)	dbText	4
CoverClassRomme	Cover classes used for pre-2003 legacy data: 1 = 5%; 2 = 5-25%; 3 = 25-50%; 4 = 50-75%; 5 = 75-95%; 6 = 95-100%	dbText	50
SpecimenCollected	Check yes if a specimen of the species was collected.	dbBoolean	1
SpecimenNumber	Enter the collector's reference number for the specimen collected.	dbText	50
Diagnostic	Check yes if the species is known to be diagnostic of the vegetation type.	dbBoolean	1
PercentCover	Percent (0-100) cover of each species	dbLong	4
IsDead	Check yes if the species being documented was dead	dbBoolean	1
CollectedBy	Name of person making collection	dbText	50
NPSAccessionNumber	Accession number of specimen	dbText	50
NPSCatalogNumber	Unique reference number for individual specimen assigned by park curator	dbText	50
SpecimenLocality	Brief description of where collection was made	dbText	250
SpecimenHabitat	Description of habitat where collection was made	dbText	250
SpecimenAssocSpecies	Description of associated species where collection was made	dbText	250

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	dbMemo	0

Field Name	Field Description	Field Type	Field Width
	reproduction factors		
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 type of ground cover if "Other" percentage field contains a value	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
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	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
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Field Name	Field Description	Field Type	Field Width
AACode	Identifier assigned to AA point by survey crew	dbText	13
SiteName	Short, descriptive name of site where point is located	dbText	100
USGSQuad	USGS quadrangle (1:24K) where point is located	dbText	50
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 reading from Trimble GPS unit)	dbText	50
UTM Error	Error, in meters, of location data (based on reading from Garmin GPS unit)	dbText	5
InPark	Select Yes if plot is within park boundaries	dbBoolean	1
GPSComments	Any brief comments on GPS data collection	dbText	255
RepresentPWP	Representativeness of point within polygon: Good, Fair, or Poor (on association page)	dbText	7
RepresentATD	Representativeness of association to description : Good, Fair, or Poor (on association page)	dbText	4
ClassificationComments	Classification comments (on association page)	dbMemo	0
PlotShape	Plot shape: Circular, Other	dbText	10

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	50
Photographer	Name of photographer	dbText	50
PhotoComments	Brief description of photo	dbText	255
NCPNImageFileID	NCPN Photo Database Image File ID	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

Field Name	Field Description	Field Type	Field Width
VegAssocRank	Rank of vegetation association (primary, secondary, tertiary)	dbText	15
FieldKey	Was name obtained from field key?	dbBoolean	1
NewName	Is it a new classification name?	dbBoolean	1
Post_Field_Name	Post-field name?	dbBoolean	1
OtherAssocCode	Other associations within 50 meters	dbText	255

Table Name: tblAAVegetation

Description: Overall vegetation characteristics of an AA point.

Field Name	Field Description	Field Type	Field Width
VegetationID	Unique record identifier	dbLong	4
AAID	Foreign key; provides link to tblAADetails	dbLong	4
ProvCommunityName	Community name (provisional) assigned by field crews by following naming protocols as described in field manual and training 04/04	dbText	120
Alliance	Alliance corresponding to provisional community name	dbText	150
Associations	Association corresponding to provisional community name	dbText	150
Phenology	Leaf phenology of the dominant stratum	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	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
EmergCovTot	Cover class of emergent stratum	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
DwarfCovPercent	[not used]	dbText	50
HTotalHt	Height class of total herbaceous stratum	dbText	2
HTotalCover	Cover class of total herbaceous stratum	dbText	15
HTotalCoverPercent	[not used]	dbText	50
H4Ht	Height class of tree seedling stratum	dbText	2
H4Cover	Cover class of tree seedling stratum	dbText	15
H4CoverPercent	[not used]	dbText	50
NonvasHt	Height class of nonvascular stratum	dbText	2

Field Name	Field Description	Field Type	Field Width
NonvasCovTot	Cover class of nonvascular stratum	dbText	15
NonvasCovPercent	[not used]	dbText	50
VineHt	Height class of vine stratum	dbText	2
VineTotCov	Cover class of vine stratum	dbText	15
VineTotPercent	[not used]	dbText	50
EpiHt	Height class of epiphyte stratum	dbText	2
EpiTotCov	Cover class of epiphyte stratum	dbText	15
EpiTotPercent	[not used]	dbText	50
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 tlkpStrataAA	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 tlkpCoverAA)	dbText	5
CoverPct	[not used]	dbText	5
Diagnostic	Check if species is known to be diagnostic of the vegetation type.	dbBoolean	1
Dead	Check if the species is dead	dbBoolean	1

Lookup tables

Table Name: tblNCPNPlants

Description: Master look-up table for plant species names and taxonomic information. Derived from ITIS (USDA - 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 A	Accepted synonyms of taxon	dbText	255
CommonName	Locally accepted common name for taxon	dbText	255
Exotic	Check yes if species is exotic	dbBoolean	1
Sensitive	check yes if species is threatened, endangered, or sensitive	dbBoolean	1
GrowthHabit	Select GrowthHabit for species -- habit can vary based on region; edit as needed to reflect habit in park	dbText	255
PLANTSCode	Code for taxonomic unit assigned by USDA PLANTS	dbText	255
FullName	temporary field; concatenation of Latin name and authority	dbText	255

Table Name: tlkpAAVegAssociation

Description: Lookup of vegetation association codes (CEGL codes from NatureServe) and vegetation association name.

Field Name	Field Description	Field Type	Field Width
VegAssocCode	Vegetation association code (CEGL code); assigned by NatureServe	dbText	255
VegAssocName	Final vegetation association name; assigned by NatureServe	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	150

Table Name: tlkpAssociations

Description: Look-up of association names

Field Name	Field Description	Field Type	Field Width
Associations	Association names from NatureServe classification	dbText	150

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: tlkpCAREVegAssocNames

Description: Lookup of vegetation association codes (CEGL codes from NatureServe) and vegetation association name.

Field Name	Field Description	Field Type	Field Width
NVC_Name_ID	NVC name identification number	dbLong	4
Final NVC Name	Name derived from final classification provided by J. Coles, Feb. 2005	dbText	255

Table Name: tlkpCover

Description: Look-up of cover classes assigned to species and strata in vegetation tables.

Field Name	Field Description	Field Type	Field Width
CoverClass	Cover class code	dbText	50
CoverClassDef	Cover class definition. For Plots: T<1%, P=1-6%, 1a=6-10%, 1b=11-15%, 02=16-25%, 03=26-35%, 04=36-45%, 05=46-55%, 06=56-65%, 07=66-75%, 08=76-85%, 09=85-96%. For Observation points: 01= 0-10%, 02=10-25%, 03=25-60%, 04=60-100%	dbText	50

Table Name: tlkpCoverAA

Description: Look-up of cover classes assigned to species and strata in AA vegetation tables.

Field Name	Field Description	Field Type	Field Width
CoverClass	Cover class code for AA points: T<1%, P=1-5%, 1a=6-10%, 1b=11-15%, 02=16-25%, 03=26-35%, 04=36-45%, 05=46-55%, 06=56-65%, 07=66-75%, 08=76-85%, 09=86-95%	dbText	50

Table Name: tlkpCowardin

Description: Look-up table 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: tlkpElevSource

Description: Lookup table 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: 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 vegetation tables.

Field Name	Field Description	Field Type	Field Width
HeightClass	Height class code	dbText	2
HeightClassDef	Height class definition: 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	50

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: Lookup of landforms in Veg Mapping Manual (from <http://soils.usda.gov/technical/handbook/contents/part629glossary1.html>)

Field Name	Field Description	Field Type	Field Width
Landform	Landforms from appendix 1 of field manual	dbText	50

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: tlkpParks

Description: Look-up table of parks in the Northern Colorado Plateau Network

Field Name	Field Description	Field Type	Field Width
ParkCode	Four-letter abbreviation for park code	dbText	4
ParkName	Full name of park where data were collected	dbText	50

Table Name: tlkpPhotoComments

Description: Lookup table of photo comments

Field Name	Field Description	Field Type	Field Width
PhotoComments	Photograph comments	dbText	50

Table Name: tlkpPhotographer

Description: Lookup table of photographer names

Field Name	Field Description	Field Type	Field Width
Photographer	Photographer name	dbText	50

Table Name: tlkpPhotoTypes

Description: Look-up of types of photos taken during data collection.

Field Name	Field Description	Field Type	Field Width
PhotoType	Type of photo taken, associated with plot	dbText	50

Table Name: tlkpPhysiogClass

Description: Look-up of physiognomic types to describe each plot or observation point.

Field Name	Field Description	Field Type	Field Width
Physiognom	Physiognomic class used to describe plot	dbText	50

Table Name: tlkpPJAge

Description: Look-up of Pinyon-Juniper age classes

Field Name	Field Description	Field Type	Field Width
PJAgeClass	Pinyon- Juniper age class, if plot contains either of these two species.	dbText	15

Table Name: tlkpPlotShapes

Description: Look-up of shapes of plots.

Field Name	Field Description	Field Type	Field Width
PlotShape	shapes of plots	dbText	15

Table Name: tlkpSoilDrainage

Description: Look-up of soil drainage classes to describe plot or observation point.

Field Name	Field Description	Field Type	Field Width
SoilDrainage	Soil drainage classes used to describe soil where plot is located	dbText	30

Table Name: tlkpSoilTexture

Description: Look-up of soil textures based on Bowker 2003 field key for CANY, ARCH, and NABR.

Field Name	Field Description	Field Type	Field Width
SoilTexture	Look-up of soil textures based on Bowker 2003 field key for CANY,	dbText	15

Field Name	Field Description	Field Type	Field Width
	ARCH, and NABR.		

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 VegetationDetails (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: tlkpStructureStages

Description: Look-up of vegetation structure stages.

Field Name	Field Description	Field Type	Field Width
StructureStage	Standard fuel model classes for forest and woodland trees indicating their position in the canopy	dbText	12

Table Name: tlkpSurveyors

Description: Look-up of teams for CARE field data collection.

Field Name	Field Description	Field Type	Field Width
SurveyorName	Last names of crew members on each CARE 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 CARE.

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

Table Name: tlkpUTMZone

Description: Look-up for UTM zones of CARE

Field Name	Field Description	Field Type	Field Width
UTMZone	UTM zone where CARE plots were collected	dbText	5

C.2. Geodatabase Documentation

Background

The geodatabase was designed to consolidate all spatial and non-spatial (i.e., tabular) data from the CARE 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.

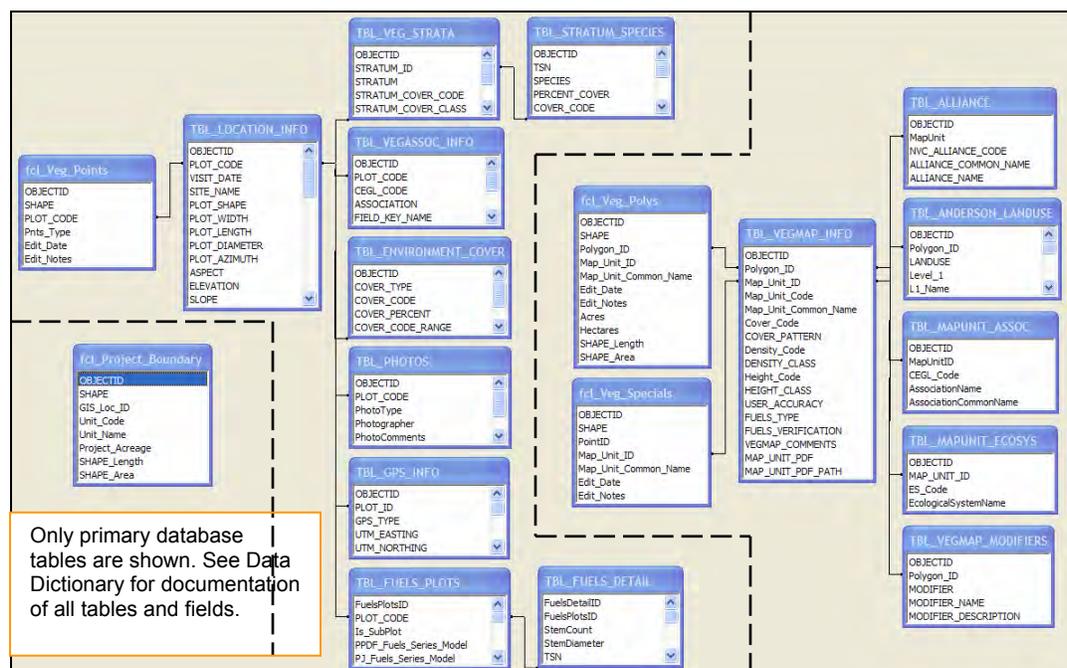


Figure 2. Entity Relationship Diagram for CARE Geodatabase

Data Dictionary

The geodatabase consists of two types of tables: spatial (i.e., feature classes), and non-spatial tables. Tables appear in alphabetical order within these two categories.

Spatial tables

Table Name: fcl_Project_Boundary

Description: The feature class of the boundary of the vegetation mapping project area.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
SHAPE	ESRI generated	dbLongBinary	0
GIS_Loc_ID	unique ID	dbText	128
Unit_Code	Four-letter park code (CARE)	dbText	10
Unit_Name	Full name of national park (Capitol Reef National Park)	dbText	255
Project_Acreage	Acreage of project area	dbLong	4
SHAPE_Length	ESRI generated	dbDouble	8

Field Name	Field Description	Field Type	Field Width
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

Table Name: fcl_Veg_Specials

Description: The feature class containing point data for vegetation types of special interest to the park too small to delineate with a polygon.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
SHAPE	ESRI generated	dbLongBinary	0
PointID	Unique Plot code, used for relating tables (TBL_VEGMAP_INFO)	dbText	15
Map_Unit_ID	The map unit identifier, used by the mappers (aka: grid_code or map class code)	dbText	15
Map_Unit_Common_Name	The name of the map unit (or map class)	dbText	250
Edit_Date	Date of any edits to the point or its attributes	dbText	20
Edit_Notes	Notes regarding any edits to the point or its attributes	dbText	150

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 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

Field Name	Field Description	Field Type	Field Width
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_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_DETAIL

Description: Details on stems, height, crown width, and other attributes of trees within plot for the veg points feature class.

Field Name	Field Description	Field Type	Field Width
FuelsDetailID	Unique identifier for record	dbLong	4
FuelsPlotsID	Foreign key to TBL_FUELS_PLOTS	dbLong	4
StemCount	Number of stems measured. Value will be 1 if forest species; >=1 if woodland species.	dbInteger	2
StemDiameter	Diameter in cm of stem(s). If stem count =1 for a forest species, diameter represents dbh. If stem count is >1 for a woodland species, diameter represents the average diameter of all stems measured at crown base.	dbDouble	8
TSN	Taxonomic Serial Number - unique taxon identifier assigned by ITIS	dbDouble	8
Species	Species name	dbText	250
WoodlandCrownWidth	In PJ woodlands, the width of the tree crown at its widest point, in meters to the nearest half-meter	dbDouble	8
WoodlandCrownHeight	In PJ woodlands, distance from the ground to the top of the living tree crown, in meters to the nearest half-meter	dbDouble	8
ForestCrownBaseHeight	In Douglas-fir, ponderosa pine, or other tall tree woodlands, the distance from the ground to the base of the living tree crown, exclusive of dead or single branches, in meters to the nearest half-meter	dbDouble	8
ForestCrownHeight	Same as for woodlands, but for real trees	dbDouble	8
CrownRatio	The ratio of crown height to total tree height.	dbText	12
StructureStage	Describes the place of the tree in the canopy - emergent above the canopy, main canopy, sub canopy, sapling, seedling	dbText	12
Comments	General comments regarding the fuels at a specific plot.	dbText	255
PLOT_CODE	Unique Plot code, used for relating tables (TBL_LOCATION_INFO)	dbText	20

Table Name: TBL_FUELS_PLOTS

Description: Details on stems, height, crown width, and other attributes of trees within plot for the veg points feature class.

Field Name	Field Description	Field Type	Field Width
FuelsPlotsID	Unique identifier for record	dbLong	4
PLOT_CODE	Unique Plot code, used for relating tables (TBL_LOCATION_INFO)	dbText	20
Is_SubPlot	Indicate if measurements are for subplot (if plot has >25 trees, one quadrant (subplot) of plot can be measured for fuels)	dbText	4
PPDF_Fuels_Series_Model	PPDF Fuels series ID	dbText	6
PJ_Fuels_Series_Model	Pinyon/Juniper Fuels series ID	dbText	6
SB_Fuels_Series_Model	Sagebrush Fuels series ID	dbText	6
PJ_Age_Class	If plot contains pinyon and/or juniper, enter value that best describes the age class of the stand	dbText	50
LitterOrigin	Litter measured in cm at origin of plot	dbText	3
LitterNorth	Litter measured in cm at 10 m north of plot center	dbText	3
LitterSouth	Litter measured in cm at 10 m south of plot center	dbText	3
LitterEast	Litter measured in cm at 10 m east of plot center	dbText	3
LitterWest	Litter measured in cm at 10 m west of plot center	dbText	3
DuffOrigin	Duff measured in cm at origin of plot	dbText	3
DuffNorth	Duff measured in cm at 10 m north of plot center	dbText	3
DuffSouth	Duff measured in cm at 10 m south of plot center	dbText	3
DuffEast	Duff measured in cm at 10 m east of plot center	dbText	3
DuffWest	Duff measured in cm at 10 m west of plot center	dbText	3

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.

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

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	Plot elevation 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)	dbBoolean	1
UNIT_CODE	4 letter park code (CARE)	dbText	10
AERIAL_PHOTO_NO	9X9 photo name on which the point most directly falls (2001 flight, plots & obs only)	dbText	30
STATE_CODE State	(Utah)	dbText	2
USGS_NAME	USGS 1:24k Topo Name	dbText	75
COUNTY_NAME	County where plot is located (Emery, Garfield, Sevier, Wayne)	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	Temporary community name assigned by field crews by following naming protocols in field manual (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 / obs is in a wetland system, select term that best describes its hydrology (Upland, Palustrine, Riverine, Lacustrine).	dbText	40
HYDROLOGY	Describes hydrology of plot (plot and obs only)	dbText	40
GEOLOGY	Geologic substrate influencing the plant community (plot and obs only); Surficial geology (AA points)	dbText	60
ENV_COMMENTS	Comments on environmental setting and its	dbText	255

Field Name	Field Description	Field Type	Field Width
	effect on the vegetation; also comments on any disturbance or reproduction factors		
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 (TBL_LOCATION_INFO)	dbText	50
PhotoType	Type of photo being referenced.	dbText	16

Field Name	Field Description	Field Type	Field Width
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 AA points in the veg points feature class.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
PLOT_CODE	Unique Plot code, used for relating tables	dbText	35
CEGL_CODE	CEGL (association) code	dbText	10
ASSOCIATION	Association corresponding to provisional community name	dbText	180
FIELD_KEY_NAME	Yes if association name was chosen from field key	dbText	10
CREATED_NAME	Yes if no name really fits from the field key, the	dbText	10

Field Name	Field Description	Field Type	Field Width
	surveyor will create a new name.		
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 50meter 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_pjme)	dbText	10
Map_Unit_Common_Name	The name of the map unit (or map class)	dbText	250
Cover_Code	Cover pattern value class code	dbText	1
COVER_PATTERN	Characterizes the pattern of vegetation on the landscape (Clumped, Linear, Gradational/Transitional, Regularly alternating, Homogenous (default)) by polygon.	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	Height class value code	dbText	1
HEIGHT_CLASS	Vegetation height classes assigned to each polygon of forest/woodland and/or shrubland types	dbText	100
USER_ACCURACY	User accuracy of the map unit (determined during AA meetings). N/A = 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	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 :/CARE/Vegetation/MapClass Descriptions/w_pjme_mu16.pdf)	dbText	250

Table Name: TBL_VEGMAP_MODIFIERS

Description: Contains modifiers for the vegetation map unit polygons.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
Polygon_ID	Unique polygon code, used for relating tables (TBL_VEGMAP_INFO)	dbText	20
MODIFIER	Modifier code (one lower case letter)	dbText	12
MODIFIER_NAME	Name/type of modifier	dbText	50
MODIFIER_DESCRIPTION	Description of modifier	dbText	255

Appendix D

Plant Species List and Crosswalk

More than 600 vascular plant species representing 73 families were noted during plot, observation point and accuracy assessment point data collection at Capitol Reef National Park (CARE). 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 Whittmann 2001 for Colorado parks, and Dorn and Lichvar 1984 for the single park in Wyoming; the CARE 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 CARE 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.

VASCULAR PLANTS

Family	Scientific Name (Welsh et al. 2003)	Scientific Name (Kartesz 1999)	Common Name (NatureServe)	TSN
Aceraceae	<i>Acer glabrum</i> Torr.	<i>Acer glabrum</i>	Rocky Mountain Maple	28742
	<i>Acer negundo</i> L.	<i>Acer negundo</i>	Box-elder	28749
Agavaceae	<i>Yucca angustissima</i> Engelm. ex Trel.	<i>Yucca angustissima</i>	Fineleaf Yucca	43131
	<i>Yucca harrimaniae</i> Trel.	<i>Yucca harrimaniae</i>	Spanish Bayonet	43144
Anacardiaceae	<i>Rhus aromatica</i> Ait.	<i>Rhus aromatica</i>	Fragrant Sumac	28779
	<i>Rhus aromatica</i> var. <i>simplicifolia</i> (Greene) Cronq.	<i>Rhus trilobata</i> var. <i>simplicifolia</i>	Singleleaf Sumac	539585
	<i>Rhus aromatica</i> var. <i>trilobata</i> (Nutt.) Gray ex. S. Wats.	<i>Rhus trilobata</i> var. <i>trilobata</i>	Skunkbush	539586
	<i>Toxicodendron rydbergii</i> (Small ex Rydb.) Greene	<i>Toxicodendron rydbergii</i>	Western Poison-ivy	28822
Apiaceae	<i>Cymopterus acaulis</i> var. <i>fendleri</i> (Gray) Goodrich	<i>Cymopterus acaulis</i> var. <i>fendleri</i>	Plains Spring-parsley	527614
	<i>Cymopterus beckii</i> Welsh & Goodrich	<i>Cymopterus beckii</i>	Feather-leaf Spring-parsley	501875
	<i>Cymopterus lemmonii</i> (Coult. & Rose) Dorn	<i>Pseudocymopterus montanus</i>	Alpine False Mountain-parsley	511931
	<i>Cymopterus purpurascens</i> (Gray) M.E. Jones	<i>Cymopterus purpurascens</i>	Wide-wing Spring-parsley	29653
	<i>Cymopterus purpureus</i> S. Wats.	<i>Cymopterus purpureus</i>	Purple Spring-parsley	29654
	<i>Cymopterus</i> Raf.	<i>Cymopterus</i>	Spring-parsley	29625
	<i>Lomatium parryi</i> (S. Wats.) J.F. Macbr.	<i>Lomatium parryi</i>	Utah Desert-parsley	29735
	Apocynaceae	<i>Amsonia tomentosa</i> Torr. & Frém.	<i>Amsonia tomentosa</i>	Woolly Bluestar
<i>Apocynum cannabinum</i> L.		<i>Apocynum cannabinum</i>	Indian-hemp	30157
Asclepiadaceae	<i>Asclepias asperula</i> (Dcne.) Woods.	<i>Asclepias asperula</i>	Spider Milkweed	30247
	<i>Asclepias cryptoceras</i> S. Wats.	<i>Asclepias cryptoceras</i>	Humboldt Milkweed	30257
	<i>Asclepias labriformis</i> M.E. Jones	<i>Asclepias labriformis</i>	Utah Milkweed	30276
	<i>Asclepias macrosperma</i> Eastw.	<i>Asclepias involucrata</i>	Dwarf Milkweed	30283
	<i>Asclepias ruthiae</i> Maguire	<i>Asclepias uncialis</i> ssp. <i>ruthiae</i>	Ruth's Milkweed	30301
	<i>Asclepias speciosa</i> Torr.	<i>Asclepias speciosa</i>	Showy Milkweed	30304
	Asteraceae	<i>Achillea millefolium</i> L.	<i>Achillea millefolium</i>	Common Yarrow
<i>Agoseris glauca</i> var. <i>laciniata</i> (D.C. Eat.) Smiley		<i>Agoseris glauca</i> var. <i>laciniata</i>	Pale Goat-chicory	182410
<i>Ambrosia acanthicarpa</i> Hook.		<i>Ambrosia acanthicarpa</i>	Flat-spine Ragweed	36497
<i>Antennaria microphylla</i> Rydb.		<i>Antennaria microphylla</i>	Small-leaf Pussytoes	185162
<i>Antennaria parvifolia</i> Nutt.		<i>Antennaria parvifolia</i>	Littleleaf Pussytoes	36749
<i>Artemisia bigelovii</i> Gray		<i>Artemisia bigelovii</i>	Bigelow Sagebrush	35452
<i>Artemisia campestris</i> L.		<i>Artemisia campestris</i>	Pacific Wormwood	183748
<i>Artemisia dracunculus</i> L.		<i>Artemisia dracunculus</i>	Dragon Wormwood	35462

Family	Scientific Name (Welsh et al. 2003)	Scientific Name (Kartesz 1999)	Common Name (NatureServe)	TSN
	<i>Artemisia filifolia</i> Torr.	<i>Artemisia filifolia</i>	Sand Sagebrush	35463
	<i>Artemisia frigida</i> Willd.	<i>Artemisia frigida</i>	Fringed Sagebrush	35465
	<i>Artemisia ludoviciana</i> Nutt.	<i>Artemisia ludoviciana</i>	White Sagebrush	35474
	<i>Artemisia nova</i> A. Nels.	<i>Artemisia nova</i>	Black Sagebrush	500971
	<i>Artemisia pygmaea</i> Gray	<i>Artemisia pygmaea</i>	Pygmy Sagebrush	35490
	<i>Artemisia spinescens</i> D.C. Eat.	<i>Picrothamnus desertorum</i>	Bud Sagebrush	35496
	<i>Artemisia tridentata</i> Nutt.	<i>Artemisia tridentata</i>	Big Sagebrush	35498
	<i>Artemisia tridentata</i> ssp. <i>tridentata</i> Nutt.	<i>Artemisia tridentata</i> ssp. <i>tridentata</i>	Basin Big Sagebrush	35499
	<i>Artemisia tridentata</i> ssp. <i>vaseyana</i> (Rydb.) Beetle	<i>Artemisia tridentata</i> ssp. <i>vaseyana</i>	Mountain Big Sagebrush	183740
	<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> Beetle & Young	<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i>	Wyoming Big Sagebrush	183741
	<i>Aster ascendens</i> Lindl.	<i>Symphotrichum ascendens</i>	Western American-aster	193303
	<i>Aster frondosus</i> (Nutt.) Torr. & Gray	<i>Symphotrichum frondosum</i>	Leafy American-aster	35574
	<i>Aster glaucodes</i> Blake	<i>Eurybia glauca</i>	Gray Wood-aster	35578
	<i>Baccharis salicina</i> Torr. & Gray	<i>Baccharis salicina</i>	Great Plains False Willow	35698
	<i>Balsamorhiza sagittata</i> (Pursh) Nutt.	<i>Balsamorhiza sagittata</i>	Arrowleaf Balsamroot	36818
	<i>Brickellia californica</i> (Torr. & Gray) Gray	<i>Brickellia californica</i>	California Brickelbush	36866
	<i>Brickellia longifolia</i> S. Wats.	<i>Brickellia longifolia</i>	Longleaf Brickelbush	36885
	<i>Brickellia microphylla</i> (Nutt.) Gray	<i>Brickellia microphylla</i>	Littleleaf Brickelbush	36886
	<i>Brickellia oblongifolia</i> Nutt.	<i>Brickellia oblongifolia</i>	Narrowleaf Brickelbush	36891
	<i>Chaenactis douglasii</i> (Hook.) Hook. & Arn.	<i>Chaenactis douglasii</i>	Dusty Maiden	36987
	<i>Chaenactis stevioides</i> Hook. & Arn.	<i>Chaenactis stevioides</i>	Broad-flower Pincushion	36998
	<i>Chaetopappa ericoides</i> (Torr.) Nesom	<i>Chaetopappa ericoides</i>	Rose-heath	501376
	<i>Chamaechaenactis scaposa</i> (Eastw.) Rydb.	<i>Chamaechaenactis scaposa</i>	Fullstem	37018
	<i>Chrysopsis villosa</i> (Pursh) Nutt. ex DC.	<i>Heterotheca villosa</i>	Hairy Goldenaster	510984
	<i>Chrysothamnus depressus</i> Nutt.	<i>Chrysothamnus depressus</i>	Long-flower Rabbitbrush	37051
	<i>Chrysothamnus linifolius</i> Greene	<i>Chrysothamnus linifolius</i>	Spearleaf Rabbitbrush	37054
	<i>Chrysothamnus nauseosus</i> (Pallas ex Pursh) Britt.	<i>Ericameria nauseosa</i> var. <i>nauseosa</i>	Rubber Rabbitbrush	37055
	<i>Chrysothamnus nauseosus</i> var. <i>bigelovii</i> (Gray) Hall	<i>Ericameria nauseosa</i> var. <i>bigelovii</i>	Bigelow's Rubber Rabbitbrush	533549
	<i>Chrysothamnus nauseosus</i> var. <i>consimilis</i> (Greene) Hall	<i>Ericameria nauseosa</i> var. <i>oreophila</i>	Rubber Rabbitbrush	533550
	<i>Chrysothamnus nauseosus</i> var. <i>junceus</i> (Greene) Hall	<i>Ericameria nauseosa</i> var. <i>junceus</i>	Rubber Rabbitbrush	533557
	<i>Chrysothamnus viscidiflorus</i> (Hook.) Nutt.	<i>Chrysothamnus viscidiflorus</i>	Green Rabbitbrush	37090
	<i>Chrysothamnus viscidiflorus</i> ssp. <i>viscidiflorus</i> var. <i>stenophyllus</i> (Gray) Hall	<i>Chrysothamnus viscidiflorus</i> var. <i>stenophyllus</i>	Green Rabbitbrush	531602

Family	Scientific Name (Welsh et al. 2003)	Scientific Name (Kartesz 1999)	Common Name (NatureServe)	TSN
	<i>Chrysothamnus viscidiflorus</i> var. <i>lanceolatus</i> (Nutt.) Greene	<i>Chrysothamnus viscidiflorus</i> ssp. <i>lanceolatus</i>	Green Rabbitbrush	533581
	<i>Cirsium calcareum</i> var. <i>bipinnatum</i> (Eastw.) Welsh	<i>Cirsium calcareum</i>	Cainville Thistle	533607
	<i>Cirsium scariosum</i> Nutt.	<i>Cirsium scariosum</i>	Meadow Thistle	36413
	<i>Cirsium undulatum</i> (Nutt.) Spreng.	<i>Cirsium undulatum</i>	Wavyleaf Thistle	36423
	<i>Cirsium vulgare</i> (Savi) Ten.	<i>Cirsium vulgare</i>	Bull Thistle	36428
	<i>Conyza canadensis</i> (L.) Cronq.	<i>Conyza canadensis</i>	Canada Horseweed	37113
	<i>Dicoria canescens</i> Gray	<i>Dicoria canescens</i>	Desert Twinbugs	37234
	<i>Dyssodia pentachaeta</i> (DC.) B.L. Robins.	<i>Thymophylla pentachaeta</i>	Five-needle Pricklyleaf	37264
	<i>Enceliopsis nudicaulis</i> (Gray) A. Nels.	<i>Enceliopsis nudicaulis</i>	Naked-stem Sunray	37314
	<i>Erigeron annuus</i> (L.) Pers.	<i>Erigeron annuus</i>	Eastern Daisy Fleabane	35804
	<i>Erigeron aphanactis</i> (Gray) Greene	<i>Erigeron aphanactis</i>	Rayless Shaggy Fleabane	35817
	<i>Erigeron caespitosus</i> Nutt.	<i>Erigeron caespitosus</i>	Tufted Fleabane	35833
	<i>Erigeron compactus</i> Blake	<i>Erigeron compactus</i>	Fernleaf Fleabane	35842
	<i>Erigeron divergens</i> Torr. & Gray	<i>Erigeron divergens</i>	Spreading Fleabane	35852
	<i>Erigeron eatonii</i> Gray	<i>Erigeron eatonii</i>	Eaton's Fleabane	35853
	<i>Erigeron flagellaris</i> Gray	<i>Erigeron flagellaris</i>	Trailing Fleabane	35865
	<i>Erigeron maguirei</i> Cronq.	<i>Erigeron maguirei</i>	Maguire's Fleabane	35898
	<i>Erigeron pulcherrimus</i> Heller	<i>Erigeron pulcherrimus</i>	Basin Fleabane	35933
	<i>Erigeron pumilus</i> ssp. <i>concinoides</i> Cronq.	<i>Erigeron concinnus</i> var. <i>concinus</i>	Navajo Fleabane	35936
	<i>Erigeron speciosus</i> var. <i>macranthus</i> (Nutt.) Cronq.	<i>Erigeron speciosus</i> var. <i>macranthus</i>	Aspen Fleabane	527963
	<i>Erigeron utahensis</i> Gray	<i>Erigeron utahensis</i>	Utah Fleabane	35967
	<i>Euthamia occidentalis</i> Nutt.	<i>Euthamia occidentalis</i>	Western Goldentop	37356
	<i>Gaillardia pinnatifida</i> Torr.	<i>Gaillardia pinnatifida</i>	Red-dome Blanket-flower	37409
	<i>Gaillardia spathulata</i> Gray	<i>Gaillardia spathulata</i>	Western Blanket-flower	502699
	<i>Gutierrezia microcephala</i> (DC.) Gray	<i>Gutierrezia microcephala</i>	Small-head Snakeweed	37482
	<i>Gutierrezia sarothrae</i> (Pursh) Britt. & Rusby	<i>Gutierrezia sarothrae</i>	Snakeweed	37483
	<i>Haplopappus acaulis</i> (Nutt.) Gray	<i>Stenotus acaulis</i>	Stemless Mock Goldenweed	37499
	<i>Haplopappus armerioides</i> (Nutt.) Gray	<i>Stenotus armerioides</i>	Skyline Goldenweed	37506
	<i>Helianthella microcephala</i> (Gray) Gray	<i>Helianthella microcephala</i>	Small-head Rockrose	37595
	<i>Helianthus petiolaris</i> Nutt.	<i>Helianthus petiolaris</i>	Prairie Sunflower	36671
	<i>Hymenopappus filifolius</i> Hook.	<i>Hymenopappus filifolius</i>	Fineleaf Woollywhite	37766
	<i>Hymenoxys acaulis</i> (Pursh) Parker	<i>Tetraneuris acaulis</i> var. <i>acaulis</i>	Arizona Bitterweed	514991

Family	Scientific Name (Welsh et al. 2003)	Scientific Name (Kartesz 1999)	Common Name (NatureServe)	TSN
	<i>Hymenoxys acaulis</i> var. <i>ivesiana</i> (Greene) Parker	<i>Tetraneuris ivesiana</i>	Ives' Four-nerve-daisy	536278
	<i>Hymenoxys acaulis</i> var. <i>nana</i> Welsh	<i>Tetraneuris acaulis</i> var. <i>nana</i>	Stemless Four-nerve-daisy	536280
	<i>Hymenoxys richardsonii</i> (Hook.) Cockerell	<i>Hymenoxys richardsonii</i>	Colorado Rubberweed	37785
	<i>Lactuca serriola</i> L.	<i>Lactuca serriola</i>	Prickly Lettuce	36608
	<i>Lygodesmia grandiflora</i> (Nutt.) Torr. & Gray	<i>Lygodesmia grandiflora</i>	Rush-pink	503622
	<i>Lygodesmia grandiflora</i> var. <i>dianthopsis</i> (Eat. ex King) Welsh	<i>Lygodesmia dianthopsis</i>	Antelope Island Skeleton-plant	537311
	<i>Lygodesmia spinosa</i> Nutt.	<i>Stephanomeria spinosa</i>	Thorny Wire-lettuce	516525
	<i>Machaeranthera canescens</i> (Pursh) Gray	<i>Machaeranthera canescens</i>	Hoary Tansy-aster	37984
	<i>Machaeranthera grindelioides</i> (Nutt.) Shinnery	<i>Machaeranthera grindelioides</i>	Rayless Tansy-aster	37992
	<i>Machaeranthera tanacetifolia</i> (Kunth) Nees	<i>Machaeranthera tanacetifolia</i>	Takhoka-daisy	38013
	<i>Malacothrix glabrata</i> (Gray ex D.C. Eat.) Gray	<i>Malacothrix glabrata</i>	Smooth Desert-dandelion	38050
	<i>Malacothrix sonchoides</i> (Nutt.) Torr. & Gray	<i>Malacothrix sonchoides</i>	Yellow-saucers	38055
	<i>Oxytenia acerosa</i> Nutt.	<i>Iva acerosa</i>	Copperweed	518080
	<i>Parthenium ligulatum</i> (M.E. Jones) Barneby	<i>Parthenium ligulatum</i>	Colorado Feverfew	38167
	<i>Petradoria pumila</i> (Nutt.) Greene	<i>Petradoria pumila</i>	Grassy Rock-goldenrod	38233
	<i>Platyschkuhria integrifolia</i> (Gray) Rydb.	<i>Platyschkuhria integrifolia</i>	Basin-daisy	38253
	<i>Psilostrophe sparsiflora</i> (Gray) A. Nels.	<i>Psilostrophe sparsiflora</i>	Green-stem Paperflower	38315
	<i>Senecio multilobatus</i> Torr. & Gray ex Gray	<i>Packera multilobata</i>	Lobeleaf Groundsel	36161
	<i>Senecio spartioides</i> Torr. & Gray	<i>Senecio spartioides</i>	Broom-like Ragwort	36184
	<i>Sonchus asper</i> (L.) Hill	<i>Sonchus asper</i>	Spiny-leaf Sowthistle	38424
	<i>Stephanomeria exigua</i> Nutt.	<i>Stephanomeria exigua</i>	White-plume Wire-lettuce	38445
	<i>Stephanomeria runcinata</i> Nutt.	<i>Stephanomeria runcinata</i>	Flowering-straw	38452
	<i>Stephanomeria tenuifolia</i> (Raf.) Hall	<i>Stephanomeria minor</i> var. <i>minor</i>	Narrowleaf Skeletonplant	38455
	<i>Taraxacum officinale</i> G.H. Weber ex Wiggers	<i>Taraxacum officinale</i>	Common Dandelion	36213
	<i>Tetradymia canescens</i> DC.	<i>Tetradymia canescens</i>	Gray Horsebrush	38494
	<i>Tetradymia glabrata</i> Torr. & Gray	<i>Tetradymia glabrata</i>	Littleleaf Horsebrush	38497
	<i>Tetradymia nuttallii</i> Torr. & Gray	<i>Tetradymia nuttallii</i>	Nuttall's Horsebrush	38498
	<i>Tetradymia spinosa</i> Hook. & Arn.	<i>Tetradymia spinosa</i>	Short-spine Horsebrush	38499
	<i>Thelesperma subnudum</i> Gray	<i>Thelesperma subnudum</i>	Navajo-tea	38528
	<i>Thelesperma subnudum</i> var. <i>alpinum</i> Welsh	<i>Thelesperma pubescens</i>	Hairy Greenthread	541242
	<i>Townsendia annua</i> Beaman	<i>Townsendia annua</i>	Annual Townsend-daisy	38538
	<i>Townsendia aprica</i> Welsh & Reveal	<i>Townsendia aprica</i>	Last Chance Townsend-daisy	38539

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

Family	Scientific Name (Welsh et al. 2003)	Scientific Name (Kartesz 1999)	Common Name (NatureServe)	TSN
	<i>Townsendia incana</i> Nutt.	<i>Townsendia incana</i>	Hoary Townsend-daisy	38549
	<i>Tragopogon dubius</i> Scop.	<i>Tragopogon dubius</i>	Meadow Goat's-beard	38564
	<i>Vancleavea stylosa</i> (Eastw.) Greene	<i>Vancleavea stylosa</i>	Pillar False Gumweed	38587
	<i>Viguiera multiflora</i> (Nutt.) Blake	<i>Heliomeris multiflora</i>	Nevada Showy False Goldeneye	523280
	<i>Wyethia scabra</i> Hook.	<i>Wyethia scabra</i>	Badland Mule's-ears	38687
	<i>Xanthium strumarium</i> L.	<i>Xanthium strumarium</i>	Rough Cocklebur	38692
	<i>Xylorhiza glabriuscula</i> Nutt.	<i>Xylorhiza glabriuscula</i>	Smooth Woody-aster	38698
	<i>Xylorhiza tortifolia</i> (Torr. & Gray) Greene	<i>Xylorhiza tortifolia</i>	Mojave Woody-aster	38700
	<i>Xylorhiza venusta</i> (M.E. Jones) Heller	<i>Xylorhiza venusta</i>	Charming Woody-aster	38701
Berberidaceae	<i>Mahonia fremontii</i> (Torr.) Fedde	<i>Mahonia fremontii</i>	Desert Oregon-grape	195033
	<i>Mahonia repens</i> (Lindl.) G. Don	<i>Mahonia repens</i>	Creeping Oregon-grape	195045
Betulaceae	<i>Alnus incana</i> (L.) Moench	<i>Alnus incana</i>	Speckled Alder	19471
	<i>Betula occidentalis</i> Hook.	<i>Betula occidentalis</i>	Water Birch	19488
	<i>Ostrya knowltonii</i> Coville	<i>Ostrya knowltonii</i>	Knowlton's Hop-hornbeam	19510
Boraginaceae	<i>Cryptantha abata</i> I.M. Johnston	<i>Cryptantha abata</i>	Dent-nut Cat's-eye	31781
	<i>Cryptantha capitata</i> (Eastw.) I.M. Johnston	<i>Cryptantha capitata</i>	Capitate Cat's-eye	31791
	<i>Cryptantha cinerea</i> (Greene) Cronq.	<i>Cryptantha cinerea</i>	James' Cat's-eye	501822
	<i>Cryptantha cinerea</i> var. <i>pustulosa</i> (Rydb.) Higgins	<i>Cryptantha cinerea</i> var. <i>pustulosa</i>	James' Cat's-eye	527552
	<i>Cryptantha confertiflora</i> (Greene) Payson	<i>Cryptantha confertiflora</i>	Basin Yellow Cat's-eye	31796
	<i>Cryptantha crassisejala</i> (Torr. & Gray) Greene	<i>Cryptantha crassisejala</i>	Thick-sepal Cat's-eye	31800
	<i>Cryptantha flava</i> (A. Nels.) Payson	<i>Cryptantha flava</i>	Plateau Yellow Cat's-eye	31770
	<i>Cryptantha flavoculata</i> (A. Nels.) Payson	<i>Cryptantha flavoculata</i>	Rough-seed Cat's-eye	31809
	<i>Cryptantha fulvocanescens</i> (S. Wats.) Payson	<i>Cryptantha fulvocanescens</i>	Tawny Cat's-eye	31811
	<i>Cryptantha gracilis</i> Osterhout	<i>Cryptantha gracilis</i>	Narrow-stem Cat's-eye	31813
	<i>Cryptantha pterocarya</i> (Torr.) Greene	<i>Cryptantha pterocarya</i>	Wingnut Cat's-eye	31856
	<i>Cryptantha recurvata</i> Coville	<i>Cryptantha recurvata</i>	Curved-nut Cat's-eye	31860
	<i>Cryptantha setosissima</i> (Gray) Payson	<i>Cryptantha setosissima</i>	Bristly Cat's-eye	31870
	<i>Lappula occidentalis</i> (S. Wats.) Greene	<i>Lappula occidentalis</i>	Flat-spine Sheepburr	503329
	<i>Lithospermum multiflorum</i> Torr. ex Gray	<i>Lithospermum multiflorum</i>	Purple Gromwell	31951
	<i>Tiquilia latior</i> (I.M. Johnston) A. Richards.	<i>Tiquilia latior</i>	Matted Crinklemat	505519
Brassicaceae	<i>Alyssum minus</i> (L.) Rothm.	<i>Alyssum minus</i>	European Madwort	508080
	<i>Arabis drummondii</i> Gray	<i>Arabis drummondii</i>	Drummond's Rockcress	22689

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	<i>Arabis holboellii</i> Hornem.	<i>Arabis holboellii</i>	Holboell's Rockcress	22702
	<i>Arabis perennans</i> S. Wats.	<i>Arabis perennans</i>	Perennial Rockcress	22720
	<i>Arabis pulchra</i> var. <i>pallens</i> M.E. Jones	<i>Arabis pulchra</i> var. <i>pallens</i>	Beautiful Rockcress	184430
	<i>Arabis selbyi</i> Rydb.	<i>Arabis selbyi</i>	Selby's Rockcress	22731
	<i>Chorispورا tenella</i> (Pallas) DC.	<i>Chorispورا tenella</i>	Crossflower 230	99
	<i>Descurainia californica</i> (Gray) O.E. Schulz	<i>Descurainia californica</i>	Sierran Tansy-mustard	22821
	<i>Descurainia pinnata</i> (Walt.) Britt.	<i>Descurainia pinnata</i>	Western Tansy-mustard	22826
	<i>Draba cuneifolia</i> var. <i>cuneifolia</i> Nutt. ex Torr. & Gray	<i>Draba cuneifolia</i> var. <i>cuneifolia</i>	Wedgeleaf Whitlow-grass	527759
	<i>Draba reptans</i> (Lam.) Fern.	<i>Draba reptans</i>	Carolina Whitlow-grass	22908
	<i>Erysimum asperum</i> (Nutt.) DC.	<i>Erysimum capitatum</i> var. <i>capitatum</i>	Western Wallflower	22931
	<i>Lepidium densiflorum</i> Schrad.	<i>Lepidium densiflorum</i>	Miner's Pepperwort	22960
	<i>Lepidium montanum</i> Nutt.	<i>Lepidium montanum</i>	Mountain Pepperwort	503381
	<i>Lepidium montanum</i> var. <i>jonesii</i> (Rydb.) C.L. Hitchc.	<i>Lepidium montanum</i> var. <i>jonesii</i>	Jones' Pepperwort	528731
	<i>Lesquerella</i> S. Wats.	<i>Lesquerella</i>	Bladderpod	23162
	<i>Malcolmia africana</i> (L.) Ait. f.	<i>Malcolmia africana</i>	African Adder's-mouth	23243
	<i>Nasturtium officinale</i> Ait. f.	<i>Rorippa nasturtium-aquaticum</i>	Watercress	23255
	<i>Physaria acutifolia</i> Rydb.	<i>Physaria acutifolia</i>	Sharpleaf Twinpod	23270
	<i>Physaria intermedia</i> (Maguire) O'Kane & Al-Shehbaz	<i>Lesquerella intermedia</i>	Santa Fe Bladderpod	-13
	<i>Physaria ludoviciana</i> Welsh et al.	<i>Lesquerella ludoviciana</i>	Louisiana Bladderpod	-9
	<i>Physaria rectipes</i> (Woot. & Stan.) O'Kane & Al-Shehbaz	<i>Lesquerella rectipes</i>	Straight Bladderpod	-14
	<i>Schoenocrambe barnebyi</i> (Welsh & Atwood) Rollins	<i>Schoenocrambe barnebyi</i>	Syes Butte Plains-mustard	195790
	<i>Schoenocrambe linifolia</i> (Nutt.) Greene	<i>Schoenocrambe linifolia</i>	Salmon River Plains-mustard	23296
	<i>Sisymbrium altissimum</i> L.	<i>Sisymbrium altissimum</i>	Tall Hedge-mustard	23312
	<i>Stanleya pinnata</i> (Pursh) Britt.	<i>Stanleya pinnata</i>	Golden Prince's-plume	23329
	<i>Stanleya viridiflora</i> Nutt.	<i>Stanleya viridiflora</i>	Green Prince's-plume	23331
	<i>Streptanthella longirostris</i> (S. Wats.) Rydb.	<i>Streptanthella longirostris</i>	Long-beak Fiddle-mustard	23333
	<i>Streptanthella</i> Rydb.	<i>Streptanthella</i>	Fiddle-mustard	23332
	<i>Streptanthus cordatus</i> Nutt.	<i>Streptanthus cordatus</i>	Heartleaf Jewelflower	23348
	<i>Thelypodium</i> Endl.	<i>Thelypodium</i>	Thelypody	23392
Cactaceae	<i>Coryphantha vivipara</i> (Nutt.) Britt. & Rose	<i>Escobaria vivipara</i>	Spinystar	19840
	<i>Echinocereus</i> Engelm.	<i>Echinocereus</i>	Hedgehog Cactus	19803
	<i>Echinocereus triglochidiatus</i> Engelm.	<i>Echinocereus triglochidiatus</i>	King-cup Cactus	19815
	<i>Echinocereus triglochidiatus</i> var. <i>melanacanthus</i> (Engelm.)	<i>Echinocereus coccineus</i> var. <i>coccineus</i>	Scarlet Hedgehog Cactus	534750

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

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	L. Benson			
	<i>Coryphantha vivipara</i> var. <i>vivipara</i>	<i>Escobaria vivipara</i> var. <i>vivipara</i>	Spinystar	-23
	<i>Opuntia erinacea</i> Engelm. & Bigelow ex Engelm.	<i>Opuntia erinacea</i>	Oldman Cactus	19705
	<i>Opuntia fragilis</i> (Nutt.) Haw.	<i>Opuntia fragilis</i>	Brittle Prickly-pear	19707
	<i>Opuntia phaeacantha</i> Engelm.	<i>Opuntia phaeacantha</i>	Tulip Prickly-pear	19724
	<i>Opuntia polyacantha</i> Haw.	<i>Opuntia polyacantha</i>	Panhandle Prickly-pear	19726
	<i>Pediocactus simpsonii</i> (Engelm.) Britt. & Rose	<i>Pediocactus simpsonii</i>	Snowball Cactus	19776
	<i>Pediocactus winkleri</i> Heil	<i>Pediocactus winkleri</i>	Winkler's Pincushion Cactus	19777
	<i>Sclerocactus parviflorus</i> Clover & Jotter	<i>Sclerocactus parviflorus</i>	Small-flower Fishhook Cactus	19761
	<i>Sclerocactus whipplei</i> (Engelm. & Bigelow) Britt. & Rose	<i>Sclerocactus whipplei</i>	Whipple's Fishhook Cactus	19765
	<i>Sclerocactus whipplei</i> var. <i>roseus</i> (Clover) L. Benson	<i>Sclerocactus parviflorus</i> ssp. <i>parviflorus</i>	Small-flower Fishhook Cactus	540500
	<i>Sclerocactus wrightiae</i> L. Benson	<i>Sclerocactus wrightiae</i>	Wright's Fishhook Cactus	19766
Campanulaceae	<i>Campanula parryi</i> Gray	<i>Campanula parryi</i>	Parry's Bellflower	34489
Capparaceae	<i>Cleome lutea</i> Hook.	<i>Cleome lutea</i>	Yellow Spiderflower	22620
Caprifoliaceae	<i>Sambucus cerulea</i> Raf.	<i>Sambucus nigra</i> ssp. <i>caerulea</i>	Blue Elder	35320
	<i>Symphoricarpos</i> Duham.	<i>Symphoricarpos</i>	Snowberry	35330
	<i>Symphoricarpos longiflorus</i> Gray	<i>Symphoricarpos longiflorus</i>	Desert Snowberry	35334
	<i>Symphoricarpos oreophilus</i> Gray	<i>Symphoricarpos oreophilus</i>	Mountain Snowberry	35338
Caryophyllaceae	<i>Arenaria fendleri</i> Gray	<i>Arenaria fendleri</i>	Fendler's Sandwort	20245
	<i>Arenaria fendleri</i> var. <i>eastwoodiae</i> (Rydb.) Harrington	<i>Arenaria eastwoodiae</i> var. <i>eastwoodiae</i>	Eastwood's Sandwort	532222
	<i>Cerastium</i> L.	<i>Cerastium</i>	Mouse-ear Chickweed	19943
	<i>Lychnis drummondii</i> (Hook.) S. Wats.	<i>Silene drummondii</i>	Drummond's Catchfly	516476
	<i>Paronychia sessiliflora</i> Nutt.	<i>Paronychia sessiliflora</i>	Low Nailwort	20346
	<i>Silene antirrhina</i> L.	<i>Silene antirrhina</i>	Sleepy Catchfly	20045
	<i>Silene</i> L.	<i>Silene</i>	Catchfly	20040
Chenopodiaceae	<i>Allenrolfea occidentalis</i> (S. Wats.) Kuntze	<i>Allenrolfea occidentalis</i>	Iodinebush	20677
	<i>Atriplex argentea</i> Nutt.	<i>Atriplex argentea</i>	Silverscale	20512
	<i>Atriplex canescens</i> (Pursh) Nutt.	<i>Atriplex canescens</i>	Fourwing Saltbush	20518
	<i>Atriplex confertifolia</i> (Torr. & Frém.) S. Wats.	<i>Atriplex confertifolia</i>	Shadscale	20519
	<i>Atriplex corrugata</i> S. Wats.	<i>Atriplex corrugata</i>	Mat Saltbush	20522
	<i>Atriplex gardneri</i> (Moq.) D. Dietr.	<i>Atriplex gardneri</i>	Gardner's Saltbush	20531
	<i>Atriplex gardneri</i> var. <i>cuneata</i> (A. Nels.) Welsh	<i>Atriplex cuneata</i> ssp. <i>cuneata</i>	Valley Saltbush	192237

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

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	<i>Atriplex rosea</i> L.	<i>Atriplex rosea</i>	Tumbling Orache	20563
	<i>Atriplex saccaria</i> S. Wats.	<i>Atriplex saccaria</i>	Sack Saltbush	20564
	<i>Bassia americana</i> Welsh et al.	<i>Kochia americana</i>	Greenmolly	-10
	<i>Chenopodium album</i> L.	<i>Chenopodium album</i>	Lamb's-quarters	20592
	<i>Chenopodium desiccatum</i> A. Nels.	<i>Chenopodium desiccatum</i>	Arid-land Goosefoot	20604
	<i>Chenopodium fremontii</i> S. Wats.	<i>Chenopodium fremontii</i>	Fremont's Goosefoot	20607
	<i>Chenopodium glaucum</i> L.	<i>Chenopodium glaucum</i>	Oakleaf Goosefoot	20610
	<i>Chenopodium leptophyllum</i> (Moq.) Nutt. ex S. Wats.	<i>Chenopodium leptophyllum</i>	Narrowleaf Goosefoot	20616
	<i>Corispermum villosum</i> Rydb.	<i>Corispermum villosum</i>	Hairy Bugseed	511432
	<i>Grayia spinosa</i> (Hook.) Moq.	<i>Grayia spinosa</i>	Spiny Hop-sage	20690
	<i>Halogeton glomeratus</i> (Bieb.) C.A. Mey.	<i>Halogeton glomeratus</i>	Salt-lover	20692
	<i>Krascheninnikovia lanata</i> (Pursh) A.D.J. Meeuse & Smit	<i>Krascheninnikovia lanata</i>	Winter-fat	503290
	<i>Monolepis nuttalliana</i> (J.A. Schultes) Greene	<i>Monolepis nuttalliana</i>	Nuttall's Poverty-weed	20700
	<i>Salsola tragus</i> L.	<i>Salsola tragus</i>	Prickly Russian-thistle	520950
	<i>Sarcobatus vermiculatus</i> (Hook.) Torr.	<i>Sarcobatus vermiculatus</i>	Black Greasewood	20707
	<i>Suaeda calceoliformis</i> (Hook.) Moq.	<i>Suaeda calceoliformis</i>	Sea-blite	505402
	<i>Suaeda torreyana</i> S. Wats.	<i>Suaeda moquinii</i>	Shrubby Seepweed	20675
	<i>Suaeda torreyana</i> var. <i>ramosissima</i> (Standl.) Munz	<i>Suaeda moquinii</i>	Shrubby Seepweed	541051
	<i>Zuckia brandegeei</i> (Gray) Welsh & Stutz ex Welsh	<i>Zuckia brandegeei</i>	Siltbush	505810
Cornaceae	<i>Cornus sericea</i> L.	<i>Cornus sericea</i>	Red-osier Dogwood	501637
Crassulaceae	<i>Sedum lanceolatum</i> Torr.	<i>Sedum lanceolatum</i>	Lanceleaf Stonecrop	24126
Crossosomataceae	<i>Glossopetalon spinescens</i> var. <i>meionandrum</i> (Koehne) Trel.	<i>Glossopetalon spinescens</i> var. <i>meionandrum</i>	Spiny Greasebush	528253
Cupressaceae	<i>Juniperus communis</i> L.	<i>Juniperus communis</i>	Common Juniper	194820
	<i>Juniperus osteosperma</i> (Torr.) Little	<i>Juniperus osteosperma</i>	Utah Juniper	194859
	<i>Juniperus scopulorum</i> Sarg.	<i>Juniperus scopulorum</i>	Rocky Mountain Juniper	194872
Cyperaceae	<i>Carex aurea</i> Nutt.	<i>Carex aurea</i>	Golden-fruit Sedge	39445
	<i>Carex geophila</i> Mackenzie	<i>Carex geophila</i>	White Mountain Sedge	39612
	<i>Carex microptera</i> Mackenzie	<i>Carex microptera</i>	Small-wing Sedge	39699
	<i>Carex nebrascensis</i> Dewey	<i>Carex nebrascensis</i>	Nebraska Sedge	39711
	<i>Carex rossii</i> Boott	<i>Carex rossii</i>	Ross' Sedge	39786
	<i>Carex stenophylla</i> auct. non Wahlenb.	<i>Carex duriuscula</i>	Needleleaf Sedge	510280
	<i>Carex vallicola</i> Dewey	<i>Carex vallicola</i>	Valley Sedge	39860

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

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	<i>Eleocharis acicularis</i> (L.) Roemer & J.A. Schultes	<i>Eleocharis acicularis</i>	Needle Spikerush	40025
	<i>Eleocharis palustris</i> (L.) Roemer & J.A. Schultes	<i>Eleocharis palustris</i>	Marsh Spikerush	40019
	<i>Scirpus americanus</i> Pers.	<i>Schoenoplectus americanus</i>	Chairmaker's Bulrush	565758
	<i>Scirpus pungens</i> Vahl	<i>Schoenoplectus pungens</i>	Common Threesquare	40275
	<i>Scirpus validus</i> Vahl	<i>Schoenoplectus tabernaemontani</i>	Softstem Bulrush	40239
Dryopteridaceae	<i>Cystopteris fragilis</i> (L.) Bernh.	<i>Cystopteris fragilis</i>	Fragile Fern	17482
Elaeagnaceae	<i>Elaeagnus angustifolia</i> L.	<i>Elaeagnus angustifolia</i>	Russian-olive	27770
	<i>Shepherdia argentea</i> (Pursh) Nutt.	<i>Shepherdia argentea</i>	Silver Buffaloberry	27778
	<i>Shepherdia canadensis</i> (L.) Nutt.	<i>Shepherdia canadensis</i>	Russet Buffaloberry	27779
	<i>Shepherdia rotundifolia</i> Parry	<i>Shepherdia rotundifolia</i>	Roundleaf Buffaloberry	27780
Ephedraceae	<i>Ephedra nevadensis</i> S. Wats.	<i>Ephedra nevadensis</i>	Nevada Joint-fir	502316
	<i>Ephedra torreyana</i> S. Wats.	<i>Ephedra torreyana</i>	Torrey Mormon-tea	502318
	<i>Ephedra viridis</i> Coville	<i>Ephedra viridis</i>	Mormon-tea	502319
Equisetaceae	<i>Equisetum arvense</i> L.	<i>Equisetum arvense</i>	Field Horsetail	17152
	<i>Equisetum hyemale</i> L.	<i>Equisetum hyemale</i>	Common Scouring-rush	17154
	<i>Equisetum laevigatum</i> A. Braun	<i>Equisetum laevigatum</i>	Smooth Horsetail	17156
Ericaceae	<i>Arctostaphylos patula</i> Greene	<i>Arctostaphylos patula</i>	Greenleaf Manzanita	23513
	<i>Arctostaphylos pungens</i> Kunth	<i>Arctostaphylos pungens</i>	Mexican Manzanita	23519
Euphorbiaceae	<i>Chamaesyce fendleri</i> (Torr. & Gray) Small	<i>Chamaesyce fendleri</i>	Fendler's Sandmat	501419
	<i>Chamaesyce glyptosperma</i> (Engelm.) Small	<i>Chamaesyce glyptosperma</i>	Rib-Seed Sandmat	501422
Fabaceae	<i>Astragalus amphioxys</i> Gray	<i>Astragalus amphioxys</i>	Aladdin's-slippers	25414
	<i>Astragalus brandegeei</i> Porter	<i>Astragalus brandegeei</i>	Brandegee's Milk-vetch	25442
	<i>Astragalus calycosus</i> var. <i>calycosus</i> Torr. ex S. Wats.	<i>Astragalus calycosus</i> var. <i>calycosus</i>	Torrey Milk-vetch	192389
	<i>Astragalus castaneiformis</i> S. Wats.	<i>Astragalus castaneiformis</i>	Chestnut Milk-vetch	25455
	<i>Astragalus ceramicus</i> Sheldon	<i>Astragalus ceramicus</i>	Painted Milk-vetch	25457
	<i>Astragalus coltonii</i> M.E. Jones	<i>Astragalus coltonii</i>	Colton's Milk-vetch	25471
	<i>Astragalus convallarius</i> Greene	<i>Astragalus convallarius</i>	Lesser Rushy Milk-vetch	25477
	<i>Astragalus desperatus</i> M.E. Jones	<i>Astragalus desperatus</i>	Rimrock Milk-vetch	25491
	<i>Astragalus episcopus</i> S. Wats.	<i>Astragalus episcopus</i>	Bishop's Milk-vetch	25507
	<i>Astragalus flavus</i> Nutt.	<i>Astragalus flavus</i>	Yellow Milk-vetch	25516
	<i>Astragalus harrisonii</i> Barneby	<i>Astragalus harrisonii</i>	Harrison's Milk-vetch	25533
	<i>Astragalus kentrophyta</i> Gray	<i>Astragalus kentrophyta</i>	Spiny Milk-vetch	25553
	<i>Astragalus lentiginosus</i> Dougl. ex Hook.	<i>Astragalus lentiginosus</i>	Freckled Milk-vetch	25559

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

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	<i>Astragalus lonchocarpus</i> Torr.	<i>Astragalus lonchocarpus</i>	Great Rushy Milk-vetch	25567
	<i>Astragalus malacoides</i> Barneby	<i>Astragalus malacoides</i>	Kaiparowits Milk-vetch	25573
	<i>Astragalus miser</i> Dougl.	<i>Astragalus miser</i>	Timber Milk-vetch	25584
	<i>Astragalus moencoppensis</i> M.E. Jones	<i>Astragalus moencoppensis</i>	Moenkopi Milk-vetch	25586
	<i>Astragalus mollissimus</i> Torr.	<i>Astragalus mollissimus</i>	Woolly Milk-vetch	25589
	<i>Astragalus musiniensis</i> M.E. Jones	<i>Astragalus musiniensis</i>	Ferron's Milk-vetch	25596
	<i>Astragalus nuttallianus</i> DC.	<i>Astragalus nuttallianus</i>	Turkey-peas	25607
	<i>Astragalus pardalinus</i> (Rydb.) Barneby	<i>Astragalus pardalinus</i>	Panther Milk-vetch	25623
	<i>Astragalus praelongus</i> Sheldon	<i>Astragalus praelongus</i>	Stinking Milk-vetch	25639
	<i>Astragalus sesquiflorus</i> S. Wats.	<i>Astragalus sesquiflorus</i>	Sandstone Milk-vetch	25675
	<i>Astragalus zionis</i> M.E. Jones	<i>Astragalus zionis</i>	Zion Milk-vetch	25734
	<i>Dalea flavescens</i> (S. Wats.) Welsh	<i>Dalea flavescens</i>	Yellow Prairie-clover	26614
	<i>Dalea oligophylla</i> (Torr.) Shinners	<i>Dalea candida</i> var. <i>oligophylla</i>	White Prairie-clover	512059
	<i>Glycyrrhiza lepidota</i> Pursh	<i>Glycyrrhiza lepidota</i>	American Licorice	26719
	<i>Hedysarum boreale</i> Nutt.	<i>Hedysarum boreale</i>	Northern Sweet-vetch	26724
	<i>Lathyrus brachycalyx</i> Rydb.	<i>Lathyrus brachycalyx</i>	Intermountain Peavine	25840
	<i>Lathyrus lanszwertii</i> Kellogg	<i>Lathyrus lanszwertii</i>	Nevada Vetchling	25855
	<i>Lupinus argenteus</i> Pursh	<i>Lupinus argenteus</i>	Silver-stem Lupine	503575
	<i>Lupinus pusillus</i> Pursh	<i>Lupinus pusillus</i>	Rusty Lupine	26099
	<i>Lupinus sericeus</i> Pursh	<i>Lupinus sericeus</i>	Pursh's Silky Lupine	26112
	<i>Medicago sativa</i> L.	<i>Medicago sativa</i>	Alfalfa	183623
	<i>Melilotus albus</i> Medikus	<i>Melilotus officinalis</i>	Sweetclover	26149
	<i>Oxytropis lambertii</i> Pursh	<i>Oxytropis lambertii</i>	Stemless Locoweed	26175
	<i>Oxytropis oreophila</i> Gray	<i>Oxytropis oreophila</i>	Mountain Locoweed	26178
	<i>Oxytropis viscida</i> Nutt.	<i>Oxytropis borealis</i> var. <i>viscida</i>	Sticky Crazyweed	26183
	<i>Psoraleidium lanceolatum</i> (Pursh) Rydb.	<i>Psoraleidium lanceolatum</i>	Lemon Scurfpea	504645
	<i>Psorothamnus fremontii</i> (Torr. ex Gray) Barneby	<i>Psorothamnus fremontii</i>	Fremont's Smokebush	26928
	<i>Psorothamnus thompsoniae</i> (Vail) Welsh & Atwood	<i>Psorothamnus thompsoniae</i>	Thompson's Smokebush	26934
	<i>Trifolium pratense</i> L.	<i>Trifolium pratense</i>	Red Clover	26313
	<i>Trifolium repens</i> L.	<i>Trifolium repens</i>	White Clover	26206
	<i>Vicia americana</i> Muhl. ex Willd.	<i>Vicia americana</i>	American Purple Vetch	26331
Fagaceae	<i>Quercus gambelii</i> Nutt.	<i>Quercus gambelii</i>	Gambel Oak	19337

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

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	<i>Quercus havardii</i> X <i>gambellii</i>	Not applicable	Hybrid Oak	-
	<i>Quercus welshii</i> Welsh et al.	<i>Quercus havardii</i> var. <i>tuckeri</i>	Tucker Sand Shinnery Oak	-11
Gentianaceae	<i>Centaurium exaltatum</i> (Griseb.) W. Wight ex Piper	<i>Centaurium exaltatum</i>	Desert Centaury	30030
	<i>Swertia albomarginata</i> (S. Wats.) Kuntze	<i>Frasera albomarginata</i>	Desert Elkweed	30109
	<i>Swertia radiata</i> (Kellogg) Kuntze	<i>Frasera speciosa</i>	Monument Plant	30120
Geraniaceae	<i>Geranium parryi</i> (Engelm.) Heller	<i>Geranium caespitosum</i> var. <i>parryi</i>	Parry's Crane's-bill	29112
	<i>Erodium cicutarium</i> (L.) L'Hér. ex Ait.	<i>Erodium cicutarium</i>	Crane's-bill	29147
	<i>Geranium caespitosum</i> James	<i>Geranium caespitosum</i>	Purple Cluster Crane's-bill	29130
	<i>Geranium caespitosum</i> var. <i>parryi</i> (Engelm.) W.A. Weber	<i>Geranium caespitosum</i> var. <i>parryi</i>	Parry's Crane's-bill	528235
	<i>Geranium richardsonii</i> Fisch. & Trautv.	<i>Geranium richardsonii</i>	White Crane's-bill	29118
Grossulariaceae	<i>Ribes aureum</i> Pursh	<i>Ribes aureum</i>	Golden Currant	24452
	<i>Ribes cereum</i> Dougl.	<i>Ribes cereum</i>	Wax Currant	24457
	<i>Ribes inerme</i> Rydb.	<i>Ribes inerme</i>	White-stem Gooseberry	24473
Hydrangeaceae	<i>Fendlerella utahensis</i> (S. Wats.) Heller	<i>Fendlerella utahensis</i>	Utah Fendlerbush	24334
Hydrophyllaceae	<i>Nama demissum</i> Gray	<i>Nama demissum</i>	Purplemat	31411
	<i>Phacelia crenulata</i> Torr. ex S. Wats.	<i>Phacelia crenulata</i>	Notchleaf Scorpionweed	31478
	<i>Phacelia demissa</i> Gray	<i>Phacelia demissa</i>	Intermountain Scorpion-weed	31483
	<i>Phacelia ivesiana</i> Torr.	<i>Phacelia ivesiana</i>	Ives' Scorpionweed	504273
	<i>Phacelia rafaensis</i> Atwood	<i>Phacelia rafaensis</i>	Plateau Scorpion-weed	31584
Iridaceae	<i>Sisyrinchium halophilum</i> Greene	<i>Sisyrinchium halophilum</i>	Nevada Blue-eyed-grass	43263
Juncaceae	<i>Juncus arcticus</i> Willd.	<i>Juncus arcticus</i>	Arctic Rush	39222
	<i>Juncus ensifolius</i> Wikstr.	<i>Juncus ensifolius</i>	Daggerleaf Rush	39269
	<i>Juncus torreyi</i> Coville	<i>Juncus torreyi</i>	Torrey Rush	39320
Juncaginaceae	<i>Triglochin maritimum</i> L.	<i>Triglochin maritima</i>	Seaside Arrow-grass	505588
Lamiaceae	<i>Marrubium vulgare</i> L.	<i>Marrubium vulgare</i>	White Horehound	32561
	<i>Mentha arvensis</i> L.	<i>Mentha arvensis</i>	Wild Mint	565302
	<i>Poliomintha incana</i> (Torr.) Gray	<i>Poliomintha incana</i>	Hoary Rosemarymint	504488
Liliaceae	<i>Allium acuminatum</i> Hook.	<i>Allium acuminatum</i>	Taper-tip Onion	42707
	<i>Allium cernuum</i> Roth	<i>Allium cernuum</i>	Nodding Onion	42721
	<i>Allium macropetalum</i> Rydb.	<i>Allium macropetalum</i>	Large-petal Onion	42682
	<i>Allium textile</i> A. Nels. & J.F. Macbr.	<i>Allium textile</i>	White Wild Onion	42670
	<i>Androstephium breviflorum</i> S. Wats.	<i>Androstephium breviflorum</i>	Pink Funnel-lily	42777

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

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	<i>Asparagus officinalis</i> L.	<i>Asparagus officinalis</i>	Garden Asparagus	42784
	<i>Calochortus aureus</i> S. Wats.	<i>Calochortus aureus</i>	Golden Mariposa-lily	42836
	<i>Calochortus nuttallii</i> Torr. & Gray	<i>Calochortus nuttallii</i>	Sego-lily	42863
	<i>Calochortus</i> Pursh	<i>Calochortus</i>	Mariposa-lily	42823
	<i>Fritillaria atropurpurea</i> Nutt.	<i>Fritillaria atropurpurea</i>	Spotted Missionbells	502669
	<i>Smilacina stellata</i> (L.) Desf.	<i>Maianthemum stellatum</i>	Starflower False Solomon's-seal	43038
	<i>Zigadenus elegans</i> Pursh	<i>Zigadenus elegans</i>	Mountain Deathcamas	43158
Linaceae	<i>Linum aristatum</i> Engelm.	<i>Linum aristatum</i>	Bristle Flax	29231
	<i>Linum perenne</i> L.	<i>Linum perenne</i>	Blue Flax	29217
	<i>Linum puberulum</i> (Engelm.) Heller	<i>Linum puberulum</i>	Plains Flax	29219
Loasaceae	<i>Mentzelia albicaulis</i> (Dougl. ex Hook.) Dougl. ex Torr. & Gray	<i>Mentzelia albicaulis</i>	White-Stem Blazingstar	503757
	<i>Mentzelia marginata</i> (Osterhout) H.J. Thompson & Prigge	<i>Mentzelia marginata</i>	Colorado Blazingstar	503782
	<i>Mentzelia multiflora</i> (Nutt.) Gray	<i>Mentzelia multiflora</i>	Adonis Blazingstar	503788
	<i>Mentzelia pterosperma</i> Eastw.	<i>Mentzelia pterosperma</i>	Wing-seed Blazingstar	503799
Malvaceae	<i>Sphaeralcea coccinea</i> (Nutt.) Rydb.	<i>Sphaeralcea coccinea</i>	Scarlet Globemallow	21920
	<i>Sphaeralcea grossulariifolia</i> (Hook. & Arn.) Rydb.	<i>Sphaeralcea grossulariifolia</i>	Currantleaf Globemallow	21939
	<i>Sphaeralcea parvifolia</i> A. Nels.	<i>Sphaeralcea parvifolia</i>	Small-leaf Globemallow	21953
	<i>Sphaeralcea</i> St.-Hil.	<i>Sphaeralcea</i>	Globemallow	21909
Monotropaceae	<i>Pterospora andromedea</i> Nutt.	<i>Pterospora andromedea</i>	Giant Pinedrops	23787
Nyctaginaceae	<i>Abronia elliptica</i> A. Nels.	<i>Abronia elliptica</i>	Fragrant White Sand-verbena	19556
	<i>Abronia fragrans</i> Nutt. ex Hook.	<i>Abronia fragrans</i>	Heart's-delight	19557
	<i>Abronia nana</i> S. Wats.	<i>Abronia nana</i>	Dwarf Sand-verbena	19565
	<i>Mirabilis linearis</i> (Pursh) Heimerl	<i>Mirabilis linearis</i>	Narrowleaf Four-o'clock	19651
	<i>Mirabilis multiflora</i> (Torr.) Gray	<i>Mirabilis multiflora</i>	Colorado Four-o'clock	19654
	<i>Mirabilis oxybaphoides</i> (Gray) Gray	<i>Mirabilis oxybaphoides</i>	Spreading Four-o'clock	19657
	<i>Tripterocalyx micranthus</i> (Torr.) Hook.	<i>Tripterocalyx micranthus</i>	Small-flower Sand-verbena	19621
Oleaceae	<i>Forestiera pubescens</i> Nutt.	<i>Forestiera pubescens</i>	Wild Privet	32957
	<i>Fraxinus americana</i> L.	<i>Fraxinus americana</i>	White Ash	32931
	<i>Fraxinus anomala</i> Torr. ex S. Wats.	<i>Fraxinus anomala</i>	Singleleaf Ash	32937
Onagraceae	<i>Calylophus lavandulifolius</i> (Torr. & Gray) Raven	<i>Calylophus lavandulifolius</i>	Lavender-leaf Sundrops	501160
	<i>Camissonia eastwoodiae</i> (Munz) Raven	<i>Camissonia eastwoodiae</i>	Eastwood's Evening-primrose	27504

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

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	<i>Camissonia scapoidea</i> (Nutt. ex Torr. & Gray) Raven	<i>Camissonia scapoidea</i>	Paiute Suncup	27543
	<i>Epilobium adenocaulon</i> Hausskn.	<i>Epilobium ciliatum</i> ssp. <i>ciliatum</i>	Fringed Willowherb	512904
	<i>Oenothera albicaulis</i> Pursh	<i>Oenothera albicaulis</i>	Prairie Evening-primrose	27373
	<i>Oenothera brachycarpa</i> Gray	<i>Oenothera brachycarpa</i>	Short-fruit Evening-primrose	27378
	<i>Oenothera caespitosa</i> Nutt.	<i>Oenothera caespitosa</i>	Tufted Evening-primrose	565328
	<i>Oenothera elata</i> Kunth	<i>Oenothera elata</i>	Hooker's Evening-primrose	27395
	<i>Oenothera pallida</i> Lindl.	<i>Oenothera pallida</i>	White-pole Evening-primrose	27436
Orchidaceae	<i>Corallorrhiza maculata</i> (Raf.) Raf.	<i>Corallorrhiza maculata</i>	Summer Coralroot	43523
	<i>Epipactis gigantea</i> Dougl. ex Hook.	<i>Epipactis gigantea</i>	Giant Helleborine	43481
	<i>Habenaria hyperborea</i> (L.) R. Br. ex Ait. f.	<i>Platanthera hyperborea</i>	Northern Green Orchid	514368
	<i>Habenaria sparsiflora</i> S. Wats.	<i>Platanthera sparsiflora</i>	Canyon Bog Orchid	514384
	<i>Spiranthes romanzoffiana</i> var. <i>diluvialis</i> (Sheviak) Welsh	<i>Spiranthes diluvialis</i>	Ute Ladie's-tresses	540892
Orobanchaceae	<i>Orobanche fasciculata</i> Nutt.	<i>Orobanche fasciculata</i>	Clustered Broomrape	34290
	<i>Orobanche ludoviciana</i> Nutt.	<i>Orobanche ludoviciana</i>	Louisiana Broomrape	34291
	<i>Orobanche multiflora</i> Nutt.	<i>Orobanche ludoviciana</i> ssp. <i>multiflora</i>	Many-flower Broomrape	34293
Pinaceae	<i>Abies concolor</i> (Gord. & Glend.) Lindl. ex Hildebr.	<i>Abies concolor</i>	White Fir	181826
	<i>Picea pungens</i> Engelm.	<i>Picea pungens</i>	Blue Spruce	183307
	<i>Pinus edulis</i> Engelm.	<i>Pinus edulis</i>	Two-needle Pinyon	183336
	<i>Pinus longaeva</i> D.K. Bailey	<i>Pinus longaeva</i>	Intermountain Bristlecone Pine	183352
	<i>Pinus ponderosa</i> P. & C. Lawson	<i>Pinus ponderosa</i>	Ponderosa Pine	183365
	<i>Pseudotsuga menziesii</i> (Mirbel) Franco	<i>Pseudotsuga menziesii</i>	Douglas-fir	183424
Plantaginaceae	<i>Plantago major</i> L.	<i>Plantago major</i>	Common Plantain	32887
	<i>Plantago patagonica</i> Jacq.	<i>Plantago patagonica</i>	Woolly Plantain	32907
Poaceae	<i>Agropyron cristatum</i> (L.) Gaertn.	<i>Agropyron cristatum</i>	Crested Wheatgrass	182478
	<i>Agrostis stolonifera</i> L.	<i>Agrostis stolonifera</i>	Creeping Bentgrass	40400
	<i>Andropogon gerardii</i> Vitman	<i>Andropogon gerardii</i>	Big Bluestem	40462
	<i>Aristida purpurea</i> Nutt.	<i>Aristida purpurea</i>	Purple Three-awn	41429
	<i>Bouteloua barbata</i> Lag.	<i>Bouteloua barbata</i>	Six-weeks Grama	41498
	<i>Bouteloua curtipendula</i> (Michx.) Torr.	<i>Bouteloua curtipendula</i>	Sideoats Grama	41500
	<i>Bouteloua eriopoda</i> (Torr.) Torr.	<i>Bouteloua eriopoda</i>	Black Grama	41501
	<i>Bouteloua gracilis</i> (Willd. ex Kunth) Lag. ex Griffiths	<i>Bouteloua gracilis</i>	Blue Grama	41493
	<i>Bromus anomalus</i> Rupr. ex Fourn.	<i>Bromus anomalus</i>	Nodding Brome	40491

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	<i>Bromus catharticus</i> Vahl	<i>Bromus catharticus</i>	Rescue Grass	501066
	<i>Bromus ciliatus</i> L.	<i>Bromus ciliatus</i>	Fringed Brome	40496
	<i>Bromus inermis</i> Leyss.	<i>Bromus inermis</i>	Smooth Brome	40502
	<i>Bromus rubens</i> L.	<i>Bromus rubens</i>	Foxtail Brome	40518
	<i>Bromus tectorum</i> L.	<i>Bromus tectorum</i>	Cheatgrass	40524
	<i>Dactylis glomerata</i> L.	<i>Dactylis glomerata</i>	Orchard Grass	193446
	<i>Distichlis spicata</i> (L.) Greene	<i>Distichlis spicata</i>	Saltgrass	40662
	<i>Elymus canadensis</i> L.	<i>Elymus canadensis</i>	Nodding Wild Rye	40683
	<i>Elymus elymoides</i> (Raf.) Swezey	<i>Elymus elymoides</i>	Bottlebrush	502264
	<i>Elymus junceus</i> Fisch.	<i>Psathyrostachys juncea</i>	Russian Wildrye	40702
	<i>Elymus lanceolatus</i> (Scribn. & J.G. Sm.) Gould	<i>Elymus lanceolatus</i>	Streamside Wild Rye	502267
	<i>Elymus repens</i> (L.) Gould	<i>Elymus repens</i>	Creeping Wild Rye	512839
	<i>Elymus salinus</i> M.E. Jones	<i>Leymus salinus</i>	Salinas Lyme Grass	512841
	<i>Elymus smithii</i> (Rydb.) Gould	<i>Pascopyrum smithii</i>	Western Wheatgrass	512844
	<i>Elymus spicatus</i> (Pursh) Gould	<i>Pseudoroegneria spicata</i>	Bluebunch Wheatgrass	512845
	<i>Elymus trachycaulus</i> (Link) Gould ex Shinners	<i>Elymus trachycaulus</i>	Slender Wild Rye	502282
	<i>Erioneuron pilosum</i> (Buckl.) Nash	<i>Erioneuron pilosum</i>	Hairy Woolly Grass	41731
	<i>Erioneuron pulchellum</i> (Kunth) Tateoka	<i>Dasyochloa pulchella</i>	Low Woolly Grass	41732
	<i>Festuca idahoensis</i> Elmer	<i>Festuca idahoensis</i>	Idaho Fescue	40816
	<i>Festuca octoflora</i> Walt.	<i>Vulpia octoflora</i>	Eight-flower Six-weeks Grass	513551
	<i>Festuca ovina</i> L.	<i>Festuca ovina</i>	Sheep Fescue	40804
	<i>Festuca pratensis</i> Huds.	<i>Lolium pratense</i>	Meadow Ryegrass	40822
	<i>Hilaria jamesii</i> (Torr.) Benth.	<i>Pleuraphis jamesii</i>	James' Galleta	41768
	<i>Hordeum jubatum</i> L.	<i>Hordeum jubatum</i>	Foxtail Barley	40871
	<i>Hordeum pusillum</i> Nutt.	<i>Hordeum pusillum</i>	Little Barley	40866
	<i>Koeleria macrantha</i> (Ledeb.) J.A. Schultes	<i>Koeleria macrantha</i>	Prairie Junegrass	503284
	<i>Lycurus phleoides</i> Kunth	<i>Lycurus phleoides</i>	Common Wolf's-tail	41839
	<i>Monroa squarrosa</i> (Nutt.) Torr.	<i>Monroa squarrosa</i>	False Buffalo Grass	41882
	<i>Muhlenbergia asperifolia</i> (Nees & Meyen ex Trin.) Parodi	<i>Muhlenbergia asperifolia</i>	Alkali Muhly	41899
	<i>Muhlenbergia pauciflora</i> Buckl.	<i>Muhlenbergia pauciflora</i>	New Mexico Muhly	41930
	<i>Muhlenbergia pungens</i> Thurb.	<i>Muhlenbergia pungens</i>	Sandhill Muhly	41934
	<i>Oryzopsis micrantha</i> (Trin. & Rupr.) Thurb.	<i>Piptatherum micranthum</i>	Little-seed Mountain Ricegrass	41989
	<i>Panicum oligosanthes</i> J.A. Schultes	<i>Dichantherium oligosanthes</i>	Few-flower Witchgrass	40912

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	<i>Phragmites australis</i> (Cav.) Trin. ex Steud.	<i>Phragmites australis</i>	Common Reed	41072
	<i>Poa fendleriana</i> (Steud.) Vasey	<i>Poa fendleriana</i>	Muttongrass	504467
	<i>Poa pratensis</i> L.	<i>Poa pratensis</i>	Kentucky Bluegrass	41088
	<i>Poa secunda</i> J. Presl	<i>Poa secunda</i>	Curly Bluegrass	41103
	<i>Polypogon monspeliensis</i> (L.) Desf.	<i>Polypogon monspeliensis</i>	Annual Rabbit's-foot Grass	41171
	<i>Polypogon semiverticillatus</i> (Forsk.) Hyl.	<i>Polypogon viridis</i>	Beardless Rabbit's-foot Grass	519463
	<i>Puccinellia nuttalliana</i> (J.A. Schultes) A.S. Hitchc.	<i>Puccinellia nuttalliana</i>	Nuttall's Alkali Grass	41200
	<i>Schizachyrium scoparium</i> (Michx.) Nash	<i>Schizachyrium scoparium</i>	Little Bluestem	42076
	<i>Sporobolus airoides</i> (Torr.) Torr.	<i>Sporobolus airoides</i>	Alkali Sacaton	42128
	<i>Sporobolus contractus</i> A.S. Hitchc.	<i>Sporobolus contractus</i>	Narrow-spike Dropseed	42131
	<i>Sporobolus cryptandrus</i> (Torr.) Gray	<i>Sporobolus cryptandrus</i>	Sand Dropseed	42132
	<i>Sporobolus flexuosus</i> (Thurb. ex Vasey) Rydb.	<i>Sporobolus flexuosus</i>	Mesa Dropseed	42137
	<i>Sporobolus giganteus</i> Nash	<i>Sporobolus giganteus</i>	Giant Dropseed	42138
	<i>Stipa arida</i> M.E. Jones	<i>Achnatherum aridum</i>	Mormon Needlegrass	42159
	<i>Stipa comata</i> Trin. & Rupr.	<i>Hesperostipa comata</i>	Needle-and-thread	42172
	<i>Stipa coronata</i> Thurb.	<i>Achnatherum coronatum</i>	Giant Needlegrass	42173
	<i>Stipa hymenoides</i> Roemer & J.A. Schultes	<i>Achnatherum hymenoides</i>	Indian Ricegrass	522063
	<i>Stipa lettermanii</i> Vasey	<i>Achnatherum lettermanii</i>	Letterman's Needlegrass	522065
	<i>Stipa nelsonii</i> Scribn.	<i>Achnatherum nelsonii</i> ssp. <i>nelsonii</i>	Nelson's Needlegrass	42182
	<i>Stipa neomexicana</i> (Thurb. ex Coult.) Scribn.	<i>Hesperostipa neomexicana</i>	New Mexico Needlegrass	42165
	<i>Stipa pinetorum</i> M.E. Jones	<i>Achnatherum pinetorum</i>	Pine Needlegrass	42188
	<i>Stipa scribneri</i> Vasey	<i>Achnatherum scribneri</i>	Scribner's Needlegrass	42193
	<i>Stipa speciosa</i> Trin. & Rupr.	<i>Achnatherum speciosum</i>	Desert Needlegrass	42194
Polemoniaceae	<i>Eriastrum</i> Woot. & Standl.	<i>Eriastrum</i>	Woolstar	31047
	<i>Gilia caespitosa</i> Gray	<i>Gilia caespitosa</i>	Rabbit Valley Gilia	31104
	<i>Gilia inconspicua</i> (Sm.) Sweet	<i>Gilia inconspicua</i>	Shy Gilia	31127
	<i>Gilia leptomeria</i> Gray	<i>Gilia leptomeria</i>	Sand Gilia	31150
	<i>Gilia subnuda</i> Torr. ex Gray	<i>Gilia subnuda</i>	Coral Gilia	31180
	<i>Ipomopsis aggregata</i> (Pursh) V. Grant	<i>Ipomopsis aggregata</i>	Scarlet Skyrocket	31192
	<i>Ipomopsis congesta</i> ssp. <i>congesta</i> (Hook.) V. Grant	<i>Ipomopsis congesta</i> ssp. <i>congesta</i>	Ball-head Skyrocket	31203
	<i>Ipomopsis gunnisonii</i> (Torr. & Gray) V. Grant	<i>Ipomopsis gunnisonii</i>	Sand-dune Skyrocket	31210
	<i>Ipomopsis longiflora</i> (Torr.) V. Grant	<i>Ipomopsis longiflora</i>	White-flower Skyrocket	31198

Family	Scientific Name (Welsh et al. 2003)	Scientific Name (Kartesz 1999)	Common Name (NatureServe)	TSN
	<i>Ipomopsis polycladon</i> (Torr.) V. Grant	<i>Ipomopsis polycladon</i>	Sprawling Skyrocket	31216
	<i>Ipomopsis pumila</i> (Nutt.) V. Grant	<i>Ipomopsis pumila</i>	Low Skyrocket	31217
	<i>Ipomopsis roseata</i> (Rydb.) V. Grant	<i>Ipomopsis roseata</i>	Rosy Skyrocket	31218
	<i>Leptodactylon pungens</i> (Torr.) Torr. ex Nutt.	<i>Leptodactylon pungens</i>	Granite Prickly-phlox	31233
	<i>Leptodactylon watsonii</i> (Gray) Rydb.	<i>Leptodactylon watsonii</i>	Watson's Prickly-phlox	503390
	<i>Linanthus nuttallii</i> ssp. <i>nuttallii</i> (Gray) Greene ex Milliken	<i>Linanthus nuttallii</i> ssp. <i>nuttallii</i>	Nuttall's Desert Trumpets	31267
	<i>Phlox austromontana</i> Coville	<i>Phlox austromontana</i>	Desert Mountain Phlox	30913
	<i>Phlox hoodii</i> Richards.	<i>Phlox hoodii</i>	Hood's Phlox	30948
	<i>Phlox hoodii</i> ssp. <i>muscooides</i> (Nutt.) Wherry	<i>Phlox hoodii</i> ssp. <i>muscooides</i>	Hood's Phlox	524486
	<i>Phlox longifolia</i> Nutt.	<i>Phlox longifolia</i>	Longleaf Phlox	30956
	<i>Phlox pulvinata</i> (Wherry) Cronq.	<i>Phlox pulvinata</i>	Cushion Phlox	30980
Polygalaceae	<i>Polygala subspinosa</i> S. Wats.	<i>Polygala subspinosa</i>	Cushion Milkwort	29319
Polygonaceae	<i>Eriogonum alatum</i> Torr.	<i>Eriogonum alatum</i>	Winged Wild Buckwheat	21057
	<i>Eriogonum bicolor</i> M.E. Jones	<i>Eriogonum bicolor</i>	Pretty Wild Buckwheat	21078
	<i>Eriogonum cernuum</i> Nutt.	<i>Eriogonum cernuum</i>	Nodding Wild Buckwheat	21090
	<i>Eriogonum corymbosum</i> Benth.	<i>Eriogonum corymbosum</i>	Crispleaf Wild Buckwheat	21103
	<i>Eriogonum corymbosum</i> var. <i>aureum</i> (M.E. Jones) Reveal	<i>Eriogonum corymbosum</i> var. <i>aureum</i>	Crispleaf Wild Buckwheat	195444
	<i>Eriogonum corymbosum</i> var. <i>revealianum</i> (Welsh) Reveal	<i>Eriogonum corymbosum</i> var. <i>revealianum</i>	Reveal's Wild Buckwheat	195448
	<i>Eriogonum deflexum</i> Torr.	<i>Eriogonum deflexum</i>	Flat-crown Wild Buckwheat	21111
	<i>Eriogonum flexum</i> M.E. Jones	<i>Stenogonum flexum</i>	Bent Two-whorl Buckwheat	513106
	<i>Eriogonum hookeri</i> S. Wats.	<i>Eriogonum hookeri</i>	Hooker's Wild Buckwheat	21156
	<i>Eriogonum inflatum</i> Torr. & Frém.	<i>Eriogonum inflatum</i>	Indian-pipeweed	21163
	<i>Eriogonum inflatum</i> var. <i>fusiforme</i> (Small) Reveal	<i>Eriogonum fusiforme</i>	Spindle Wild Buckwheat	195498
	<i>Eriogonum leptocladon</i> Torr. & Gray	<i>Eriogonum leptocladon</i>	Sand Wild Buckwheat	21179
	<i>Eriogonum maculatum</i> Heller	<i>Eriogonum maculatum</i>	Spotted Buckwheat	21188
	<i>Eriogonum</i> Michx.	<i>Eriogonum</i>	Wild Buckwheat	21054
	<i>Eriogonum microthecum</i> Nutt.	<i>Eriogonum microthecum</i>	Slender Wild Buckwheat	21192
	<i>Eriogonum ovalifolium</i> Nutt.	<i>Eriogonum ovalifolium</i>	Cushion Wild Buckwheat	21212
	<i>Eriogonum racemosum</i> Nutt.	<i>Eriogonum racemosum</i>	Red-root Wild Buckwheat	21230
	<i>Eriogonum shockleyi</i> S. Wats.	<i>Eriogonum shockleyi</i>	Shockley's Buckwheat	21245
	<i>Eriogonum tumulosum</i> (Barneby) Reveal	<i>Eriogonum tumulosum</i>	Woodside Buckwheat	21264
	<i>Eriogonum umbellatum</i> Torr.	<i>Eriogonum umbellatum</i>	Sulphurflower Wild Buckwheat	21266
	<i>Eriogonum umbellatum</i> var. <i>subaridum</i> S. Stokes	<i>Eriogonum umbellatum</i> var. <i>subaridum</i>	Sulphur-flower Wild Buckwheat	528025

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

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	<i>Eriogonum wetherillii</i> Eastw.	<i>Eriogonum wetherillii</i>	Wetherill's Buckwheat	21278
	<i>Polygonum douglasii</i> Greene	<i>Polygonum douglasii</i>	Douglas' Knotweed	20891
	<i>Polygonum lapathifolium</i> L.	<i>Polygonum lapathifolium</i>	Pale Smartweed	20860
	<i>Rumex crispus</i> L.	<i>Rumex crispus</i>	Curly Dock	20937
	<i>Rumex hymenosepalus</i> Torr.	<i>Rumex hymenosepalus</i>	Sand Dock	20962
	<i>Stenogonum flexum</i> (M.E. Jones) Reveal & J.T. Howell	<i>Stenogonum flexum</i>	Bent Two-whorl Buckwheat	21321
Portulacaceae	<i>Portulaca oleracea</i> L.	<i>Portulaca oleracea</i>	Little Hogweed	20422
	<i>Talinum brevifolium</i> Torr.	<i>Talinum brevifolium</i>	Pygmy Fameflower	20445
Primulaceae	<i>Androsace septentrionalis</i> L.	<i>Androsace septentrionalis</i>	Pygmy-flower Rock-jasmine	23935
Pteridaceae	<i>Adiantum capillus-veneris</i> L.	<i>Adiantum capillus-veneris</i>	Southern Maidenhair	17308
	<i>Cheilanthes feei</i> T. Moore	<i>Cheilanthes feei</i>	Slender Lipfern	17441
Ranunculaceae	<i>Actaea rubra</i> (Ait.) Willd.	<i>Actaea rubra</i>	Red Baneberry	18723
	<i>Aquilegia caerulea</i> James	<i>Aquilegia caerulea</i>	Colorado Blue Columbine	565004
	<i>Clematis columbiana</i> (Nutt.) Torr. & Gray	<i>Clematis columbiana</i>	Columbian Virgin's-bower	18693
	<i>Clematis ligusticifolia</i> Nutt.	<i>Clematis ligusticifolia</i>	Deciduous Traveler's-joy	18702
	<i>Delphinium andersonii</i> Gray	<i>Delphinium andersonii</i>	Desert Larkspur	501976
	<i>Delphinium andersonii</i> var. <i>scaposum</i> (Greene) Welsh	<i>Delphinium scaposum</i>	Bare-stem Larkspur	534315
	<i>Ranunculus cymbalaria</i> Pursh	<i>Ranunculus cymbalaria</i>	Alkali Buttercup	18600
	<i>Thalictrum fendleri</i> Engelm. ex Gray	<i>Thalictrum fendleri</i>	Fendler's Meadowrue	18670
	<i>Thalictrum sparsiflorum</i> Turcz. ex Fisch. & C.A. Mey.	<i>Thalictrum sparsiflorum</i>	Few-flower Meadowrue	18679
Rhamnaceae	<i>Ceanothus fendleri</i> Gray	<i>Ceanothus fendleri</i>	Fendler's Buckbrush	28467
	<i>Rhamnus betulifolia</i> Greene	<i>Frangula betulifolia</i>	Birchleaf False Buckthorn	28563
Rosaceae	<i>Amelanchier alnifolia</i> (Nutt.) Nutt. ex M. Roemer	<i>Amelanchier alnifolia</i>	Saskatoon Serviceberry	25109
	<i>Amelanchier utahensis</i> Koehne	<i>Amelanchier utahensis</i>	Utah Serviceberry	25121
	<i>Cercocarpus intricatus</i> S. Wats.	<i>Cercocarpus intricatus</i>	Littleleaf Mountain-mahogany	25133
	<i>Cercocarpus ledifolius</i> Nutt.	<i>Cercocarpus ledifolius</i>	Curl-leaf Mountain-mahogany	25134
	<i>Cercocarpus montanus</i> Raf.	<i>Cercocarpus montanus</i>	Mountain-mahogany	25136
	<i>Coleogyne ramosissima</i> Torr.	<i>Coleogyne ramosissima</i>	Blackbrush	25150
	<i>Fallugia paradoxa</i> (D. Don) Endl. ex Torr.	<i>Fallugia paradoxa</i>	Apache Plume	25167
	<i>Fragaria vesca</i> L.	<i>Fragaria vesca</i>	Woodland Strawberry	24634
	<i>Fragaria virginiana</i> Duchesne	<i>Fragaria virginiana</i>	Virginia Strawberry	24639
	<i>Holodiscus dumosus</i> (Nutt. ex Hook.) Heller	<i>Holodiscus dumosus</i>	Glandular Oceanspray	25178

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

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	<i>Petrophyton caespitosum</i> (Nutt.) Rydb.	<i>Petrophyton caespitosum</i>	Tufted Rockmat	25272
	<i>Physocarpus alternans</i> (M.E. Jones) J.T. Howell	<i>Physocarpus alternans</i>	Dwarf Ninebark	25278
	<i>Potentilla anserina</i> L.	<i>Argentina anserina</i>	Silverweed	24687
	<i>Potentilla concinna</i> Richards.	<i>Potentilla concinna</i>	Red Cinquefoil	24700
	<i>Potentilla crinita</i> Gray	<i>Potentilla crinita</i>	Bearded Cinquefoil	504575
	<i>Potentilla diversifolia</i> Lehm.	<i>Potentilla diversifolia</i>	Mountain Meadow Cinquefoil	24702
	<i>Potentilla gracilis</i> Dougl. ex Hook.	<i>Potentilla gracilis</i>	Graceful Cinquefoil	24714
	<i>Potentilla hippiana</i> Lehm.	<i>Potentilla hippiana</i>	Woolly Cinquefoil	24718
	<i>Potentilla pensylvanica</i> L.	<i>Potentilla pensylvanica</i>	Pennsylvania Cinquefoil	24736
	<i>Purshia mexicana</i> (D. Don) Henrickson	<i>Purshia mexicana</i>	Mexican Cliffrose	195899
	<i>Purshia mexicana</i> var. <i>stansburiana</i> (Torr.) Welsh	<i>Purshia stansburiana</i>	Stansbury Cliffrose	195902
	<i>Purshia tridentata</i> (Pursh) DC.	<i>Purshia tridentata</i>	Bitterbrush	25290
	<i>Rosa woodsii</i> Lindl.	<i>Rosa woodsii</i>	Woods' Rose	24847
Rubiaceae	<i>Galium aparine</i> L.	<i>Galium aparine</i>	Sticky Willy	34797
	<i>Galium multiflorum</i> Kellogg	<i>Galium multiflorum</i>	Many-flower Bedstraw	34892
Salicaceae	<i>Populus angustifolia</i> James	<i>Populus angustifolia</i>	Narrowleaf Cottonwood	22452
	<i>Populus fremontii</i> S. Wats.	<i>Populus fremontii</i>	Fremont Cottonwood	22459
	<i>Populus tremuloides</i> Michx.	<i>Populus tremuloides</i>	Quaking Aspen	195773
	<i>Populus X intercurrents</i> S. Goodrich & S.L. Welsh	<i>Populus X acuminata</i>	Lanceleaf Cottonwood	-16
	<i>Salix amygdaloides</i> Anderss.	<i>Salix amygdaloides</i>	Peachleaf Willow	22499
	<i>Salix boothii</i> Dorn	<i>Salix boothii</i>	Booth's Willow	22509
	<i>Salix eriocephala</i> Michx.	<i>Salix eriocephala</i>	Missouri Willow	22528
	<i>Salix exigua</i> Nutt.	<i>Salix exigua</i>	Coyote Willow	22529
	<i>Salix gooddingii</i> Ball	<i>Salix gooddingii</i>	Goodding's Willow	22539
Santalaceae	<i>Comandra umbellata</i> var. <i>pallida</i> (A. DC.) M.E. Jones	<i>Comandra umbellata</i> ssp. <i>pallida</i>	Bastard Toadflax	533741
Saxifragaceae	<i>Heuchera parvifolia</i> Nutt. ex Torr. & Gray	<i>Heuchera parvifolia</i>	Littleleaf Alumroot	24366
	<i>Parnassia palustris</i> L.	<i>Parnassia palustris</i>	Arctic Grass-of-Parnassus	24206
Scrophulariaceae	<i>Castilleja chromosa</i> A. Nels.	<i>Castilleja applegatei</i> ssp. <i>martinii</i>	Wavyleaf Indian-paintbrush	33102
	<i>Castilleja exilis</i> A. Nels.	<i>Castilleja minor</i> ssp. <i>minor</i>	Alkali Indian-paintbrush	33113
	<i>Castilleja linariifolia</i> Benth.	<i>Castilleja linariifolia</i>	Wyoming Indian-paintbrush	33138
	<i>Castilleja scabrada</i> Eastw.	<i>Castilleja scabrada</i>	Rough Indian-paintbrush	33165
	<i>Cordylanthus parviflorus</i> (Ferris) Wiggins	<i>Cordylanthus parviflorus</i>	Purple Bird's-beak	33572
	<i>Cordylanthus wrightii</i> Gray	<i>Cordylanthus wrightii</i>	Wright's Bird's-beak	33577

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

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	<i>Mimulus eastwoodiae</i> Rydb.	<i>Mimulus eastwoodiae</i>	Eastwood's Monkeyflower	33309
	<i>Pedicularis centranthera</i> Gray	<i>Pedicularis centranthera</i>	Dwarf Lousewort	33367
	<i>Penstemon ambiguus</i> Torr.	<i>Penstemon ambiguus</i>	Gilia Penstemon	33808
	<i>Penstemon angustifolius</i> Nutt. ex Pursh	<i>Penstemon angustifolius</i>	Narrowleaf Beardtongue	33812
	<i>Penstemon barbatus</i> (Cav.) Roth	<i>Penstemon barbatus</i>	Beard-lip Beardtongue	33825
	<i>Penstemon carnosus</i> Pennell	<i>Penstemon carnosus</i>	Fleshy Beardtongue	33673
	<i>Penstemon comarrhenus</i> Gray	<i>Penstemon comarrhenus</i>	Dusty Beardtongue	33854
	<i>Penstemon eatonii</i> Gray	<i>Penstemon eatonii</i>	Eaton's Firecracker	33686
	<i>Penstemon lentus</i> Pennell	<i>Penstemon lentus</i>	Handsome Beardtongue	33721
	<i>Penstemon ophianthus</i> Pennell	<i>Penstemon ophianthus</i>	Arizona Beardtongue	504222
	<i>Penstemon pachyphyllus</i> Gray ex Rydb.	<i>Penstemon pachyphyllus</i>	Thickleaf Beardtongue	33963
	<i>Penstemon palmeri</i> Gray	<i>Penstemon palmeri</i>	Scented Beardtongue	33738
	<i>Penstemon rostriflorus</i> Kellogg	<i>Penstemon rostriflorus</i>	Beaked Beardtongue	504226
	<i>Penstemon</i> Schmidel	<i>Penstemon</i>	Beardtongue	33665
	<i>Penstemon strictiformis</i> Rydb.	<i>Penstemon strictiformis</i>	Stiff Beardtongue	504227
	<i>Penstemon strictus</i> Benth.	<i>Penstemon strictus</i>	Rocky Mountain Beardtongue	33772
	<i>Penstemon utahensis</i> Eastw.	<i>Penstemon utahensis</i>	Utah Firecracker	33785
	<i>Veronica americana</i> Schwein. ex Benth.	<i>Veronica americana</i>	American Brooklime	33399
	<i>Veronica anagallis-aquatica</i> L.	<i>Veronica anagallis-aquatica</i>	Water Speedwell	565594
Solanaceae	<i>Lycium andersonii</i> Gray	<i>Lycium andersonii</i>	Redberry Desert-thorn	30532
Tamaricaceae	<i>Tamarix chinensis</i> Lour.	<i>Tamarix chinensis</i>	Chinese Tamarisk	22308
Typhaceae	<i>Typha latifolia</i> L.	<i>Typha latifolia</i>	Broadleaf Cattail	42326
Ulmaceae	<i>Celtis reticulata</i> Torr.	<i>Celtis laevigata</i> var. <i>reticulata</i>	Netleaf Hackberry	19045
Violaceae	<i>Viola canadensis</i> L.	<i>Viola canadensis</i>	Canadian White Violet	22053
Viscaceae	<i>Arceuthobium</i> Bieb.	<i>Arceuthobium</i>	Dwarf Mistletoe	27886
	<i>Arceuthobium divaricatum</i> Engelm.	<i>Arceuthobium divaricatum</i>	Pinyon Dwarf-mistletoe	27891
	<i>Phoradendron juniperinum</i> Engelm. ex Gray	<i>Phoradendron juniperinum</i>	Juniper Mistletoe	27866
Zannichelliaceae	<i>Zannichellia palustris</i> L.	<i>Zannichellia palustris</i>	Horned Pondweed	39068

NON-VASCULAR PLANTS

Family	Scientific Name	Scientific Name	Common Name (NatureServe)	TSN
Catillariaceae	<i>Toninia</i> A. Massal.	<i>Toninia</i>	Bruised Lichen	190205
Collemaaceae	<i>Collema</i> Wigg.	<i>Collema</i>	Jelly Lichen	191331
Hymeneliaceae	<i>Aspicilia</i> Massal.	<i>Aspicilia</i>	Rimmed Lichen	189695
	<i>Aspicilia reptans</i> (Looman) Wetmore	<i>Aspicilia reptans</i>	Rimmed Lichen	189747
Pottiaceae	<i>Hymenostylium recurvirostre</i> (Hedw.) Dix.	<i>Hymenostylium recurvirostre</i>	Hymenostylium Moss	547861
Psoraceae	<i>Psora</i> Hoffm.	<i>Psora</i>	Scale Lichen	190026
Selaginellaceae	<i>Selaginella mutica</i> D.C. Eat. ex Underwood	<i>Selaginella mutica</i>	Bluntleaf Spike-moss	17086
Teloschistaceae	<i>Fulgensia</i> Massal. and De Not.	<i>Fulgensia</i>	Sulphur Lichen	191759

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. Thirteen associations in the table below were documented only during accuracy assessment (Plot codes in the rightmost column contain the letters “AA”). Seven other associations were not sampled, but are included because they were noted as common and occurring consistently in very small patches or within community mosaics. 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 field plots for the association. 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	Plots
Acer negundo - Ostrya knowltonii Woodland	CEGL002342	1	CARE.9440
Acer negundo / Quercus gambelii Woodland	CEGL002797	2	CARE_AA.1493, CARE_AA.1809
Acer negundo / Rhus trilobata Woodland	CEGL002750	1	CARE_AA.1802
Achnatherum hymenoides Colorado Plateau Herbaceous Vegetation	CEGL002343	4	CARE.0509, CARE.0618, CARE.9089, CARE.9358
Achnatherum hymenoides Shrub Herbaceous Alliance	A.1543	1	CARE.0416
Amelanchier utahensis Shrubland	CEGL001067	2	CARE.0628, CARE_AA.0543
Aquilegia micrantha - Mimulus eastwoodiae Herbaceous Vegetation	CEGL002729	3	CARE.9052, CARE.9138, CARE.9424
*Arctostaphylos patula Shrubland	CEGL002696	N/A	Described from field notes
Artemisia bigelovii Shrubland	CEGL000276	2	CARE.9061, CARE_AA.1036
Artemisia filifolia Colorado Plateau Shrubland	CEGL002697	5	CARE.0519, CARE.0522, CARE.0570, CARE.9145, CARE.9200
Artemisia frigida - (Bouteloua gracilis, Achnatherum hymenoides, Poa secunda) - Lichens Rocky Mesa Dwarf-shrubland	CEGL002344	6	CARE.0661, CARE.0708, CARE.0713, CARE.0723, CARE.9700, CARE.9702
Artemisia nova - Purshia tridentata / Poa fendleriana Shrubland	CEGL002345	3	CARE.0718, CARE.0721, CARE.9703
Artemisia nova / Poa fendleriana Shrubland	CEGL002698	3	CARE.0710, CARE.0711, CARE.9073
Artemisia tridentata - (Ericameria nauseosa) / Bromus tectorum Semi-natural Shrubland	CEGL002699	1	CARE.8704
Artemisia tridentata / Achnatherum hymenoides Shrubland	CEGL001006	1	CARE.9045
Artemisia tridentata ssp. tridentata / Pleuraphis jamesii Shrubland	CEGL001015	3	CARE.0424, CARE.9315, CARE.9353
Artemisia tridentata ssp. tridentata / Sporobolus airoides Shrubland	CEGL002200	1	CARE_AA.1321
Artemisia tridentata ssp. vaseyana / Poa fendleriana Shrubland	CEGL002812	3	CARE.0712, CARE.0715, CARE.0725
Artemisia tridentata ssp. wyomingensis / (Agropyron cristatum, Psathyrostachys juncea) Seeded Grasses Semi-natural Shrubland	CEGL002185	6	CARE.0473, CARE.0474, CARE_AA.0077, CARE_AA.0780, CARE_AA.1394, CARE_AA.1460
Artemisia tridentata ssp. wyomingensis / Bouteloua gracilis Shrubland	CEGL001041	4	CARE.0532, CARE.0580, CARE_AA.0353, CARE_AA.0781
Artemisia tridentata ssp. wyomingensis / Disturbed Understory Semi-natural Shrubland	CEGL002083	4	CARE.0425, CARE.0466, CARE.0467, CARE.0471

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

Plant Association Scientific Name	Element Code	No. of Samples	Plots
Atriplex canescens – Ephedra viridis Talus Shrubland	CEGL002346	2	CARE.0616, CARE.0617
Atriplex canescens / Bouteloua gracilis Shrubland	CEGL001283	1	CARE.0442
Atriplex canescens / Pleuraphis jamesii Shrubland	CEGL001288	1	CARE.0574
Atriplex canescens / Sporobolus airoides Shrubland	CEGL001291	1	CARE.0478
Atriplex canescens Desert Wash Shrubland	CEGL003470	1	CARE_AA.0147
Atriplex canescens Shrubland	CEGL001281	2	CARE.0427, CARE..8701
Atriplex confertifolia - Krascheninnikovia lanata Shrubland	CEGL001301	1	CARE.0448
Atriplex confertifolia - Sarcobatus vermiculatus Shrubland	CEGL001313	3	CARE.9001, CARE.9048, CARE.9216
Atriplex confertifolia / Achnatherum hymenoides Shrubland	CEGL001311	2	CARE.0516, CARE.9143
Atriplex confertifolia / Pleuraphis jamesii Shrubland	CEGL001304	19	CARE.0402, CARE.0444, CARE.0454, CARE.0513, CARE.0515, CARE.0571, CARE.9004, CARE.9022, CARE.9027, CARE.9077, CARE.9104, CARE.9106, CARE.9213, CARE.9318, CARE.9407, CARE.9408, CARE.9409, CARE.9410, CARE.9417
Atriplex confertifolia Great Basin Shrubland	CEGL001294	2	CARE.0458, CARE.8702
Atriplex corrugata Dwarf-shrubland	CEGL001437	8	CARE.0407, CARE.0414, CARE.0428, CARE.9013, CARE.9147, CARE.9183, CARE.9221, CARE.9654
Atriplex gardneri / Achnatherum hymenoides Dwarf-shrubland	CEGL001444	4	CARE.9021, CARE.9025, CARE.9081, CARE.9130
Atriplex gardneri / Pleuraphis jamesii Dwarf-shrubland	CEGL001441	3	CARE.9038, CARE.9218, CARE.9323
Atriplex gardneri / Xylorhiza venusta Dwarf-shrubland	CEGL001446	1	CARE.9047
Atriplex gardneri Dwarf-shrubland	CEGL001438	9	CARE.0405, CARE.0408, CARE.0460, CARE.0517, CARE.9020, CARE.9039, CARE.9085, CARE.9219, CARE.9222
* <i>Atriplex</i> spp. Extreme Sparse Shrubland	[Park Special]	N/A	Described from field notes
Betula occidentalis Shrubland	CEGL001080	2	CARE.0637, CARE.0638
Bouteloua eriopoda - Pleuraphis jamesii Herbaceous Vegetation	CEGL001751	1	CARE.0553

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

Plant Association Scientific Name	Element Code	No. of Samples	Plots
Bouteloua gracilis - Hesperostipa comata Herbaceous Vegetation	CEGL002932	1	CARE_AA.0242
Bouteloua gracilis - Pleuraphis jamesii Herbaceous Vegetation	CEGL001759	1	CARE_AA.1804
Bromus tectorum Semi-natural Herbaceous Vegetation	CEGL003019	1	CARE.8705
Celtis laevigata var. reticulata Slickrock Canyon Woodland	CEGL002359	5	CARE.0508, CARE.0562, CARE.9093, CARE.9328, CARE.9357
Cercocarpus intricatus Slickrock Sparse Vegetation	CEGL002977	9	CARE.9034, CARE.9097, CARE.9111, CARE.9115, CARE.9116, CARE.9169, CARE.9180, CARE.9203, CARE.9420
Cercocarpus ledifolius / Artemisia tridentata ssp. vaseyana Woodland	CEGL001022	1	CARE.0582
Chrysothamnus viscidiflorus Talus Shrubland	CEGL002347	1	CARE.0629
Coleogyne ramosissima - Purshia stansburiana - Quercus havardii var. tuckeri Shrubland	CEGL002348	4	CARE.0602, CARE.0650, CARE.0651, CARE.0654
Coleogyne ramosissima / Pleuraphis jamesii Shrubland	CEGL001334	1	CARE.9438
Coleogyne ramosissima Shrubland	CEGL001332	13	CARE.0406, CARE.0511, CARE.0514, CARE.0518, CARE.0559, CARE.0561, CARE.0564, CARE.9003, CARE.9007, CARE.9009, CARE.9144, CARE.9312, CARE.9439
Cornus sericea Shrubland	CEGL001165	2	CARE.9092, CARE.9094
Eleocharis palustris Herbaceous Vegetation	CEGL001833	2	CARE.9095, CARE.9107
Ephedra torreyana - (Atriplex spp.) / Nonvascular Gypsum Sparse Vegetation	CEGL002349	9	CARE.0421, CARE.0477, CARE.0523, CARE.9032, CARE.9132, CARE.9309, CARE_AA.0450 , CARE_AA.1058, CARE_AA.1278
Ephedra torreyana - Artemisia bigelovii Sparse Vegetation	CEGL002350	17	CARE.0401, CARE.0404, CARE.0418, CARE.0443, CARE.0451, CARE.0459, CARE.0543, CARE.0554, CARE.0560, CARE.9012, CARE.9024, CARE.9040, CARE.9096, CARE.9223, CARE.9412, CARE.9435, CARE_AA.0390
Ephedra torreyana / Achnatherum hymenoides - Pleuraphis jamesii Shrubland	CEGL002352	8	CARE.0429, CARE.0435, CARE.0623, CARE.0624, CARE.0625, CARE.0626, CARE.0627, CARE.9129

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

Plant Association Scientific Name	Element Code	No. of Samples	Plots
Ephedra torreyana / Bouteloua gracilis - Pleuraphis jamesii Shrubland	CEGL002351	7	CARE.0621, CARE.0622, CARE.9344, CARE_AA.0166 , CARE_AA.0637, CARE_AA.0865, CARE_AA.1228
Ephedra torreyana Sparse Vegetation	CEGL002353	4	CARE.0419, CARE.0434, CARE.0436, CARE_AA.0333
Ephedra viridis / (Achnatherum hymenoides, Hesperostipa comata) Shrubland	CEGL002354	5	CARE.0639, CARE.0640, CARE.0704, CARE.0706, CARE.0709
Ephedra viridis / Bromus tectorum Semi-natural Shrubland	CEGL002355	1	CARE.0652
Ephedra viridis / Pleuraphis jamesii Shrubland	CEGL002356	2	CARE.0601, CARE.0603
Ericameria nauseosa / Bouteloua gracilis Shrub Herbaceous Vegetation	CEGL003495	2	CARE.0439, CARE.0441
Ericameria nauseosa / Bromus tectorum Semi-natural Shrubland	CEGL002937	2	CARE.9023, CARE.9026
Ericameria nauseosa / Sporobolus airoides Shrubland	CEGL002918	2	CARE.0433, CARE.9059
Ericameria nauseosa Desert Wash Shrubland	CEGL002261	12	CARE.0437, CARE.0438, CARE.9049, CARE.9055, CARE.9105, CARE.9110, CARE.9113, CARE.9141, CARE.9305, CARE.9363, CARE.9366, CARE_AA.0702
Ericameria nauseosa Sand Deposit Sparse Shrubland	CEGL002980	3	CARE.0403, CARE.9058, CARE.9062
Eriogonum corymbosum Badlands Sparse Vegetation	CEGL002979	6	CARE.0422, CARE.0620, CARE.9078, CARE.9319, CARE.9343, CARE.9704
Eriogonum leptocladon Sparse Vegetation	CEGL002822	1	CARE.0420
Eriogonum leptocladon / Muhlenbergia pungens Shrubland	CEGL002821	1	CARE.9054
Fallugia paradoxa Desert Wash Shrubland	CEGL002357	7	CARE.0544, CARE.0545, CARE.0619, CARE.9158, CARE.9184, CARE.9191, CARE.9196
Fraxinus anomala Woodland	CEGL002752	11	CARE.9002, CARE.9006, CARE.9088, CARE.9133, CARE.9188, CARE.9226, CARE.9227, CARE.9301, CARE.9307, CARE.9317, CARE.9335
Grayia spinosa Shrubland	CEGL002358	1	CARE.0558

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

Plant Association Scientific Name	Element Code	No. of Samples	Plots
Gutierrezia sarothrae / Sporobolus airoides - Pleuraphis jamesii Shrub Herbaceous Vegetation	CEGL001776	1	CARE_AA.0498
*Halogeton glomeratus Semi-natural Herbaceous Vegetation	Park Special	N/A	Described from field notes
Hesperostipa comata Great Basin Herbaceous Vegetation	CEGL001705	1	CARE.9112
Juncus balticus Herbaceous Vegetation	CEGL001838	1	CARE.9652
Juniperus osteosperma - (Pinus edulis) / Coleogyne ramosissima - Purshia stansburiana - Quercus havardii var. tuckeri Wooded Shrubland	CEGL003774	1	CARE_AA.0662
Juniperus osteosperma / Artemisia tridentata ssp. tridentata Woodland	CEGL002360	2	CARE.9173, CARE.9177
Juniperus osteosperma / Artemisia tridentata ssp. wyomingensis Woodland	CEGL000730	2	CARE.0412, CARE.0415
Juniperus osteosperma / Bouteloua gracilis Woodland	CEGL002361	1	CARE.0410
Juniperus osteosperma / Cercocarpus intricatus Woodland	CEGL000733	2	CARE.9102, CARE.9348
Juniperus osteosperma / Hesperostipa comata Woodland	CEGL002815	1	CARE.0476
Juniperus osteosperma / Leymus salinus Woodland	CEGL003109	5	CARE.9029, CARE.9042, CARE.9043, CARE.9189, CARE.9190
Juniperus osteosperma / Pleuraphis jamesii Woodland	CEGL002362	3	CARE.0409, CARE.9194, CARE.9423
Juniperus osteosperma / Sparse Understory Woodland	CEGL000732	2	CARE.0411, CARE.0525
Krascheninnikovia lanata / Pleuraphis jamesii Dwarf-shrubland	CEGL001322	1	CARE_AA.0757
Krascheninnikovia lanata Dwarf-shrubland	CEGL001320	1	CARE_AA.1402
Leymus salinus Shale Sparse Vegetation	CEGL002745	3	CARE.0503, CARE.0531, CARE.0581
*Mesic Canyon Bottom Shrubland	Park Special	N/A	Described from field notes
Muhlenbergia pungens Herbaceous Vegetation	CEGL002363	2	CARE.9098, CARE.9414
Phragmites australis Western North America Temperate Semi-natural Herbaceous Vegetation	CEGL001475	2	CARE.0432, CARE.9362
Picea pungens / Cornus sericea Woodland	CEGL000388	1	CARE.9442

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

Plant Association Scientific Name	Element Code	No. of Samples	Plots
Pinus edulis - (Juniperus osteosperma) / Bouteloua gracilis Woodland	CEGL000778	13	CARE.0450, CARE.0453, CARE.0480, CARE.0481, CARE.9066, CARE.9067, CARE.9137, CARE.9159, CARE.9413, CARE.9415, CARE.9418, CARE.9419, CARE.9430
Pinus edulis - (Juniperus monosperma, Juniperus osteosperma) / Hesperostipa comata Woodland	CEGL000797	8	CARE.9031, CARE.9037, CARE.9069, CARE.9136, CARE.9193, CARE.9320, CARE.9351, CARE_AA.0850
Pinus edulis - Juniperus osteosperma / (Shepherdia rotundifolia, Amelanchier utahensis) Wooded Shrubland	CEGL002334	37	CARE.0423, CARE.0461, CARE.0462, CARE.0468, CARE.0469, CARE.0472, CARE.0475, CARE.0506, CARE.0507, CARE.0529, CARE.0573, CARE.9014, CARE.9028, CARE.9033, CARE.9064, CARE.9117, CARE.9119, CARE.9152, CARE.9153, CARE.9154, CARE.9164, CARE.9166, CARE.9171, CARE.9178, CARE.9211, CARE.9212, CARE.9308, CARE.9314, CARE.9332, CARE.9334, CARE.9339, CARE.9340, CARE.9406, CARE.9422, CARE.9425, CARE.9429, CARE.9431
Pinus edulis - Juniperus osteosperma / Achnatherum hymenoides Woodland	CEGL002364	2	CARE.9121, CARE.9134
Pinus edulis - Juniperus osteosperma / Amelanchier utahensis Woodland	CEGL002329	2	CARE.9701, CARE_AA.0516
Pinus edulis - Juniperus osteosperma / Arctostaphylos patula Woodland	CEGL002939	2	CARE.0557, CARE.9035
Pinus edulis - Juniperus osteosperma / Artemisia bigelovii Woodland	CEGL002118	2	CARE.9336, CARE.9342
Pinus edulis - Juniperus osteosperma / Artemisia nova Woodland	CEGL002331	4	CARE.0470, CARE.0524, CARE.0565, CARE.9421
Pinus edulis - Juniperus osteosperma / Artemisia pygmaea Woodland	CEGL002365	3	CARE.0446, CARE.0610, CARE.9405
Pinus edulis - Juniperus osteosperma / Atriplex spp. Woodland	CEGL002366	5	CARE.0611, CARE.0612, CARE.9428, CARE_AA.0287, CARE_AA.1344
Pinus edulis - Juniperus osteosperma / Bromus tectorum Semi-natural Woodland	CEGL002367	1	CARE.9187
Pinus edulis - Juniperus osteosperma / Cercocarpus intricatus Woodland	CEGL000779	12	CARE.0555, CARE.9016, CARE.9082, CARE.9091, CARE.9109, CARE.9122, CARE.9124, CARE.9135, CARE.9225, CARE.9324, CARE.9331, CARE.9368

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

Plant Association Scientific Name	Element Code	No. of Samples	Plots
Pinus edulis - Juniperus osteosperma / Cercocarpus ledifolius Woodland	CEGL002940	2	CARE.0714, CARE.0716
Pinus edulis - Juniperus osteosperma / Coleogyne ramosissima Woodland	CEGL000781	5	CARE.0563, CARE.9185, CARE_AA.0186, CARE_AA.0873, CARE_AA.0904
Pinus edulis - Juniperus osteosperma / Cushion Plant Woodland	CEGL002375	4	CARE.9337, CARE.9350, CARE.9401, CARE.9404
Pinus edulis - Juniperus osteosperma / Ephedra torreyana - Artemisia bigelovii Woodland	CEGL002369	20	CARE.0455, CARE.0456, CARE.0572, CARE.9041, CARE.9044, CARE.9046, CARE.9068, CARE.9080, CARE.9083, CARE.9087, CARE.9100, CARE.9127, CARE.9179, CARE.9204, CARE.9220, CARE.9306, CARE.9321, CARE.9345, CARE.9352, CARE.9432
Pinus edulis - Juniperus osteosperma / Ephedra viridis Woodland	CEGL002370	1	CARE.0417
Pinus edulis - Juniperus osteosperma / Hesperostipa neomexicana Woodland	CEGL002371	1	CARE.9433
Pinus edulis - Juniperus osteosperma / Muhlenbergia pungens Woodland	CEGL002373	3	CARE.9108, CARE.9125, CARE.9403
Pinus edulis - Juniperus osteosperma / Opuntia fragilis Woodland	CEGL002374	3	CARE.0505, CARE.0655, CARE.0656
Pinus edulis - Juniperus osteosperma / Petradoria pumila Woodland	CEGL002332	2	CARE.9011, CARE.9151
Pinus edulis - Juniperus osteosperma / Pleuraphis jamesii Woodland	CEGL002379	2	CARE.9079, CARE_AA.1646
Pinus edulis - Juniperus osteosperma / Psathyrostachys juncea Semi-natural Woodland	CEGL002368	1	CARE.0465
Pinus edulis - Juniperus osteosperma / Purshia stansburiana Woodland	CEGL000782	24	CARE.0431, CARE.0501, CARE.0526, CARE.0552, CARE.9072, CARE.9120, CARE.9126, CARE.9128, CARE.9150, CARE.9155, CARE.9170, CARE.9186, CARE.9206, CARE.9207, CARE.9208, CARE.9217, CARE.9304, CARE.9354, CARE.9426, CARE.9427, CARE.9444, CARE_AA.0198, CARE_AA.0766, CARE_AA.1545
Pinus edulis - Juniperus osteosperma / Purshia tridentata Woodland	CEGL000789	2	CARE_AA.0414, CARE_AA.0958
Pinus edulis - Juniperus osteosperma / Quercus havardii var. tuckeri Woodland	CEGL002497	3	CARE.0606, CARE.0607, CARE.0608
Pinus edulis - Juniperus osteosperma / Shepherdia rotundifolia Woodland	CEGL002335	5	CARE.0445, CARE.0636, CARE.0660, CARE_AA.0689, CARE_AA.1425

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

Plant Association Scientific Name	Element Code	No. of Samples	Plots
Pinus edulis - Juniperus osteosperma / Sparse Understory Woodland	CEGL002148	9	CARE.0426, CARE.0504, CARE.0527, CARE.0533, CARE.0534, CARE.0577, CARE.0578, CARE.0579, CARE.8703
Pinus edulis - Juniperus spp. / Artemisia tridentata (ssp. wyomingensis, ssp. vaseyana) Woodland	CEGL000776	28	CARE.0463, CARE.0464, CARE.0502, CARE.9174, CARE.9205, CARE_AA.0014, CARE_AA.0109, CARE_AA.0189, CARE_AA.0308, CARE_AA.0391, CARE_AA.0497, CARE_AA.0590, CARE_AA.0610, CARE_AA.0628, CARE_AA.0629, CARE_AA.0813, CARE_AA.0849, CARE_AA.0942, CARE_AA.0960, CARE_AA.1027, CARE_AA.1197, CARE_AA.1571, CARE_AA.1581
Pinus edulis - Juniperus spp. / Cercocarpus montanus - Mixed Shrubs Woodland	CEGL000780	7	CARE.0535, CARE.0556, CARE.0575, CARE.0576, CARE.9162, CARE.9165, CARE.9313
Pinus edulis - Juniperus spp. / Leymus salinus Woodland	CEGL002340	3	CARE.9156, CARE.9157, CARE.9195
Pinus edulis - Juniperus spp. / Quercus gambelii Woodland	CEGL000791	6	CARE.0551, CARE.0609, CARE.0632, CARE.0705, CARE.0707, CARE_AA.1462
Pinus longaeva Woodland	CEGL002380	5	CARE.0536, CARE.0538, CARE.9148, CARE.9416, CARE.9443
Pinus ponderosa - Pseudotsuga menziesii / Purshia tridentata Woodland	CEGL000214	3	CARE.0537, CARE.0539, CARE.0584
Pinus ponderosa / Arctostaphylos patula Woodland	CEGL000842	4	CARE.9076, CARE.9090, CARE.9167, CARE.9168
Pinus ponderosa / Artemisia nova Woodland	CEGL000846	2	CARE.0587, CARE.0588
Pinus ponderosa / Artemisia tridentata ssp. vaseyana Woodland	CEGL002794	1	CARE.9706
Pinus ponderosa / Cercocarpus ledifolius Woodland	CEGL000850	2	CARE.0719, CARE.9402
Pinus ponderosa / Purshia tridentata Woodland	CEGL000867	3	CARE.0586, CARE.0589, CARE.9074
Pinus ponderosa / Quercus gambelii Woodland	CEGL000870	2	CARE.0702, CARE_AA.0727
Pinus ponderosa / Sparse Understory Woodland	CEGL002384	1	CARE.0657
Pinus ponderosa Slickrock Sparse Vegetation	CEGL002972	4	CARE.0700, CARE_AA.0416, CARE_AA.1109, CARE_AA.1331
Pleuraphis jamesii - Sporobolus airoides Herbaceous Vegetation	CEGL001778	1	CARE.9114
Pleuraphis jamesii Herbaceous Vegetation	CEGL001777	1	CARE.0521

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

Plant Association Scientific Name	Element Code	No. of Samples	Plots
* <i>Poa fendleriana</i> / Non-vascular Herbaceous Vegetation	Park Special	N/A	Described from field notes
<i>Poliomintha incana</i> - <i>Artemisia filifolia</i> - <i>Vancleavea stylosa</i> Shrubland	CEGL002418	4	CARE.0510, CARE.0568, CARE.9010, CARE.9436
<i>Populus angustifolia</i> / <i>Rhus trilobata</i> Woodland	CEGL000652	2	CARE.0634, CARE.0635
<i>Populus fremontii</i> - <i>Salix gooddingii</i> Woodland	CEGL000944	2	CARE.9369, CARE.9370
<i>Populus fremontii</i> / <i>Acer negundo</i> Forest	CEGL000662	1	CARE.9347
<i>Populus fremontii</i> / <i>Ericameria nauseosa</i> Woodland	CEGL002465	12	CARE.9123, CARE.9139, CARE.9176, CARE.9182, CARE.9198, CARE.9215, CARE.9316, CARE.9338, CARE.9349, CARE.9356, CARE.9360, CARE.9437
<i>Populus fremontii</i> / Mesic Forbs Woodland	CEGL002470	1	CARE.9214
<i>Populus fremontii</i> / Mesic Graminoids Woodland	CEGL002473	3	CARE.9118, CARE.9333, CARE.9653
<i>Populus fremontii</i> / <i>Salix exigua</i> Forest	CEGL000666	5	CARE.9099, CARE.9175, CARE.9181, CARE.9300, CARE.9302
<i>Populus tremuloides</i> / <i>Symphoricarpos oreophilus</i> Forest	CEGL000610	4	CARE.0540, CARE.0541, CARE.0542, CARE.9075
<i>Pseudotsuga menziesii</i> / <i>Acer glabrum</i> Forest	CEGL000418	2	CARE.0631, CARE_AA.0984
<i>Pseudotsuga menziesii</i> / <i>Betula occidentalis</i> Woodland	CEGL002639	1	CARE.0659
<i>Pseudotsuga menziesii</i> / <i>Cercocarpus ledifolius</i> Woodland	CEGL000897	2	CARE.0583, CARE.9149
<i>Pseudotsuga menziesii</i> / <i>Cercocarpus montanus</i> Woodland	CEGL000898	2	CARE.0717, CARE.9163
<i>Pseudotsuga menziesii</i> / <i>Quercus gambelii</i> Forest	CEGL000452	3	CARE.0658, CARE_AA.0053, CARE_AA.1023
<i>Pseudotsuga menziesii</i> / <i>Symphoricarpos oreophilus</i> Forest	CEGL000462	2	CARE.0720, CARE.0722
<i>Pseudotsuga menziesii</i> Scree Woodland	CEGL000911	2	CARE.0530, CARE.9655
<i>Quercus gambelii</i> / <i>Amelanchier utahensis</i> Shrubland	CEGL001110	3	CARE.0633, CARE.0701, CARE.0703
<i>Quercus gambelii</i> / Sparse Understory Shrubland	CEGL002337	1	CARE.0512
<i>Quercus havardii</i> var. <i>tuckeri</i> Shrubland	CEGL002486	5	CARE.0567, CARE.0569, CARE.0604, CARE.0605, CARE.0653

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

Plant Association Scientific Name	Element Code	No. of Samples	Plots
Rhus trilobata Intermittently Flooded Shrubland	CEGL001121	1	CARE_AA.1244
Salix exigua / Barren Shrubland	CEGL001200	1	CARE.9202
Salix exigua / Mesic Graminoids Shrubland	CEGL001203	2	CARE.0447, CARE.9053
Salix gooddingii Temporarily Flooded Woodland Alliance	A.640	2	CARE.9371, CARE.9372
Sarcobatus vermiculatus / Artemisia tridentata Shrubland	CEGL001359	2	CARE.9051, CARE.9063
Sarcobatus vermiculatus / Atriplex confertifolia - (Picrothamnus desertorum, Suaeda moquinii) Shrubland	CEGL001371	2	CARE.9015, CARE.9355
Sarcobatus vermiculatus / Distichlis spicata Shrubland	CEGL001363	1	CARE.0615
Sarcobatus vermiculatus / Sporobolus airoides Shrubland	CEGL001368	3	CARE.0449, CARE.0457, CARE_AA.1142
Sarcobatus vermiculatus Disturbed Shrubland	CEGL001357	5	CARE.0413, CARE.0520, CARE.0613, CARE.0614, CARE.9322
Schoenoplectus pungens Herbaceous Vegetation	CEGL001587	1	CARE.0452
Slickrock Fin Pocket	Park Special	4	CARE.0528, CARE.9103, CARE.9326, CARE.9327
*Sparse Cushion Plant Herbaceous Vegetation	Park Special	N/A	Described from field data
Sporobolus airoides Southern Plains Herbaceous Vegetation	CEGL001685	5	CARE_AA.0548, CARE_AA.0551, CARE_AA.0669, CARE_AA.1008, CARE_AA.1086
Sporobolus flexuosus Herbaceous Alliance	A.1268	2	CARE.0630, CARE.9199
Symphoricarpos oreophilus Shrubland	CEGL002951	1	CARE.0727
Tamarix spp. Temporarily Flooded Semi-natural Shrubland	CEGL003114	1	CARE.9310
Typha (latifolia, angustifolia) Western Herbaceous Vegetation	CEGL002010	1	CARE.9329
Waterpocket Community	Park Special	1	CARE.9101
*Wet Meadow Herbaceous Vegetation	Park Special	N/A	Described from field notes
Zuckia brandegeei Sparse Vegetation	CEGL002493	7	CARE.0440, CARE.0479, CARE.0566, CARE.9019, CARE.9197, CARE.9210, CARE.9411

Appendix F

Plant Association Descriptions for Capitol Reef National Park

The Capitol Reef National Park (CARE) vegetation mapping project identified 167 National Vegetation Classification (NVC) plant associations or alliances and eight park special vegetation types. Detailed vegetation descriptions are essential for recognizing floristic vegetation types (association and alliance levels of the NVC) in the field. Local and global descriptions “*provide specific information on the geographical distribution, level of acceptable physiognomic and compositional variation, and the key ecological process and environmental / abiotic factors that are associated with a type*” (Grossman et al. 1998). The two levels of vegetation description are valuable for comparing each association as it appears in the park with the global range of variation for that association.

The following report was prepared by NatureServe to provide local and global descriptions for each plant association found at CARE. These descriptions reflect NatureServe’s accumulated data and analysis. Global descriptions of NVC associations are available on NatureServe’s Explorer Web site (<http://www.natureserve.org/explorer>); local descriptions are not. Only local descriptions are available for provisional and park special vegetation types. No plot data and therefore no descriptions are available for one association (*Arctostaphylos patula* Shrubland) and six park special types (*Atriplex* spp. Extreme Sparse Shrubland, *Halogeton glomeratus* Semi-natural Herbaceous Vegetation, Mesic Canyon Bottom Shrubland, *Poa fendleriana* / Non-vascular Herbaceous Vegetation, Sparse Cushion Plant Herbaceous Vegetation, Wet Meadow Herbaceous Vegetation).

In this appendix, NVC plant associations are arranged by physiognomic class (e.g., Forest, Shrubland), with upland types listed before riparian and wetland types. Within each physiognomic class, associations are sorted into formations (e.g., Conical-crowned temperate), and alliances (e.g., *Juniperus osteosperma* Woodland Alliance).

TABLE OF CONTENTS

I. FOREST 251

Conical-crowned temperate or subpolar needle-leaved evergreen forest..... 251

Pseudotsuga menziesii Forest Alliance 251

Pseudotsuga menziesii / *Acer glabrum* Forest 251

Pseudotsuga menziesii / *Quercus gambelii* Forest..... 253

Pseudotsuga menziesii / *Symphoricarpos oreophilus* Forest 255

Montane or boreal cold-deciduous forest 258

Populus tremuloides Forest Alliance..... 258

Populus tremuloides / *Symphoricarpos oreophilus* Forest 258

Temporarily flooded cold-deciduous forest..... 260

Populus fremontii Temporarily Flooded Forest Alliance 260

Populus fremontii / *Acer negundo* Forest 260

Populus fremontii / *Salix exigua* Forest 262

II. WOODLAND 265

Rounded-crowned temperate or subpolar needle-leaved evergreen woodland 265

Juniperus osteosperma Woodland Alliance..... 265

Juniperus osteosperma / *Artemisia tridentata* ssp. *tridentata* Woodland 265

Juniperus osteosperma / *Artemisia tridentata* ssp. *wyomingensis* Woodland 267

Juniperus osteosperma / *Bouteloua gracilis* Woodland [Provisional]..... 268

Juniperus osteosperma / *Cercocarpus intricatus* Woodland 271

Juniperus osteosperma / *Hesperostipa comata* Woodland 273

Juniperus osteosperma / *Leymus salinus* Woodland 275

Juniperus osteosperma / *Pleuraphis jamesii* Woodland 277

Juniperus osteosperma / Sparse Understory Woodland 279

Pinus edulis - (*Juniperus* spp.) Woodland Alliance..... 281

Pinus edulis - (*Juniperus monosperma*, *Juniperus osteosperma*) / *Hesperostipa comata* Woodland 281

Pinus edulis - (*Juniperus osteosperma*) / *Bouteloua gracilis* Woodland 284

Pinus edulis - *Juniperus osteosperma* / *Achnatherum hymenoides* Woodland 286

Pinus edulis - *Juniperus osteosperma* / *Amelanchier utahensis* Woodland..... 288

Pinus edulis - *Juniperus osteosperma* / *Arctostaphylos patula* Woodland 290

Pinus edulis - *Juniperus osteosperma* / *Artemisia bigelovii* Woodland..... 292

Pinus edulis - *Juniperus osteosperma* / *Artemisia nova* Woodland 294

Pinus edulis - *Juniperus osteosperma* / *Artemisia pygmaea* Woodland 297

Pinus edulis - *Juniperus osteosperma* / *Atriplex* spp. Woodland [Provisional] 299

Pinus edulis - *Juniperus osteosperma* / *Bromus tectorum* Semi-natural Woodland 301

Pinus edulis - *Juniperus osteosperma* / *Cercocarpus intricatus* Woodland 303

Pinus edulis - *Juniperus osteosperma* / *Cercocarpus ledifolius* Woodland..... 306

Pinus edulis - *Juniperus osteosperma* / *Coleogyne ramosissima* Woodland 308

Pinus edulis - *Juniperus osteosperma* / Cushion Plant Woodland..... 310

Pinus edulis - *Juniperus osteosperma* / *Ephedra torreyana* - *Artemisia bigelovii* Woodland 312

Pinus edulis - *Juniperus osteosperma* / *Ephedra viridis* Woodland 315

Pinus edulis - *Juniperus osteosperma* / *Hesperostipa neomexicana* Woodland 317

Pinus edulis - *Juniperus osteosperma* / *Muhlenbergia pungens* Woodland 318

Pinus edulis - *Juniperus osteosperma* / *Opuntia fragilis* Woodland..... 319

Pinus edulis - *Juniperus osteosperma* / *Petradoria pumila* Woodland..... 322

Pinus edulis - *Juniperus osteosperma* / *Pleuraphis jamesii* Woodland 324

Pinus edulis - *Juniperus osteosperma* / *Psathyrostachys juncea* Semi-natural Woodland 326

Pinus edulis - *Juniperus osteosperma* / *Purshia stansburiana* Woodland..... 327

Pinus edulis - *Juniperus osteosperma* / *Purshia tridentata* Woodland..... 330

Pinus edulis - *Juniperus osteosperma* / *Quercus havardii* var. *tuckeri* Woodland 332

<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / <i>Shepherdia rotundifolia</i> Woodland	335
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / Sparse Understory Woodland.....	337
<i>Pinus edulis</i> - <i>Juniperus</i> spp. / <i>Artemisia tridentata</i> (ssp. <i>wyomingensis</i> , ssp. <i>vaseyana</i>) Woodland.....	339
<i>Pinus edulis</i> - <i>Juniperus</i> spp. / <i>Cercocarpus montanus</i> - Mixed Shrubs Woodland.....	342
<i>Pinus edulis</i> - <i>Juniperus</i> spp. / <i>Leymus salinus</i> Woodland	345
<i>Pinus edulis</i> - <i>Juniperus</i> spp. / <i>Quercus gambelii</i> Woodland	347
<i>Pinus longaeva</i> Woodland Alliance	350
<i>Pinus longaeva</i> Woodland	350
<i>Pinus ponderosa</i> - <i>Pseudotsuga menziesii</i> Woodland Alliance.....	352
<i>Pinus ponderosa</i> - <i>Pseudotsuga menziesii</i> / <i>Purshia tridentata</i> Woodland	352
<i>Pinus ponderosa</i> Woodland Alliance	354
<i>Pinus ponderosa</i> / <i>Arctostaphylos patula</i> Woodland.....	354
<i>Pinus ponderosa</i> / <i>Artemisia nova</i> Woodland.....	356
<i>Pinus ponderosa</i> / <i>Artemisia tridentata</i> ssp. <i>vaseyana</i> Woodland	358
<i>Pinus ponderosa</i> / <i>Cercocarpus ledifolius</i> Woodland	360
<i>Pinus ponderosa</i> / <i>Purshia tridentata</i> Woodland.....	363
<i>Pinus ponderosa</i> / <i>Quercus gambelii</i> Woodland	365
<i>Pinus ponderosa</i> / Sparse Understory Woodland [Provisional].....	367
Conical-crowned temperate or subpolar needle-leaved evergreen woodland.....	369
<i>Pseudotsuga menziesii</i> Woodland Alliance	369
<i>Pseudotsuga menziesii</i> / <i>Cercocarpus ledifolius</i> Woodland	369
<i>Pseudotsuga menziesii</i> / <i>Cercocarpus montanus</i> Woodland.....	372
<i>Pseudotsuga menziesii</i> Scree Woodland.....	374
Temporarily flooded temperate or subpolar needle-leaved evergreen woodland.....	376
<i>Picea pungens</i> Temporarily Flooded Woodland Alliance	376
<i>Picea pungens</i> / <i>Cornus sericea</i> Woodland	376
<i>Pseudotsuga menziesii</i> Temporarily Flooded Woodland Alliance	378
<i>Pseudotsuga menziesii</i> / <i>Betula occidentalis</i> Woodland	378
Sclerophyllous extremely xeromorphic evergreen woodland	381
<i>Cercocarpus ledifolius</i> Woodland Alliance	381
<i>Cercocarpus ledifolius</i> / <i>Artemisia tridentata</i> ssp. <i>vaseyana</i> Woodland	381
Cold-deciduous woodland	383
<i>Celtis laevigata</i> var. <i>reticulata</i> Woodland Alliance	383
<i>Celtis laevigata</i> var. <i>reticulata</i> Slickrock Canyon Woodland [Provisional].....	383
Temporarily flooded cold-deciduous woodland	385
<i>Acer negundo</i> Temporarily Flooded Woodland Alliance	385
<i>Acer negundo</i> - <i>Ostrya knowltonii</i> Woodland [Provisional].....	385
<i>Acer negundo</i> / <i>Quercus gambelii</i> Woodland	387
<i>Acer negundo</i> / <i>Rhus trilobata</i> Woodland.....	388
<i>Fraxinus anomala</i> Temporarily Flooded Woodland Alliance.....	390
<i>Fraxinus anomala</i> Woodland	390
<i>Populus angustifolia</i> Temporarily Flooded Woodland Alliance	393
<i>Populus angustifolia</i> / <i>Rhus trilobata</i> Woodland.....	393
<i>Populus fremontii</i> Temporarily Flooded Woodland Alliance	395
<i>Populus fremontii</i> - <i>Salix gooddingii</i> Woodland.....	395
<i>Populus fremontii</i> / <i>Ericameria nauseosa</i> Woodland	398
<i>Populus fremontii</i> / Mesic Forbs Woodland	400
<i>Populus fremontii</i> / Mesic Graminoids Woodland.....	402
III. SHRUBLAND.....	404

Lowland microphyllous evergreen shrubland.....	404
<i>Artemisia filifolia</i> Shrubland Alliance.....	404
<i>Artemisia filifolia</i> Colorado Plateau Shrubland	404
<i>Artemisia nova</i> Shrubland Alliance	407
<i>Artemisia nova</i> - <i>Purshia tridentata</i> / <i>Poa fendleriana</i> Shrubland	407
<i>Artemisia nova</i> / <i>Poa fendleriana</i> Shrubland	409
<i>Artemisia tridentata</i> (ssp. <i>tridentata</i> , ssp. <i>xericensis</i>) Shrubland Alliance.....	411
<i>Artemisia tridentata</i> ssp. <i>tridentata</i> / <i>Pleuraphis jamesii</i> Shrubland	411
<i>Artemisia tridentata</i> ssp. <i>tridentata</i> / <i>Sporobolus airoides</i> Shrubland	413
<i>Artemisia tridentata</i> Shrubland Alliance	415
<i>Artemisia tridentata</i> - (<i>Ericameria nauseosa</i>) / <i>Bromus tectorum</i> Semi-natural Shrubland	415
<i>Artemisia tridentata</i> / <i>Achnatherum hymenoides</i> Shrubland.....	417
<i>Artemisia tridentata</i> ssp. <i>vaseyana</i> Shrubland Alliance	419
<i>Artemisia tridentata</i> ssp. <i>vaseyana</i> / <i>Poa fendleriana</i> Shrubland	419
<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> Shrubland Alliance	421
<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> / (<i>Agropyron cristatum</i> , <i>Psathyrostachys juncea</i>) Seeded Grasses Semi-natural Shrubland	421
<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> / <i>Bouteloua gracilis</i> Shrubland	423
<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> / Disturbed Understory Semi-natural Shrubland	425
<i>Chrysothamnus viscidiflorus</i> Shrubland Alliance.....	427
<i>Chrysothamnus viscidiflorus</i> Talus Shrubland.....	427
<i>Ericameria nauseosa</i> Shrubland Alliance	429
<i>Ericameria nauseosa</i> / <i>Bromus tectorum</i> Semi-natural Shrubland	429
<i>Ericameria nauseosa</i> / <i>Sporobolus airoides</i> Shrubland.....	431
<i>Ericameria nauseosa</i> Desert Wash Shrubland.....	433
<i>Ericameria nauseosa</i> Sand Deposit Sparse Shrubland	435
Temporarily flooded microphyllous shrubland	437
<i>Tamarix</i> spp. Semi-natural Temporarily Flooded Shrubland Alliance	437
<i>Tamarix</i> spp. Temporarily Flooded Semi-natural Shrubland.....	437
Broad-leaved and microphyllous evergreen extremely xeromorphic subdesert shrubland	439
<i>Artemisia bigelovii</i> Shrubland Alliance	439
<i>Artemisia bigelovii</i> Shrubland.....	439
<i>Ephedra torreyana</i> Shrubland Alliance.....	441
<i>Ephedra torreyana</i> / <i>Achnatherum hymenoides</i> - <i>Pleuraphis jamesii</i> Shrubland	441
<i>Ephedra torreyana</i> / <i>Bouteloua gracilis</i> - <i>Pleuraphis jamesii</i> Shrubland	443
<i>Ephedra viridis</i> Shrubland Alliance.....	445
<i>Ephedra viridis</i> / (<i>Achnatherum hymenoides</i> , <i>Hesperostipa comata</i>) Shrubland	445
<i>Ephedra viridis</i> / <i>Bromus tectorum</i> Semi-natural Shrubland	448
<i>Ephedra viridis</i> / <i>Pleuraphis jamesii</i> Shrubland	449
<i>Poliomintha incana</i> Shrubland Alliance	452
<i>Poliomintha incana</i> - <i>Artemisia filifolia</i> - <i>Vancleavea stylosa</i> Shrubland	452
Facultatively deciduous extremely xeromorphic subdesert shrubland.....	454
<i>Atriplex canescens</i> Shrubland Alliance	454
<i>Atriplex canescens</i> - <i>Ephedra viridis</i> Talus Shrubland	454
<i>Atriplex canescens</i> / <i>Bouteloua gracilis</i> Shrubland	456
<i>Atriplex canescens</i> / <i>Pleuraphis jamesii</i> Shrubland	458
<i>Atriplex canescens</i> / <i>Sporobolus airoides</i> Shrubland.....	461
<i>Atriplex canescens</i> Desert Wash Shrubland.....	463
<i>Atriplex canescens</i> Shrubland.....	465
<i>Atriplex confertifolia</i> Shrubland Alliance.....	467

<i>Atriplex confertifolia</i> - <i>Krascheninnikovia lanata</i> Shrubland	467
<i>Atriplex confertifolia</i> - <i>Sarcobatus vermiculatus</i> Shrubland	469
<i>Atriplex confertifolia</i> / <i>Achnatherum hymenoides</i> Shrubland	471
<i>Atriplex confertifolia</i> / <i>Pleuraphis jamesii</i> Shrubland	473
<i>Atriplex confertifolia</i> Great Basin Shrubland.....	476
Coleogyne ramosissima Shrubland Alliance	478
<i>Coleogyne ramosissima</i> - <i>Purshia stansburiana</i> - <i>Quercus havardii</i> var. <i>tuckeri</i> Shrubland	478
<i>Coleogyne ramosissima</i> / <i>Pleuraphis jamesii</i> Shrubland.....	481
<i>Coleogyne ramosissima</i> Shrubland.....	483
Extremely xeromorphic evergreen shrubland with a sparse tree layer	485
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> Wooded Shrubland Alliance.....	485
<i>Juniperus osteosperma</i> - (<i>Pinus edulis</i>) / <i>Coleogyne ramosissima</i> - <i>Purshia stansburiana</i> - <i>Quercus havardii</i> var. <i>tuckeri</i> Wooded Shrubland.....	485
<i>Pinus edulis</i> - <i>Juniperus osteosperma</i> / (<i>Shepherdia rotundifolia</i> , <i>Amelanchier utahensis</i>) Wooded Shrubland	488
Temperate cold-deciduous shrubland	491
<i>Amelanchier utahensis</i> Shrubland Alliance	491
<i>Amelanchier utahensis</i> Shrubland.....	491
<i>Quercus gambelii</i> Shrubland Alliance.....	493
<i>Quercus gambelii</i> / <i>Amelanchier utahensis</i> Shrubland	493
<i>Quercus gambelii</i> / Sparse Understory Shrubland	495
<i>Quercus havardii</i> var. <i>tuckeri</i> Shrubland Alliance	497
<i>Quercus havardii</i> var. <i>tuckeri</i> Shrubland.....	497
<i>Symphoricarpos oreophilus</i> Shrubland Alliance.....	500
<i>Symphoricarpos oreophilus</i> Shrubland.....	500
Intermittently flooded cold-deciduous shrubland.....	502
<i>Fallugia paradoxa</i> Intermittently Flooded Shrubland Alliance.....	502
<i>Fallugia paradoxa</i> Desert Wash Shrubland.....	502
<i>Rhus trilobata</i> Intermittently Flooded Shrubland Alliance.....	504
<i>Rhus trilobata</i> Intermittently Flooded Shrubland	504
Temporarily flooded cold-deciduous shrubland	507
<i>Cornus sericea</i> Temporarily Flooded Shrubland Alliance	507
<i>Cornus sericea</i> Shrubland.....	507
<i>Salix (exigua, interior)</i> Temporarily Flooded Shrubland Alliance	509
<i>Salix exigua</i> / Barren Shrubland	509
<i>Salix exigua</i> / Mesic Graminoids Shrubland.....	511
Seasonally flooded cold-deciduous shrubland.....	513
<i>Betula occidentalis</i> Seasonally Flooded Shrubland Alliance	513
<i>Betula occidentalis</i> Shrubland	513
Extremely xeromorphic deciduous subdesert shrubland without succulents	516
<i>Grayia spinosa</i> Shrubland Alliance	516
<i>Grayia spinosa</i> Shrubland	516
Intermittently flooded extremely xeromorphic deciduous subdesert shrubland	518
<i>Sarcobatus vermiculatus</i> Intermittently Flooded Shrubland Alliance.....	518
<i>Sarcobatus vermiculatus</i> / <i>Artemisia tridentata</i> Shrubland	518
<i>Sarcobatus vermiculatus</i> / <i>Atriplex confertifolia</i> - (<i>Picrothamnus desertorum</i> , <i>Suaeda moquinii</i>) Shrubland	520
<i>Sarcobatus vermiculatus</i> / <i>Distichlis spicata</i> Shrubland.....	522
<i>Sarcobatus vermiculatus</i> / <i>Sporobolus airoides</i> Shrubland	525
<i>Sarcobatus vermiculatus</i> Disturbed Shrubland.....	527
IV. DWARF-SHRUBLAND.....	529

Extremely xeromorphic evergreen subdesert dwarf-shrubland.....	529
<i>Krascheninnikovia lanata</i> Dwarf-shrubland Alliance	529
<i>Krascheninnikovia lanata</i> / <i>Pleuraphis jamesii</i> Dwarf-shrubland	529
<i>Krascheninnikovia lanata</i> Dwarf-shrubland	531
Facultatively deciduous subdesert dwarf-shrubland	533
<i>Atriplex corrugata</i> Dwarf-shrubland Alliance	533
<i>Atriplex corrugata</i> Dwarf-shrubland	533
<i>Atriplex gardneri</i> Dwarf-shrubland Alliance	536
<i>Atriplex gardneri</i> / <i>Achnatherum hymenoides</i> Dwarf-shrubland	536
<i>Atriplex gardneri</i> / <i>Pleuraphis jamesii</i> Dwarf-shrubland	538
<i>Atriplex gardneri</i> / <i>Xylorhiza venusta</i> Dwarf-shrubland.....	540
<i>Atriplex gardneri</i> Dwarf-shrubland	541
Cespitose cold-deciduous dwarf-shrubland.....	544
<i>Artemisia frigida</i> Dwarf-shrubland Alliance.....	544
<i>Artemisia frigida</i> - (<i>Bouteloua gracilis</i> , <i>Achnatherum hymenoides</i> , <i>Poa secunda</i>) - Lichens Rocky Mesa Dwarf-shrubland	544
Extremely xeromorphic deciduous subdesert dwarf-shrubland without succulents.....	546
<i>Eriogonum (corymbosum, leptocladon)</i> Dwarf-shrubland Alliance	546
<i>Eriogonum leptocladon</i> / <i>Muhlenbergia pungens</i> Shrubland [Provisional].....	546
V. HERBACEOUS VEGETATION	548
Medium-tall bunch temperate or subpolar grassland	548
<i>Achnatherum hymenoides</i> Herbaceous Alliance	548
<i>Achnatherum hymenoides</i> Colorado Plateau Herbaceous Vegetation	548
<i>Hesperostipa comata</i> Bunch Herbaceous Alliance.....	550
<i>Hesperostipa comata</i> Great Basin Herbaceous Vegetation	550
<i>Sporobolus airoides</i> Herbaceous Alliance	552
<i>Sporobolus airoides</i> Southern Plains Herbaceous Vegetation	552
Short sod temperate or subpolar grassland.....	554
<i>Bouteloua eriopoda</i> Herbaceous Alliance.....	554
<i>Bouteloua eriopoda</i> - <i>Pleuraphis jamesii</i> Herbaceous Vegetation	554
<i>Bouteloua gracilis</i> Herbaceous Alliance.....	556
<i>Bouteloua gracilis</i> - <i>Hesperostipa comata</i> Herbaceous Vegetation [Provisional].....	556
<i>Bouteloua gracilis</i> - <i>Pleuraphis jamesii</i> Herbaceous Vegetation	558
<i>Pleuraphis jamesii</i> Herbaceous Alliance	561
<i>Pleuraphis jamesii</i> - <i>Sporobolus airoides</i> Herbaceous Vegetation	561
<i>Pleuraphis jamesii</i> Herbaceous Vegetation	563
Seasonally flooded temperate or subpolar grassland	565
<i>Eleocharis (palustris, macrostachya)</i> Seasonally Flooded Herbaceous Alliance	565
<i>Eleocharis palustris</i> Herbaceous Vegetation	565
<i>Juncus balticus</i>) Seasonally Flooded Herbaceous Alliance	568
<i>Juncus balticus</i> Herbaceous Vegetation	568
Semipermanently flooded temperate or subpolar grassland	570
<i>Phragmites australis</i> Semipermanently Flooded Herbaceous Alliance.....	570
<i>Phragmites australis</i> Western North America Temperate Semi-natural Herbaceous Vegetation	570
<i>Schoenoplectus pungens</i> Semipermanently Flooded Herbaceous Alliance.....	572
<i>Schoenoplectus pungens</i> Herbaceous Vegetation	572
<i>Typha (angustifolia, latifolia)</i> - (<i>Schoenoplectus</i> spp.) Semipermanently Flooded Herbaceous Alliance.....	575
<i>Typha (latifolia, angustifolia)</i> Western Herbaceous Vegetation.....	575

Medium-tall temperate or subpolar grassland with a sparse needle-leaved or microphyllous evergreen shrub layer	577
<i>Sporobolus airoides</i> - (<i>Pleuraphis jamesii</i>) Shrub Herbaceous Alliance	577
<i>Gutierrezia sarothrae</i> / <i>Sporobolus airoides</i> - <i>Pleuraphis jamesii</i> Shrub Herbaceous Vegetation	577
Short temperate or subpolar grassland with a sparse microphyllous evergreen shrub layer	579
<i>Ericameria nauseosa</i> Shrub Short Herbaceous Alliance	579
<i>Ericameria nauseosa</i> / <i>Bouteloua gracilis</i> Shrub Herbaceous Vegetation	579
<i>Muhlenbergia pungens</i> Herbaceous Alliance	581
<i>Muhlenbergia pungens</i> Herbaceous Vegetation	581
Saturated temperate perennial forb vegetation	583
<i>Aquilegia micrantha</i> Saturated Hanging Garden Herbaceous Alliance	583
<i>Aquilegia micrantha</i> - <i>Mimulus eastwoodiae</i> Herbaceous Vegetation	583
Short temperate annual grassland.....	585
<i>Bromus tectorum</i> Semi-natural Herbaceous Alliance	585
<i>Bromus tectorum</i> Semi-natural Herbaceous Vegetation	585
VII. SPARSE VEGETATION	587
Cliffs with sparse vascular vegetation	587
Wooded Bedrock Sparsely Vegetated Alliance	587
<i>Pinus ponderosa</i> Slickrock Sparse Vegetation	587
Pavement with sparse vascular vegetation	589
<i>Cercocarpus intricatus</i> Sparsely Vegetated Alliance	589
<i>Cercocarpus intricatus</i> Slickrock Sparse Vegetation	589
Dry slopes.....	591
<i>Ephedra torreyana</i> Sparsely Vegetated Alliance.....	591
<i>Ephedra torreyana</i> - (<i>Atriplex</i> spp.) / Nonvascular Gypsum Sparse Vegetation	591
<i>Ephedra torreyana</i> - <i>Artemisia bigelovii</i> Sparse Vegetation	593
<i>Ephedra torreyana</i> Sparse Vegetation.....	596
<i>Leymus salinus</i> Sparsely Vegetated Alliance	598
<i>Leymus salinus</i> Shale Sparse Vegetation.....	598
Painted Desert Sparsely Vegetated Alliance.....	600
<i>Eriogonum corymbosum</i> Badlands Sparse Vegetation	600
<i>Eriogonum leptocladon</i> Sparse Vegetation.....	602
<i>Zuckia brandegeei</i> Sparse Vegetation Alliance.....	603
<i>Zuckia brandegeei</i> Sparse Vegetation.....	603
VIII. PLANT COMMUNITIES IDENTIFIED TO ALLIANCE-LEVEL	605
Alliances	605
<i>Achnatherum hymenoides</i> Shrub Herbaceous Alliance	605
<i>Salix gooddingii</i> Temporarily Flooded Woodland Alliance	607
<i>Sporobolus flexuosus</i> Herbaceous Alliance	609
IX. HIERARCHY PLACEMENT UNDETERMINED	612
Park Specials	612
Slickrock Fin Pocket [Park Special]	612
Waterpocket Community [Park Special]	613
BIBLIOGRAPHY	615

***Pseudotsuga menziesii* / *Acer glabrum* Forest
Douglas-fir / Rocky Mountain Maple Forest**

CODE	CEGL000418
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	<i>PSEUDOTSUGA MENZIESII</i> FOREST ALLIANCE (A.157) Douglas-fir 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

This forest association occurs in the montane zone throughout the Rocky Mountains. Elevations vary from 1465 to 2654 m (4800-8700 ft.). Sites are cool and moist, generally occurring on northern or eastern aspects, on steep, mid to lower slopes, and ravines or stream bottoms where cold-air drainage is a factor. Substrates are variable and may be gravelly or not, with soil texture ranging from sandy loam to clay derived from colluvium. A *Pseudotsuga menziesii*-dominated tree canopy characterizes the vegetation with *Acer glabrum* dominating or codominating the understory. The evergreen needle-leaved tree canopy is generally moderately dense to dense (50-80% cover). Mature seral tree species such as *Pinus contorta*, *Pinus flexilis*, *Pinus ponderosa*, *Larix occidentalis*, *Populus angustifolia*, or *Populus tremuloides* may be present to codominant. *Abies concolor* is typically absent. The tall-shrub layer is open (patchy) to moderately dense and dominated or codominated by *Acer glabrum* with other tall shrubs such as *Amelanchier alnifolia*, *Cornus sericea*, *Quercus gambelii*, *Prunus virginiana*, *Sorbus scopulina*, *Spiraea betulifolia*, or *Salix scouleriana*. An open to moderately dense short-shrub layer is usually present and often dominated by *Physocarpus malvaceus* with other species such as *Lonicera utahensis*, *Mahonia repens*, *Paxistima myrsinites*, *Rosa* spp., *Ribes cereum*, *Symphoricarpos albus*, or *Symphoricarpos oreophilus*. The vine *Clematis columbiana* may also be present in small amounts. In some stands the tall- and short-shrub layers are not distinct. The sparse herbaceous layer generally includes diverse forbs with graminoids present to codominant.

DISTRIBUTION

Capitol Reef National Park

This rare association was sampled in North Coleman Canyon. It occurs in deep, narrow canyons along the western boundary of the park.

Globally

This forest association occurs in the montane zone in the southern, central, and northern Rocky Mountains from northern Colorado, through Utah, Wyoming, and Idaho, extending into Oregon and Alberta, and possibly Montana.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This association occurs near the bottoms of deep, narrow canyons. Stands are on moderate (8°) slopes at 1985 m elevation. Aspect is less important than topographic position. The unvegetated surface has high cover of litter, moderate cover of live vegetation and rocks, and low exposure of bare soil. Downed wood is uncommon. Parent materials are mixed Chinle shale and Wingate sandstone colluvium. Soils are rapidly drained clay loams.

Globally

This forest association occurs in the montane zone throughout the Rocky Mountains. Elevations vary from 1465 to 2654 m (4800-8700 ft.). Sites are cool and moist, generally occurring on northern or eastern aspects, on steep, mid to lower slopes, and ravines or stream bottoms where cold-air drainage is a factor. Substrates are variable and may be gravelly or not, with soil texture ranging from sandy loam to clay derived from colluvium. Parent materials include loess, basalt, diorite, dolomite, limestone, granite, quartz monzonite, or sandstone. Ground surface has high cover of litter 3-7 cm deep, sometimes with significant cover of rock, and low cover of bare soil.

VEGETATION DESCRIPTION

Capitol Reef National Park

This mesic Douglas-fir association is rare in the park. Total vegetation cover generally exceeds 100% in this densely vegetated stand. The canopy is codominated by 10 to 15-m tall *Pseudotsuga menziesii* and *Pinus ponderosa* trees with between 40 and 65% total cover. *Acer glabrum* dominates the shrub layer with between 20 and 40% cover. A subcanopy of 10 to 15-m tall *Populus angustifolia* and *Pseudotsuga menziesii* trees may be present. The remaining shrub may include *Cornus sericea*, *Amelanchier utahensis*, *Quercus gambelii*, *Rosa woodsii*, and *Symphoricarpos oreophilus*. The herbaceous layer provides sparse cover because of the dense shade cast by the canopy; no graminoid or forb species provides more than 1% cover. The vine *Clematis columbiana* may be present.

Globally

This minor Rocky Mountain conifer association is characterized by a *Pseudotsuga menziesii*-dominated tree canopy with *Acer glabrum* dominating or codominating the understory. The evergreen needle-leaved tree canopy is at least moderately dense (50-80% cover), although occasionally cover will be as low as 15%. Mature seral tree species like *Pinus contorta*, *Pinus flexilis*, *Pinus ponderosa*, *Larix occidentalis*, *Populus angustifolia*, or *Populus tremuloides* may be present to codominant. *Abies concolor* is typically absent. The tall-shrub layer is open (patchy) to dense and dominated or codominated by *Acer glabrum* with other tall shrubs such as *Cornus sericea*, *Amelanchier alnifolia*, *Quercus gambelii*, *Prunus virginiana*, *Sorbus scopulina*, *Spiraea betulifolia*, or *Salix scouleriana*. An open to moderately dense short-shrub layer is usually present and often dominated by *Physocarpus malvaceus* with other species such as *Holodiscus dumosus*, *Lonicera utahensis*, *Mahonia repens*, *Symphoricarpos albus*, *Paxistima myrsinites*, *Prunus virginiana*, *Rosa* spp., *Ribes cereum*, *Ribes inerme*, *Sambucus racemosa*, or *Symphoricarpos oreophilus*. The vine *Clematis columbiana* may also be present. In some stands the tall- and short-shrub layers are not distinct. The sparse herbaceous layer is dominated by graminoids with scattered forbs; documented species include *Agrostis scabra*, *Arnica cordifolia*, *Mitella stauropetala*, *Erigeron speciosus*, *Calamagrostis rubescens*, *Carex geyeri*, *Elymus glaucus*, *Heracleum maximum*, *Eurybia conspicua*, *Fragaria vesca*, *Galium triflorum*, *Moehringia macrophylla*, *Osmorhiza berteroi*, *Poa nervosa*, *Maianthemum amplexicaule*, and *Thalictrum* spp.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pinus ponderosa</i> , <i>Pseudotsuga menziesii</i>
Tree canopy	<i>Populus angustifolia</i>
Tree subcanopy	<i>Populus angustifolia</i>
Tall shrub/sapling	<i>Acer glabrum</i> , <i>Cornus sericea</i> , <i>Quercus gambelii</i>
Short shrub/sapling	<i>Rosa woodsii</i> , <i>Symphoricarpos oreophilus</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pseudotsuga menziesii</i>
Tall shrub/sapling	<i>Acer glabrum</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G4? (1-Feb-1996).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

All phases of the *Pseudotsuga menziesii* / *Acer glabrum* Habitat Type are included in the concept of this association

(Steele et al. 1981, 1983, Mauk and Henderson 1984).

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Douglas-fir are present because the canyon narrows to the head, providing a cool shady area. Douglas-fir and ponderosa pine trees do not grow in open canyon bottoms. There is episodic flooding in the canyon. One AA plot covers both sides of the steeply sloping benches on the floor of the canyon with well-developed, though bouldery soils.

Capitol Reef National Park Data: The description is based on 2004 field data and data collected in 2005 during accuracy assessment (2 plots: CARE.0631, CARE_AA.0984).

Local Description Authors: J. Von Loh, mod. D. Clark and J. Coles

Global Description Authors: K.A. Schulz, mod. G. Kittel and J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Henderson et al. 1976, Johnson and Simon 1987, Johnston 1987, Jones and Ogle 2000, Kagan et al. 2000, Mauk and Henderson 1984, Steele et al. 1981, Steele et al. 1983, Titus et al. 1998, Western Ecology Working Group n.d.

***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	<i>PSEUDOTSUGA MENZIESII</i> FOREST ALLIANCE (A.157) Douglas-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 forest association occurs on mountains and plateaus from Colorado to Trans-Pecos Texas, west into Arizona and Utah. Elevation ranges from 1229 to 2870 m (4030-9400 ft.). Stands are found along drainages, lower and middle slopes, steep upper slopes, and ridge tops. 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 hill slopes (southern aspects at higher elevations). Soils vary, but are often shallow and rocky ranging from sandy loams to clay. The vegetation is characterized by a relatively sparse to moderately dense evergreen tree canopy dominated by *Pseudotsuga menziesii* sometimes with scattered large *Pinus ponderosa*, *Pinus strobiformis*, *Pinus edulis*, or *Juniperus* spp. (especially on drier sites). *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 over 25%. At higher elevations, the *Quercus gambelii* are more tree-like 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 herbaceous layer is generally sparse and composed of mostly graminoids with scattered forbs, but can be moderately dense and diverse. Associated species include *Amelanchier* spp., *Holodiscus dumosus*, *Mahonia repens*, *Paxistima myrsinites*, *Robinia neomexicana*, *Rosa woodsii*, *Carex* spp., *Festuca arizonica*, *Muhlenbergia virescens*, *Poa fendleriana*, *Lathyrus lanszwertii* var. *leucanthus*, *Thalictrum fendleri*, and *Vicia americana*. The shrub layer has equal or greater cover than grasses.

DISTRIBUTION

Capitol Reef National Park

This association is rare in the park. It is represented by plots located in the upper end of both North and South Coleman canyons in the park. It probably occurs in the upper reaches of Bear Canyon.

Globally

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

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This forest association occurs on the lower and middle slopes of deep, narrow canyons. Stands are generally on steep (40°) slopes between 1975 and 2000 m elevation. Aspect is less important than topographic position near the bottom of shaded canyons. Litter covers most of the unvegetated surface, with low exposure of bare soil. Downed wood is uncommon. Soils are rapidly drained sandy loams derived from Wingate sandstone.

Globally

This forest association occurs on mountains and plateaus at elevation ranges from 1229 to 2870 m (4030-9400 ft.). Stands are found along drainages, gentle to moderate lower and middle slopes, steep upper slopes, and ridge tops. 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 hill slopes (southern aspects at higher elevations). Soils vary but are often shallow and rocky, ranging from sandy loams to clay. The surface is generally largely covered with a thin layer of litter. Parent materials include alluvium, fractured limestone, sandstone, granite, basalt, andesite, and even slickrock.

This forest association was sampled once next to an intermittently flooded drainage at the head of a canyon. The site is moderately steep (12°), oriented to the north (356°), and lies at 1229 m elevation. Large rocks cover most of the unvegetated surface with low cover of litter and bare soil. The soil is a rapidly drained loamy sand.

VEGETATION DESCRIPTION

Capitol Reef National Park

This Douglas-fir association is rare in the park. Total vegetation cover ranges from 85% to more than 100%. The canopy consists of 10 to 15-m tall *Pseudotsuga menziesii* trees with between 5 and 15% cover. *Quercus gambelii* clones form a closed subcanopy or tall-shrub layer with between 60 and 85% cover. Scattered *Pinus edulis* trees may be present with sparse cover. The remaining shrub layer may include *Shepherdia rotundifolia*, *Acer glabrum*, *Rosa woodsii*, and *Symphoricarpos longiflorus*. The herbaceous layer provides sparse cover and includes only the short bunchgrass *Poa fendleriana*.

Globally

This association is characterized by a relatively sparse to moderately dense evergreen tree canopy dominated by *Pseudotsuga menziesii*, sometimes with scattered large *Pinus ponderosa*, *Pinus strobiformis*, *Pinus edulis*, or *Juniperus* spp. (especially on drier sites). *Abies concolor* is typically not present. *Quercus gambelii* dominates both the subcanopy (tree form, if present) and the 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 over 25%. At higher elevations, the *Quercus gambelii* are more tree-like 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. Other common shrub species, depending on geographic location, may include *Acer glabrum*, *Ribes cereum*, *Arctostaphylos patula*, *Amelanchier* spp., *Cercocarpus montanus*, *Holodiscus dumosus*, *Mahonia repens*, *Paxistima myrsinites*, *Prunus virginiana*, *Robinia neomexicana*, and *Rosa woodsii*. The generally sparse herbaceous layer is composed of mostly graminoids with scattered forbs but ranges to moderately dense and diverse. Associated graminoids may include *Bromus* spp., *Carex rossii*, *Festuca arizonica*, *Muhlenbergia montana*, *Koeleria macrantha*, *Muhlenbergia virescens*, and *Poa fendleriana*. Common forbs include *Achillea millefolium*, *Lathyrus lanszwertii* var. *leucanthus*, *Thalictrum fendleri*, and *Vicia americana*. The shrub layer has equal or greater cover than grasses. This open conifer forest transitions to *Quercus gambelii* woodlands in drier sites and at lower elevations.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pseudotsuga menziesii</i>
Tall shrub/sapling	<i>Quercus gambelii</i> , <i>Shepherdia rotundifolia</i>
Short shrub/sapling	<i>Symphoricarpos longiflorus</i>

Globally

Stratum

Tree canopy

Tall shrub/sapling

Species

Pinus ponderosa, *Pinus strobiformis*, *Pseudotsuga menziesii*

Quercus gambelii

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Four phases of this association are described in the habitat type literature: *Festuca arizonica* phase, *Holodiscus dumosus* phase, *Muhlenbergia virescens* phase. All are defined by having at least 5% cover of both *Quercus gambelii* and the nominal species. The *Quercus gambelii* (typic) phase is distinguished by the lack of an herbaceous layer (Alexander et al. 1984b, Alexander et al. 1987, DeVelice et al. 1986, Fitzhugh et al. 1987, Johnston 1987, Larson and Moir 1987, Muldavin et al. 1996, Stuever and Hayden 1997b). There are 3 similar USNVC *Pseudotsuga menziesii* associations that use these phase species as the nominal species. These phases represent "intermediate" vegetation. Review of these associations is needed to clarify relationships between associations.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Stands occur as small pockets on north-facing toe slopes near the heads of canyons. One plot has signs of historic fire, with a burnt Douglas-fir log toppled across the plot.

Capitol Reef National Park Data: The description is based on 2004 field data and data collected in 2005 during accuracy assessment (3 plots: CARE.0658, CARE_AA.0053, CARE_AA.1023).

Local Description Authors: J. Von Loh, mod. D. Clark and J. Coles

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, 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, 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	<i>PSEUDOTSUGA MENZIESII</i> FOREST ALLIANCE (A.157) 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 ft.). 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

Capitol Reef National Park

This association was sampled adjacent to the park boundary, north of Sidehill Spring and below Tub Flat.

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 eastern Oregon and Washington.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This forest association was observed on mountain slopes. Sites are moderately steep (12 to 20° slopes), occur between 2750 and 2895 m elevation, and are oriented to northeastern aspects. The unvegetated surface has high cover of litter and up to 10% cover of downed wood. Parent materials are boulder deposits of volcanic origin. Soils are rapidly drained silts to clay loams.

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 ft.). 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 silt loam 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

Capitol Reef National Park

This forest association has total vegetation cover ranging from 76 to 145%. It is characterized by an open canopy, typically 10-15 m tall, of *Pseudotsuga menziesii* and *Populus tremuloides* trees that each range in cover from 25 to 45% and an open canopy of *Symphoricarpos oreophilus* short shrubs that ranges in cover from 1 to 35%. One stand supports emergent trees of *Pinus ponderosa*, from 20-35 m tall, that range in cover from 15 to 25%. A subcanopy layer of 2 to 5-m tall *Pseudotsuga menziesii* trees provides low to moderate cover. The remaining shrub layer is low in species composition, provides sparse to low cover, and includes *Mahonia repens* and *Rosa woodsii*. The herbaceous layer is relatively diverse but sparse, and only the forb *Lupinus sericeus* provides up to 1% cover.

Globally

This association 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* is present and usually dominates the sparse to moderately dense short-shrub layer. Shrub associates vary depending on location 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 sparse herbaceous layer is composed of mostly graminoids with scattered forbs. Associated graminoids may include *Bromus* spp., *Carex geyeri*, *Carex rossii*, *Festuca idahoensis*, *Leucopoa kingii*, *Koeleria macrantha*, and *Poa fendleriana*. Common forbs include *Achillea millefolium*, *Arnica cordifolia*, *Artemisia frigida*, *Thalictrum fendleri*, and *Vicia americana*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pinus ponderosa</i> , <i>Pseudotsuga menziesii</i>
Tree canopy	<i>Populus tremuloides</i>
Tree subcanopy	<i>Pseudotsuga menziesii</i>
Short shrub/sapling	<i>Symphoricarpos oreophilus</i>
Herb (field)	<i>Mahonia repens</i>
Herb (field)	<i>Lupinus sericeus</i>
Herb (field)	<i>Populus tremuloides</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pseudotsuga menziesii</i>
Short shrub/sapling	<i>Symphoricarpos oreophilus</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (1-Feb-1996).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

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

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: One stand located outside the park was heavily grazed by cattle and elk. Canopy closure among stands is variable from moderate to dense.

Capitol Reef National Park Data: The description is based on 2004 field data (2 plots: CARE.0720, CARE.0722).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: K.A. Schulz, mod. J. Drake and J. Coles

REFERENCES: Arno 1980, 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, Williams and Lillybridge 1983, Williams and Lillybridge 1985, Williams et al. 1990b, Wright et al. 1979, Youngblood and Mauk 1985

***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	<i>POPULUS TREMULOIDES</i> FOREST ALLIANCE (A.274) Quaking Aspen Forest Alliance

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

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This 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 ft.) 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 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

Capitol Reef National Park

This association is rare in the park but more common on adjacent U.S. Forest Service lands. It is found on higher elevation plateaus and was sampled near Deep Creek Ridge near Tub Flats, and at Indian Spring near Billings Pass.

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

Capitol Reef National Park

This forest association was observed on the ridges and tops of higher elevation plateaus. Sites are gentle to moderately steep (3 to 24° slopes), occur between 2530 and 2890 m elevation, and are oriented from northern to southeastern aspects. The unvegetated surface has moderate to high cover of litter and live vegetation basal area. Downed wood is common, up to 20% cover. Parent materials are sandstones that have deposited on slopes as talus or rock fall. Soils are rapidly drained to well-drained, rich in organic content in the upper layers.

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 ft.) 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

Capitol Reef National Park

This forest association is rare at the higher park elevations. The total vegetation cover ranges from 150 to 185% in these multi-canopied and dense stands. This forest association is characterized by a moderately closed canopy, typically 10-35 m tall, of *Populus tremuloides* trees that range in cover from 55 to 75% and understory *Symphoricarpos oreophilus* short shrubs that range in cover from 25 to 55%. One stand had canopy trees of *Pseudotsuga menziesii* that provided low cover. Subcanopy trees provide low to moderate cover in all stands and include *Juniperus scopulorum*, *Picea* sp., *Populus tremuloides*, and *Pseudotsuga menziesii*. The remaining shrub layer is low in species diversity but can provide moderate cover of the short shrub *Rosa woodsii*. The herbaceous layer is moderately diverse and provides sparse to low cover. The common graminoids include *Poa fendleriana* and *Poa pratensis*. Forbs common to this association include *Achillea millefolium*, *Antennaria parvifolia*, *Aquilegia caerulea*, *Geranium caespitosum*, *Lupinus argenteus*, and *Taraxacum officinale*.

Globally

This association is characterized by a moderately dense to dense tree canopy of *Populus tremuloides* with a short-shrub layer 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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus scopulorum</i> , <i>Pseudotsuga menziesii</i>
Tree canopy	<i>Populus tremuloides</i>
Tree subcanopy	<i>Pseudotsuga menziesii</i>
Tree subcanopy	<i>Populus tremuloides</i>
Short shrub/sapling	<i>Rosa woodsii</i> , <i>Symphoricarpos oreophilus</i>
Herb (field)	<i>Actaea rubra</i> , <i>Frasera speciosa</i> , <i>Lupinus argenteus</i>
Herb (field)	<i>Poa fendleriana</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Populus tremuloides</i>
Short shrub/sapling	<i>Symphoricarpos oreophilus</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Poa pratensis

Globally

Poa pratensis

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (1-Apr-1999).

CLASSIFICATION COMMENTS

Capitol Reef 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. They 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

Capitol Reef National Park Inventory Notes: Denser canopy so understory is short shrubs, young aspen, and spruce. More rock and less dense canopy so more grass and litter and fewer shrubs. Stands are used by elk; there are scars on trees from ungulate rubbing. Moderate grazing is evident at one site. Steep slope at one site; quaking aspen bend downhill at base of trunk then curve back uphill. Black and big sagebrush communities occupy less steep slope downhill from the plot.

Capitol Reef National Park Data: The description is based on 1986 and 2003 field data (4 plots: CARE.0540, CARE.0541, CARE.0542, CARE.9075).

Local Description Authors: J. Von Loh, mod. D. Clark

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, NVNHP 2003, Reed 1971, Titus et al. 1998, Western Ecology Working Group n.d., Youngblood and Mueggler 1981

***Populus fremontii* / *Acer negundo* Forest
Fremont Cottonwood / Box-elder Forest**

CODE	CEGL000662
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Deciduous forest (I.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous forest (I.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
FORMATION	Temporarily flooded cold-deciduous forest (I.B.2.N.d.)
ALLIANCE	<i>POPULUS FREMONTII</i> TEMPORARILY FLOODED FOREST ALLIANCE (A.313) Fremont Cottonwood Temporarily Flooded Forest Alliance

ECOLOGICAL SYSTEM(S): North American Warm Desert Lower Montane Riparian Woodland and Shrubland (CES302.748)
North American Warm Desert Riparian Woodland and Shrubland (CES302.753)
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 forested riparian association is known from canyon bottoms in southwestern New Mexico and southern Utah, but it is likely to occur in Arizona, Nevada and California. Stands occur on gently sloping, lower riparian terraces associated with perennial streams. These sites flood periodically but not annually. The principal species depend on the water table being within 1 meter of the surface throughout the growing season in order to become established. Once established, both *Populus fremontii* and *Acer negundo* are capable of persisting as terraces become isolated from the water table. Soils are coarse, sandy and generally are poorly developed. In this association, *Populus fremontii* and *Acer negundo* form moderate to dense canopies, usually accompanied by *Juglans major* as a codominant in the southern part of the range. There is no structural information for New Mexico occurrences, but other associated woody species in southern New Mexico include *Ptelea trifoliata* var. *angustifolia*) and *Amorpha fruticosa*. In the Colorado Plateau, total canopy cover ranges from 60% to more than 100%. Associated woody understory species include *Salix exigua*, *Rhus trilobata*, and *Brickellia longifolia*. The herbaceous component of the community is variable depending on the site, the depth to water table and the flood frequency.

DISTRIBUTION

Capitol Reef National Park

This association is rare in the park and was sampled in Spring Canyon.

Globally

This association is known to occur in southwestern New Mexico and southern Utah. It may occur in northern Arizona, Nevada and California, but will not occur in Colorado, as *Populus fremontii* is replaced by *Populus deltoides* ssp. *monilifera* and *Populus deltoides* ssp. *wislizeni* there.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This forest association was observed in drainages of canyon bottoms. The site is gentle (2° slope), occurs at 1616 m elevation, and is oriented to a northeastern aspect. The unvegetated surface is unrecorded. Parent materials are variable and include sandstones and shale that have eroded and deposited as alluvium. Soils are typically somewhat poorly drained on these temporarily flooded sites.

Globally

This forested riparian association is known from canyon bottoms in southwestern New Mexico and southern Utah, but it is likely to occur in Arizona, Nevada and California. Stands occur on lower riparian terraces associated with perennial streams. These sites flood periodically but not annually. Soils are usually coarse, sandy and poorly developed.

VEGETATION DESCRIPTION

Capitol Reef National Park

This riparian forest association is rare in riparian areas of the park. The vegetation is characterized by a relatively closed canopy of *Populus fremontii* and *Acer negundo* trees that range in cover from 6 to 25%. The shrub layer is diverse in cover and composition. The most abundant tall shrub is *Salix exigua*. Short and dwarf-shrubs provide sparse to low cover and include *Brickellia longifolia* and *Rhus trilobata*. The herbaceous layer is diverse in terms of species composition and provides sparse to moderate cover. The most abundant graminoid is *Agrostis gigantea*. Forbs are sparse, with no one species present in low abundance. *Clematis ligusticifolia* is often present.

Globally

In this association, *Populus fremontii* and *Acer negundo* form moderate to dense canopies, sometimes with *Juglans major* as a codominant in the southern part of the range. There is no structural information for New Mexico occurrences, but other associated woody species in southern New Mexico include *Ptelea trifoliata* var. *angustifolia* and *Amorpha fruticosa*. In the Colorado Plateau, total canopy cover ranges from 60% to more than 100%. Associated woody understory species include *Salix exigua*, *Rhus trilobata*, and *Brickellia longifolia*. The herbaceous component of the community is variable depending on the site, the depth to water table and the flood frequency.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Acer negundo</i> , <i>Populus fremontii</i>

Tall shrub/sapling *Salix exigua*
Short shrub/sapling *Brickellia longifolia*
Herb (field) *Agrostis gigantea*

Globally
Stratum Species
Tree canopy *Acer negundo*, *Populus fremontii*

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park
Bromus tectorum, *Conyza canadensis*, *Descurainia pinnata*, *Tamarix chinensis*, *Tragopogon dubius*

Globally
Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: G2Q (1-Dec-2000). This lowland riparian association is limited to southwestern New Mexico and southern Utah where plants, particularly trees and shrubs, have access to the water table. As with many riparian zone communities in the Southwest, 150 years of livestock grazing, agricultural conversion, urbanization, recreation, and the alteration of hydrological regimes have led to extensive fragmentation and loss of this community. Viable occurrences are mostly found along unregulated rivers where periodic flooding and sustained maintenance flows lead to successful reproduction and establishment of native riparian species. In the Southwest, such unregulated rivers are few, hence the community has become globally rare, still is threatened, and declines continue today. This association is ranked G2Q to reflect its rarity and the fact that it is reported only from a single research study. More vegetation inventory and classification work are needed to resolve this questionable status.

CLASSIFICATION COMMENTS

Capitol Reef National Park
Data are not available.

Globally
Reported only by Henry (1981) but has been documented in Capitol Reef National Park in Utah. Further east, in a zone of hybridization between *Populus fremontii* and *P. deltoides* ssp. *wislizeni*, the related association *Populus deltoides* ssp. *wislizeni* / *Acer negundo* Woodland (CEGL002336) occurs in Natural Bridges National Monument.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: This association can easily be identified in the field where cottonwood and box-elder occur together.

Capitol Reef National Park Data: The description is based on 1987 field data (1 plot: CARE.9347).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: E. Muldavin, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Henry 1981, NVNHP 2003,

***Populus fremontii* / *Salix exigua* Forest**
Fremont Cottonwood / Coyote Willow Forest

CODE	CEGL000666
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Deciduous forest (I.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous forest (I.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
FORMATION	Temporarily flooded cold-deciduous forest (I.B.2.N.d.)
ALLIANCE	<i>POPULUS FREMONTII</i> TEMPORARILY FLOODED FOREST ALLIANCE (A.313) Fremont Cottonwood Temporarily Flooded Forest 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 association is documented from along large rivers in Utah, southwestern New Mexico, and Arizona. Stands are found on stable bars at mid elevations of the floodplain. Substrates are typically relatively recently deposited alluvium. Periodic flooding is required for the growth, maintenance and reproduction of this forest. Characteristic of this deciduous forest is the dominance of *Populus fremontii* in the moderately dense to dense tree canopy and *Salix exigua* in the tall-shrub layer. *Salix gooddingii* or *Baccharis salicifolia* are not abundant or are absent. Other associated species include *Castilleja linariifolia*, *Distichlis spicata*, *Leymus cinereus*, *Muhlenbergia asperifolia*, *Phragmites australis*, and species of *Equisetum*, *Juncus*, and *Carex*. Introduced species such as *Elaeagnus angustifolia*, *Tamarix* spp., *Poa pratensis*, and *Melilotus* spp. are often present in disturbed stands.

DISTRIBUTION

Capitol Reef National Park

This association is rare to uncommon in the park and was sampled north of Spring Canyon in the Fold, in Oak Creek Canyon, and along the Fremont River.

Globally

This riparian forest is known from southwestern New Mexico along the Gila River, the East Fork of the Virgin River in southwestern Utah, the Fremont River in southeastern Utah, and in canyons in north-central Arizona. It likely occurs elsewhere in Utah and Arizona.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This forest association was observed on toe slopes and benches in drainages of canyon bottoms and basin floors. Sites are gentle (2° slope), occur from 1616 to 1951 m elevation, and are oriented to all aspects. The unvegetated surface is unrecorded. Parent materials are variable and include sandstones and shale that have eroded and deposited as alluvium. Soils are typically somewhat poorly drained on these temporarily flooded sites.

Globally

This riparian forest association is documented from along large rivers in southwestern Utah, southwestern New Mexico, and Arizona. Elevation ranges from 1220-1950 m (4000-6400 ft.). Stands are found on stable bars in floodplains and along stream banks in canyons, where the water table is still high but flooding occurs only occasionally. Substrates are typically relatively recently deposited alluvium. Stream gradient is typically gentle, and soils are rapidly drained, sandy or silty clays derived from alluvium (Szaro 1989, Muldavin et al. 2000a).

VEGETATION DESCRIPTION

Capitol Reef National Park

This riparian forest association is rare to uncommon in riparian areas of the park. The vegetation is characterized by a relatively closed canopy of *Populus fremontii* trees and *Salix exigua* tall shrubs. One stand supports a canopy of *Populus angustifolia* instead of *Populus fremontii*. The shrub layer is diverse in cover and composition. The most abundant tall shrub is *Salix exigua*. Associated tall and short shrubs provide sparse to low cover, and the more common and abundant include *Alnus incana*, *Amelanchier utahensis*, *Tamarix chinensis*, and *Ericameria nauseosa*. The herbaceous layer is diverse and provides sparse to moderate cover. Common graminoids include *Juncus balticus*, *Phragmites australis*, and *Schoenoplectus americanus*. Forbs are typically sparse; however, *Equisetum arvense* and *Equisetum laevigatum* fern allies, and *Maianthemum stellatum* can be locally abundant. Although sparse in terms of cover, the vine *Clematis ligusticifolia* is often present.

Globally

This association is characterized by an open to dense, deciduous tree canopy (10 to 75% cover) dominated by *Populus fremontii* with *Salix exigua* dominating the tall-shrub layer. *Acer negundo* may be present in the tree canopy, but *Salix gooddingii* is typically not present. *Baccharis salicifolia* is also typically not abundant in the shrub layer, but a variety of other riparian and upland shrub species may be present, including *Betula occidentalis*, *Amelanchier*

spp., *Ericameria nauseosa*, *Artemisia tridentata*, or *Quercus gambelii*. The herbaceous layer is generally sparse, depending on the density of the shrub and tree layers. *Castilleja linariifolia*, *Distichlis spicata*, *Leymus cinereus*, *Muhlenbergia asperifolia*, *Phragmites australis*, and species of *Equisetum*, *Juncus*, and *Carex* are commonly present (Szaro 1989, Muldavin et al. 2000a). Introduced species such as *Elaeagnus angustifolia*, *Tamarix* spp., *Alhagi maurorum*, *Melilotus officinalis*, *Bromus* spp., and *Poa pratensis* are often present in disturbed stands.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Elaeagnus angustifolia</i> , <i>Populus angustifolia</i> , <i>Populus fremontii</i>
Tall shrub/sapling	<i>Alnus incana</i> , <i>Amelanchier utahensis</i> , <i>Salix exigua</i> , <i>Tamarix chinensis</i>
Short shrub/sapling	<i>Ericameria nauseosa</i>
Herb (field)	<i>Maianthemum stellatum</i>
Herb (field)	<i>Juncus balticus</i> , <i>Phragmites australis</i> , <i>Schoenoplectus americanus</i>
Herb (field)	<i>Equisetum arvense</i> , <i>Equisetum laevigatum</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Populus fremontii</i>
Tall shrub/sapling	<i>Salix exigua</i>
Herb (field)	<i>Phragmites australis</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Conyza canadensis*, *Dactylis glomerata*, *Descurainia pinnata*, *Elaeagnus angustifolia*, *Lactuca serriola*, *Melilotus officinalis*, *Polypogon monspeliensis*, *Salsola tragus*, *Tamarix chinensis*, *Tragopogon dubius*

Globally

Bromus tectorum, *Elaeagnus angustifolia*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (20-Sep-2001). Few intact examples of this association remain in the southwestern U.S. It is documented from the Gila, middle Rio Grande and, possibly the lower Pecos rivers of southern New Mexico, as well as a number of tributary drainages in southern Utah. It may also occur in southern Arizona. It is found on stable bars at mid-elevations of the floodplain; it develops on recently deposited alluvium. Flood flows are required for the growth, maintenance and reproduction of this community type. The association continues to be in decline, primarily as a function of major hydrological alterations (dams and diversions), grazing, off-road vehicles and agricultural conversion. The remaining functional stands are restricted to wild rivers such as the Gila and San Francisco rivers, and possibly along the Mimbres River in New Mexico, or the San Pedro River in Arizona. A significant association with respect to biodiversity, particularly birds in the Southwest. Stands are rare that have not been invaded by exotic trees, shrubs and herbs. Even protected examples are threatened by continued declines in upland watershed conditions.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This association was not reported in the Handbook of Wetland Vegetation Communities of New Mexico (Muldavin et al. 2000a) and needs further review to distinguish it from similar associations such as *Populus fremontii* - *Salix gooddingii* / *Salix exigua* Forest (CEGL002684). Part of the confusion is related to a taxonomic change in Rio Grande cottonwood from *Populus fremontii* var. *wislizeni* S. Wats. to *Populus deltoides* ssp. *wislizeni* (S. Wats.) Eckenwalder. This change resulted in part of this association (central NM along the Rio Grande) being moved into *Populus deltoides* (ssp. *wislizeni*, ssp. *monilifera*) / *Salix exigua* Woodland (CEGL002685). More work is needed to determine the range and possible areas of overlap between these two cottonwood species, and vegetation types in which they are important.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: There is light to moderate grazing in Oak Creek Canyon.

Capitol Reef National Park Data: The description is based on 1986 and 1987 field data (5 plots: CARE.9099, CARE.9175, CARE.9181, CARE.9300, CARE.9302).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: E. Milford, E. Muldavin, mod. K. Schulz and J. Coles

REFERENCES: Bourgeron and Engelking 1994, Cogan et al. 2004, Driscoll et al. 1984, Hansen et al. 2004b, Muldavin et al. 1993b, Muldavin et al. 2000a, NMNHP unpubl. data, Szaro 1989

***Juniperus osteosperma* / *Artemisia tridentata* ssp. *tridentata* Woodland Utah Juniper / Basin Big Sagebrush Woodland**

CODE	CEGL002360
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	<i>JUNIPERUS OSTEOSPERMA</i> WOODLAND ALLIANCE (A.536) Utah Juniper Woodland Alliance

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

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This woodland association occurs locally on benches, alluvial terraces, plateaus and draws in northwestern Colorado and eastern Utah. Elevations range from 1620 m in Colorado to 1860 m in Utah. Sites are located on gentle to moderate slopes, and tend to occupy relatively cool microsites, either on north aspects or cold-air drainages. Stands of this association tend to develop in *Artemisia tridentata* ssp. *tridentata* shrublands that have escaped disturbance for a long enough time to allow *Juniperus osteosperma* trees from nearby woodlands to invade. Soils are deep and generally are derived from alluvium. The best-developed stands occur on canyon floors where terraces are protected from flooding. The tree canopy is generally open, with between 10 and 50% cover by *Juniperus osteosperma*. *Artemisia tridentata* ssp. *tridentata* often has equal or greater cover than the tree layer, and shrubs may be 2 m high. If other shrubs are present, it is with low cover; species reported include *Amelanchier utahensis*, *Ericameria nauseosa*, *Atriplex canescens*, *Opuntia* spp., and *Gutierrezia sarothrae*. The herbaceous layer is diverse and well-developed in stands that have been protected from grazing, and may be dominated by grasses such as *Bouteloua gracilis*, *Hesperostipa comata*, or *Distichlis spicata*. However, most stands have experienced a long history of grazing, and in these cases, the herbaceous layer is generally dominated by *Bromus tectorum*.

DISTRIBUTION

Capitol Reef National Park

This association is rare in the park and was sampled along Oak Creek Canyon and west of Sandy Ranch in the park.

Globally

This association has been sampled in eastern Utah and northwestern Colorado. It is likely to be widespread throughout the Colorado Plateau.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on the steps-in-slope of valleys and on high plains. Sites are gentle (2° slopes), occur between 1768 and 1860 m elevation, and are oriented to northeastern aspects. The unvegetated surface is unrecorded. Parent materials are variable and include sandstones and shale deposited as alluvium. Soils are well-drained fine sands.

Globally

This woodland association occurs locally in small patches occupying benches, alluvial terraces, plateaus and draws in the Colorado Plateau of western Colorado and eastern Utah. Elevations range from 1620 m in Colorado to 1860 m in Utah. Sites are located on gentle to moderate (3-46%) slopes and tend to occupy relatively cool microsites, either on north aspects or cold-air drainages. Soils are deep and generally are derived from alluvium.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is uncommon within the park, occupying broad canyon floors where terraces are protected from flooding. The vegetation is characterized by an open canopy of *Juniperus osteosperma* trees and *Artemisia tridentata* ssp. *tridentata* shrubs. The associated shrub layer is composed of dwarf-shrubs that are low in species diversity, provide sparse to low cover, and include *Gutierrezia sarothrae* and *Opuntia polyacantha*. The herbaceous layer is moderately diverse and provides low cover. Graminoids typically provide low cover and include the perennial short grass *Bouteloua gracilis*.

Globally

This woodland association is best developed on canyon floors on terraces that are protected from flooding. The tree canopy is generally open, with between 10 and 50% cover by *Juniperus osteosperma*. *Artemisia tridentata* ssp. *tridentata* often has equal or greater cover than the tree layer, and shrubs may be 2 m tall. If other shrubs are present, it is with low cover; species reported include *Amelanchier utahensis*, *Ericameria nauseosa*, *Atriplex canescens*, *Opuntia* spp., and *Gutierrezia sarothrae*. The herbaceous layer is diverse and well-developed in stands that have been protected from grazing, and may be dominated by grasses such as *Bouteloua gracilis*, *Hesperostipa comata*, or *Distichlis spicata*. However, most stands have experienced a long history of grazing, and in these cases, the herbaceous layer is generally dominated by *Bromus tectorum*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>tridentata</i>
Herb (field)	<i>Bouteloua gracilis</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>tridentata</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Descurainia pinnata, *Portulaca oleracea*

Globally

Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (22-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Stands are grazed moderately by cattle. One plot is located on a small bench 8 m above a creek.

Capitol Reef National Park Data: The description is based on 1986 field data (2 plots: CARE.9173, CARE.9177).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Juniperus osteosperma* / *Artemisia tridentata* ssp. *wyomingensis* Woodland
Utah Juniper / Wyoming Big Sagebrush Woodland**

CODE	CEGL000730
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	<i>JUNIPERUS OSTEOSPERMA</i> WOODLAND ALLIANCE (A.536) Utah Juniper Woodland Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Pinyon-Juniper Woodland (CES304.767)
Rocky Mountain Foothill Limber Pine-Juniper Woodland (CES306.955)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This sparse woodland association has been reported from semi-arid foothills, plateaus and mountains throughout much of the western Rocky Mountains, Colorado Plateau, and Great Basin. Elevation ranges from 1220 to 2260 m (4000-7400 ft.). This community generally occurs on a variety of slopes and aspects, often at the break between foothill and basin. Soils are generally coarse-textured, calcareous alluvial or eolian deposits derived from sandstone and shale. Evidence of erosion such as gullies and rills is frequent. There are generally significant amounts of bare ground, litter, and desert pavement at the soil surface. Rock cover is variable. The vegetation is characterized by an open tree canopy dominated by *Juniperus osteosperma* with *Artemisia tridentata* ssp. *wyomingensis* dominating the sparse to moderately dense short-shrub layer. Tree canopy cover values are over 5%, but typically less than 20%, and canopy height is usually 2-10 m. Other shrubs, such as *Atriplex canescens*, *Atriplex confertifolia*, *Artemisia nova*, *Chrysothamnus viscidiflorus*, *Ephedra nevadensis*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, *Opuntia* spp., or *Purshia* spp., may be present but generally with low cover. The sparse to moderately dense herbaceous layer is dominated by graminoids such as *Achnatherum hymenoides*, *Aristida* spp., *Bouteloua* spp., *Carex filifolia*, *Elymus elymoides*, *Hesperostipa comata*, *Pleuraphis jamesii*, *Pascopyrum smithii*, *Poa secunda*, *Pseudoroegneria spicata*, *Sporobolus* spp., and introduced annual *Bromus* spp. Associated forbs may include *Artemisia frigida*, *Eriogonum* spp., *Gayophytum racemosum*, *Leptodactylon pungens*, *Phlox hoodii*, and *Plantago patagonica*.

DISTRIBUTION

Capitol Reef National Park

This rare association was sampled along the Red Canyon Trail and near Sandy Ranch on the park boundary.

Globally

This sparse woodland association occurs throughout much of the western Rocky Mountains, Colorado Plateau, and Great Basin region and extends east to the Bighorn Mountains and hills of central Wyoming.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on the mid- and low slopes of valleys. Sites are gentle (3° slopes), occur between 1720 and 1738 m elevation, and are oriented to northern and northeastern aspects. The unvegetated surface has high exposure of bare soil and low to moderate cover of litter. Downed wood has 10% cover in one stand. Parent materials are exposures of shale. Soils are well-drained to rapidly drained silt loams to sandy clays.

Globally

This sparse woodland association has been reported from semi-arid foothills, plateaus and mountains throughout much of the western Rocky Mountains, Colorado Plateau, and Great Basin. Elevation ranges from 1220 to 2260 m

(4000-7400 ft.). This community occurs on a variety of slopes and aspects, often at the break between foothill and basin. Soils are generally coarse-textured, calcareous alluvial or eolian deposits derived from sandstone and shale. Evidence of erosion such as gullies and rills is common. There are generally significant amounts of bare ground, litter, and desert pavement at the soil surface. Rock cover is variable.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is rare within the park. The total vegetation cover ranges from 21 to 75% in these sparsely to moderately vegetated stands. This woodland association is characterized by an open canopy, typically 2-10 m tall, of *Juniperus osteosperma* trees that range in cover from 5 to 15% and *Artemisia tridentata* ssp. *wyomingensis* short shrubs that range in cover from 15 to 25%. The associated shrub layer is composed of few dwarf-shrubs (often *Gutierrezia sarothrae* or *Opuntia polyacantha*) that provide sparse to low cover. The herbaceous layer is low in species diversity and provides sparse to low cover. Graminoids provide low cover in one stand and include the perennial short grass *Bouteloua gracilis* and the annual *Vulpia octoflora*.

Globally

The vegetation is characterized by an open tree canopy dominated by *Juniperus osteosperma* with *Artemisia tridentata* ssp. *wyomingensis* dominating the sparse to moderately dense short-shrub layer. Tree canopy cover values are over 5%, but typically less than 20%, and the height of the tree canopy is 2-10 m. Other shrubs, such as *Atriplex canescens*, *Atriplex confertifolia*, *Artemisia nova*, *Chrysothamnus viscidiflorus*, *Ephedra nevadensis*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, *Opuntia* spp., or *Purshia* spp., may be present but generally with low cover. The herbaceous layer tends to have sparse to low cover but can range to moderately dense cover in some stands. It is dominated by graminoids such as *Achnatherum hymenoides*, *Aristida* spp., *Bouteloua* spp., *Carex filifolia*, *Elymus elymoides*, *Hesperostipa comata*, *Pleuraphis jamesii*, *Pascopyrum smithii*, *Poa secunda*, *Pseudoroegneria spicata*, *Sporobolus* spp., and introduced annual *Bromus* spp. Associated forbs may include *Artemisia frigida*, *Eriogonum* spp., *Gayophytum racemosum*, *Leptodactylon pungens*, *Phlox hoodii*, and *Plantago patagonica*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i>
Herb (field)	<i>Gutierrezia sarothrae</i>
Herb (field)	<i>Bouteloua gracilis</i> , <i>Vulpia octoflora</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Descurainia pinnata

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5? (1-Feb-1996).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

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* ssp. *wyomingensis* shrublands with scattered pinyon and juniper

trees, but they are considered a variation of the woodland type because of the ecological values of the trees.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Stands are grazed by cattle, sometimes heavily so. Drought effects on Wyoming big sagebrush are evident. Utah juniper is invading into Wyoming big sagebrush stands.

Capitol Reef National Park Data: The description is based on 2003 field data (2 plots: CARE.0412, CARE.0415).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: K.A. Schulz, mod. J. Drake and J. Coles

REFERENCES: Barney and Frischknecht 1974, Blackburn 1967, Blackburn et al. 1968a, Blackburn et al. 1968c, Blackburn et al. 1969a, Blackburn et al. 1969e, Blackburn et al. 1971, Bourgeron and Engelking 1994, Bradley 1964, Brotherson and Evenson 1983, Bunting 1987, CONHP unpubl. data 2003, Cogan et al. 2004, Dastrup 1963, DeVelice and Lesica 1993, Donart et al. 1978b, Driscoll et al. 1984, Everett 1987, Francis 1986, Isaacson 1967, Jameson et al. 1962, Johnson and Payne 1968, Johnston 1987, Jones 1992b, Larson and Moir 1987, MTNHP 2002b, Milton and Purdy 1983, Moir and Carleton 1987, NVNHP 2003, Stuever and Hayden 1997a, USFS 1983a, West et al. 1998, Western Ecology Working Group n.d., Wright et al. 1979

***Juniperus osteosperma* / *Bouteloua gracilis* Woodland [Provisional]**

Utah Juniper / Blue Grama Woodland

CODE	CEGL002361
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	<i>JUNIPERUS OSTEOSPERMA</i> WOODLAND ALLIANCE (A.536) Utah Juniper Woodland Alliance

ECOLOGICAL SYSTEM(S): 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 has only been described from Capitol Reef National Park in southern Utah. This summary is derived from 2003 plot data collected in the park. It is documented from the slopes of broad sedimentary valleys. Sites slope gently to the east at 1561 m elevation. The unvegetated surface has moderate cover of litter and high cover of gravel. There is low to moderate exposure of bare soil. Soils are well-drained and derived from the underlying Morrison Formation. Total vegetation cover does not exceed 35% in this sparsely vegetated stand. The vegetation is characterized by a savanna-like distribution of 2 to 5-m tall *Juniperus osteosperma* that have as much as 15% cover and the short grass *Bouteloua gracilis* that has up to 5% cover. There is no developed shrub layer, but scattered shrubs may include *Gutierrezia sarothrae*. Young *Juniperus osteosperma* may also be present. The herbaceous layer is sparse in terms of cover. *Vulpia octoflora* is the only recorded species.

DISTRIBUTION

Capitol Reef National Park

This woodland association is rare in the park and was sampled along Notom Road.

Globally

This association has only been described from Capitol Reef National Park in southern Utah. It is likely to occur in adjacent northern Arizona and New Mexico.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed growing on the midslopes of valleys. The site is gentle (2° slope), occurs at

1561 m elevation, and is oriented to an eastern aspect. The unvegetated surface has moderate cover of litter and high cover of small rocks. There is low to moderate exposure of bare soil. Parent materials at the site are Morrison Formation shale outcrops. Soils are well-drained sandy loams.

Globally

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

VEGETATION DESCRIPTION

Capitol Reef National Park

Total vegetation cover ranges from 9 to 35% in this sparsely vegetated stand. This woodland association is characterized by a savanna-like distribution of the typically 2 to 5-m tall tree *Juniperus osteosperma* that ranges in cover from 1 to 15% and the short grass *Bouteloua gracilis* that ranges in cover from 1 to 5%. The shrub layer consists of short and dwarf-shrubs providing sparse to low cover. Shrubs typically present with sparse cover include *Gutierrezia sarothrae* and sapling *Juniperus osteosperma*. The herbaceous layer is low in species diversity and sparse in terms of cover. An associated graminoid includes the annual *Vulpia octoflora*.

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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Herb (field)	<i>Gutierrezia sarothrae</i>
Herb (field)	<i>Bouteloua gracilis, Vulpia octoflora</i>

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (22-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef 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

Capitol Reef National Park Inventory Notes: Utah juniper trees are scattered in the type but bunched. Small swale occurs within the site. There are signs of cattle grazing.

Capitol Reef National Park Data: The description is based on 2003 field data (1 plot: CARE.0410).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Juniperus osteosperma* / *Cercocarpus intricatus* Woodland
Utah Juniper / Littleleaf Mountain-mahogany Woodland**

CODE	CEGL000733
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	<i>JUNIPERUS OSTEOSPERMA</i> WOODLAND ALLIANCE (A.536) Utah Juniper Woodland Alliance

ECOLOGICAL SYSTEM(S): Great Basin Pinyon-Juniper Woodland (CES304.773)
Inter-Mountain Basins Cliff and Canyon (CES304.779)
Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)
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 occurs on steep, rocky ridges in the Great Basin of Nevada, whereas in the Colorado Plateau of Utah and Colorado it occupies gentle to moderate slopes on mesas, benches and canyon floors where bedrock is partially covered by sandy soils. Stands are located between 1500 and 1980 m (4920-6500 ft.) elevation. Aspect may influence the distribution of stands locally, but across the full range, stands may occur on any aspect. At least half the unvegetated surface is bare ground or sandstone slickrock, with the remainder divided primarily between litter and biological soil crusts. Soils are shallow or skeletal and are rapidly drained sands or sandy loams. Total vegetation cover rarely exceeds 35% because the high exposure of rock limits where plants can grow. The canopy is open, with *Juniperus osteosperma* trees providing between 5 and 25% cover; the trees are often stunted. There is a well-developed shrub layer in which *Cercocarpus intricatus* is dominant or codominant. Total shrub cover ranges from 5 to 15%. Associated shrubs include *Amelanchier utahensis*, *Fraxinus anomala*, *Artemisia bigelovii*, *Glossopetalon spinescens* var. *meionandrum*, *Atriplex confertifolia*, *Cercocarpus montanus*, *Chrysothamnus Greenei*, *Philadelphus microphyllus*, *Symphoricarpos longiflorus*, and *Ephedra viridis*. The herbaceous layer is diverse in terms of species composition and provides sparse to low cover. Graminoids commonly include *Aristida purpurea*, *Achnatherum hymenoides*, *Hesperostipa* and/or *Achnatherum* spp., and *Muhlenbergia pungens*. Forbs are diverse but provide sparse cover; *Stenotus acaulis* occurs throughout the range.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon and was sampled in Spring Canyon.

Globally

This association is known from southeastern Utah, western Colorado and northern Nevada. It may also occur in eastern California and is likely to occur in scattered stands throughout the Great Basin and Colorado Plateau.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on rock shelves above canyon floors and on the upper slopes of exposed bedrock formations. Sites are gentle (3° slopes), occur between 1738 and 1829 m elevation, and are oriented to western and northwestern aspects. The unvegetated surface is unrecorded. Parent materials are Navajo sandstone bedrock, exposed as slickrock. Soils are rapidly drained fine sands.

Globally

This woodland association occurs on steep, rocky ridges in the Great Basin of Nevada, whereas in the Colorado Plateau of Utah and Colorado it occupies gentle to moderate slopes on mesas, benches and canyon floors where bedrock is partially covered by sandy soils. Stands are located between 1500 and 1980 m (4920-6500 ft.) elevation.

Aspect may influence the distribution of stands locally, but range-wide stands may occur on any aspect. At least half the unvegetated surface is bare ground or sandstone slickrock, with the remainder divided primarily between litter and biological soil crusts. Soils are shallow or skeletal and are rapidly drained sands or sandy loams.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is uncommon within the park. The vegetation is characterized by an open canopy of *Juniperus osteosperma* trees and *Cercocarpus intricatus* short shrubs. The associated shrub layer is diverse and provides low to moderate cover. The tall shrubs often present with low cover include *Amelanchier utahensis* and *Fraxinus anomala*. Associated short shrubs are relatively diverse in terms of species composition, provide low cover, and include *Artemisia bigelovii* and *Ephedra viridis*. The herbaceous layer is diverse in terms of species composition and provides sparse to low cover. Graminoids commonly include *Aristida purpurea* and *Muhlenbergia pungens*. Forbs are diverse but provide sparse cover.

Globally

Total vegetation cover rarely exceeds 35% because the high exposure of slickrock limits where plants can grow. The canopy is open, with *Juniperus osteosperma* trees providing between 5 and 25% cover. There is a well-developed shrub layer in which *Cercocarpus intricatus* is dominant or codominant. Total shrub cover ranges from 5 to 15%. Associated shrubs include *Amelanchier utahensis*, *Artemisia bigelovii*, *Atriplex confertifolia*, *Cercocarpus montanus*, *Chrysothamnus Greenei*, *Echinocereus triglochidiatus*, *Ephedra viridis*, *Fraxinus anomala*, *Glossopetalon spinescens* var. *meionandrum*, *Opuntia erinacea*, *Philadelphus microphyllus*, *Quercus havardii* var. *tuckeri*, *Rhus trilobata*, *Symphoricarpos longiflorus*, and *Yucca angustissima*. The herbaceous layer is diverse in terms of species composition and provides sparse to low cover. Graminoids commonly include *Aristida purpurea*, *Achnatherum hymenoides*, *Hesperostipa* and/or *Achnatherum* spp., and *Muhlenbergia pungens*. Forbs are diverse but provide sparse cover; *Stenotus acaulis* occurs throughout the range. *Tetraeneuris acaulis*, *Lepidium montanum*, and *Cryptantha flavoculata* are also reported from plots.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Tall shrub/sapling	<i>Amelanchier utahensis</i> , <i>Fraxinus anomala</i>
Short shrub/sapling	<i>Cercocarpus intricatus</i> , <i>Ephedra viridis</i>
Herb (field)	<i>Artemisia bigelovii</i>
Herb (field)	<i>Muhlenbergia pungens</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Short shrub/sapling	<i>Cercocarpus intricatus</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

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

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

It is unusual for sites as rocky as those occupied by this association not to have *Pinus edulis* in the understory. It is not clear why *Pinus* is absent from these stands, but the sites may be too warm or may be isolated from other

woodlands containing *Pinus*.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Data are not available.

Capitol Reef National Park Data: The description is based on 1986 and 1987 field data (2 plots: CARE.9102, CARE.9348).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Blackburn et al. 1968c, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, NVNHP 2003, Western Ecology Working Group n.d.

***Juniperus osteosperma* / *Hesperostipa comata* Woodland
Utah Juniper / Needle-and-Thread Woodland**

CODE	CEGL002815
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	<i>JUNIPERUS OSTEOSPERMA</i> WOODLAND ALLIANCE (A.536) Utah Juniper Woodland Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Pinyon-Juniper Woodland (CES304.767)
Inter-Mountain Basins Juniper Savanna (CES304.782)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This woodland association occurs on slopes, hills, benches and alluvial terraces in the Colorado Plateau of western Colorado and eastern Utah. Sites are on level to moderately sloping terrain that may be oriented to any aspect. Elevation of most stands ranges from 1423 to 1880 m (4670-6165 ft.) but may occur as high as 2200 m (7215 ft.) on warm southerly exposures that discourage establishment of *Pinus edulis*. Most sites have sandy soils derived from eolian sands, sandstone or alluvium, but at Capitol Reef National Park, some stands occur on barren shale slopes of the Carmel Formation. Soils are generally sandy loams, with a few stands on clay loams. Gravel, bare ground or cryptobiotic crusts cover much of the unvegetated surface. The vegetation is characterized by a savanna-like distribution of 2 to 5-m tall *Juniperus osteosperma* trees that range in cover from 5 to 15% and the bunchgrass *Hesperostipa comata* that ranges in cover from 5 to 25%. Shrubs are generally present but too sparse to form a layer. Common species include *Coleogyne ramosissima*, *Ephedra torreyana*, *Ephedra viridis*, *Eriogonum microthecum*, *Gutierrezia sarothrae*, and *Opuntia polyacantha*. The herbaceous layer is diverse and has up to 30% cover, including *Hesperostipa*. Other characteristic graminoids include *Poa fendleriana*, *Bouteloua eriopoda*, *Bouteloua gracilis*, *Pleuraphis jamesii*, and *Achnatherum hymenoides*. Forbs may be diverse but contribute little cover; *Hymenoxys richardsonii* and *Mirabilis multiflora* are among the few species recorded in sampled plots.

DISTRIBUTION

Capitol Reef National Park

This association was sampled within Little Sand Flat. It also occurs sporadically in the southern portion of the park along the Fold.

Globally

This association has been described from the Colorado Plateau, specifically from western Colorado and eastern Utah. It is likely to occur on sandy soils at low to moderate elevations throughout the plateau.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This wooded herbaceous association was observed growing on the high slopes of interfluves. The site is moderately steep (20° slope) and is oriented to a southeastern aspect. The unvegetated surface has high cover of litter and large rocks and moderate cover of live vegetation basal area. Parent materials are Carmel shale outcrops or Navajo sandstone dunes. Soils are rapidly drained sandy loams.

Globally

This woodland association occurs on slopes, hills, benches and alluvial terraces in the Colorado Plateau of western Colorado and eastern Utah. Sites are on level to moderately sloping terrain that may be oriented to any aspect. Elevation of most stands ranges from 1423 to 1880 m (4670-6165 ft.) but may occur as high as 2200 m (7215 ft.) on warm southerly exposures that discourage establishment of *Pinus edulis*. Most sites have sandy soils derived from eolian sands, sandstone or alluvium, but some stands occur on barren shale slopes of the Carmel (Capitol Reef National Park) and Chinle formations (Canyonlands National Park). Soils are generally sandy loams, with a few stands on clay loams. Gravel, bare ground or cryptobiotic crusts cover much of the unvegetated surface.

VEGETATION DESCRIPTION

Capitol Reef National Park

This association is rare in the park. The total vegetation cover ranges from 24 to 60% in this sparsely to moderately vegetated stand. This woodland association is characterized by a savanna-like distribution of the typically 2 to 5-m tall tree *Juniperus osteosperma* that ranges in cover from 5 to 15% and the tall bunchgrass *Hesperostipa comata* that ranges in cover from 15 to 25%. The shrub layer is short-statured with short and dwarf-shrubs providing sparse to low cover. Shrubs typically present include *Ephedra torreyana* and *Ephedra viridis*. The herbaceous layer is low in species diversity and sparse in terms of cover. Associated grasses include *Bouteloua eriopoda* and *Hesperostipa* sp.

Globally

This woodland association has total vegetation cover that ranges from 24 to 60%. It is characterized by a savanna-like distribution of 2 to 5-m tall *Juniperus osteosperma* trees that range in cover from 5 to 15% and the tall bunchgrass *Hesperostipa comata* that ranges in cover from 5 to 25%. Shrubs are generally present but too sparse to form a layer. Common species include *Atriplex canescens*, *Coleogyne ramosissima*, *Ephedra torreyana*, *Ephedra viridis*, *Eriogonum microthecum*, *Ericameria nauseosa*, *Krascheninnikovia lanata*, *Gutierrezia sarothrae*, *Opuntia erinacea*, and *Opuntia polyacantha*. The herbaceous layer is diverse and has up to 30% cover, including *Hesperostipa* spp. Other characteristic graminoids include *Poa fendleriana*, *Bouteloua eriopoda*, *Bouteloua gracilis*, *Pleuraphis jamesii*, and *Achnatherum hymenoides*. Forbs may be diverse but contribute little cover; *Chaetopappa ericoides*, *Hymenoxys richardsonii*, *Machaeranthera grindelioides*, *Mirabilis multiflora*, *Streptanthella longirostris*, *Tetaneuris acaulis*, and *Townsendia incana* are among the species recorded in sampled plots. *Bromus tectorum* may be abundant in plots that have experienced chronic or severe disturbance.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Short shrub/sapling	<i>Ephedra torreyana</i> , <i>Ephedra viridis</i>
Herb (field)	<i>Bouteloua eriopoda</i> , <i>Hesperostipa comata</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Herb (field)	<i>Hesperostipa comata</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (6-Jul-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Surrounding area with similar aspect has identical community. There is fire scarring on Utah juniper trees.

Capitol Reef National Park Data: The description is based on 2003 field data (1 plot: CARE.0476).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Western Ecology Working Group n.d.

***Juniperus osteosperma* / *Leymus salinus* Woodland
Utah Juniper / Salinas Lyme Grass Woodland**

CODE	CEGL003109
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	<i>JUNIPERUS OSTEOSPERMA</i> WOODLAND ALLIANCE (A.536) Utah Juniper Woodland Alliance

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

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This sparse woodland association occurs on low to mid-elevation hogbacks, colluvial slopes and badlands in the Colorado Plateau of western Colorado and eastern Utah. Elevations range from 1488 to 1997 m (4880-6550 ft.), and most sites are on cooler north and east aspects. Slopes may be gentle to moderately steep (3-46% slope) and are generally underlain by Mesozoic marine shales of the Morrison Formation or Mancos shale. Colluvium from sandstone cliffs or outcrops upslope from the stand may cover the ground surface. Soils are rapidly drained sandy loams or silty clays. The vegetation is characterized by a sparse to open canopy of *Juniperus osteosperma* with between 1 and 25% cover. *Pinus edulis* is either absent or present in very low amounts in the canopy, although *Juniperus osteosperma* and *Pinus edulis* seedlings may be present. There is no shrub layer, but scattered short and dwarf-shrubs may total 10% cover in more heavily vegetated stands. Common species include *Atriplex confertifolia*, *Artemisia bigelovii*, *Artemisia nova*, *Artemisia tridentata* ssp. *wyomingensis*, *Chrysothamnus viscidiflorus*, *Gutierrezia sarothrae*, *Glossopetalon spinescens* var. *meionandrum*, *Ephedra viridis*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Opuntia erinacea*, *Opuntia polyacantha*, *Shepherdia rotundifolia*, and *Yucca harrimaniae*. The herbaceous layer is dominated by *Leymus salinus* with between 1 and 25% cover. The remainder of the herbaceous cover is sparse but diverse. Additional graminoids present include *Achnatherum hymenoides*, *Pleuraphis jamesii*, *Poa fendleriana*, and *Poa secunda*. Forbs include *Arenaria hookeri*, *Arenaria fendleri*, *Calochortus gunnisonii*, *Cymopterus bulbosus*, *Cymopterus purpureus*, *Eriogonum umbellatum*, *Leptodactylon pungens*, *Lepidium montanum*, *Oenothera pallida*, *Phlox austromontana*, *Petradoria pumila*, *Phlox hoodii*, *Sphaeralcea coccinea*, *Streptanthella longirostris*, *Stenotus acaulis*, and *Xylorhiza venusta*.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon in the park and was sampled along Lower Muley Canyon and in Hall's Creek drainage south of Bitter Creek Divide.

Globally

The plant association occurs on low-elevation marine shales in western Colorado and eastern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed growing on slopes, mesa tops, and on gentle ridges. Sites are gentle (2° slopes), occur between 1616 and 1982 m, and are oriented to northern and eastern aspects. The unvegetated surface is unrecorded. Parent materials are variable and include sandstones and shale. Soils are likely well-drained to rapidly drained sands.

Globally

This sparse woodland association occurs on canyon rims, ledges, low to mid-elevation hogbacks, colluvial slopes, toe slopes and badlands in the Colorado Plateau of western Colorado and eastern Utah. Elevations range from 1488 to 1997 m (4880-6550 ft.), and most sites are on cooler north and east aspects, although they are reported from west aspects in the Piceance Basin of northwestern Colorado (Baker 1982b). Slopes may be gentle to moderately steep (3-46% slope) and are generally underlain by Mesozoic marine shales of the Morrison Formation, Chinle Formation or Mancos shale. Other parent materials include Kayenta Formation and Cedar Mesa sandstone. Colluvium from sandstone cliffs or outcrops upslope covers the ground surface. Soils are rapidly drained sandy loams or silty clays.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is uncommon, occurring primarily in the vicinity of Wagon Box Mesa. The vegetation is characterized by an open canopy of *Juniperus osteosperma* trees, and the tall bunchgrass *Leymus salinus*. *Pinus edulis* trees occur in three stands. The shrub layer is diverse in terms of species composition and provides sparse to low cover. The common short and dwarf-shrubs include *Artemisia bigelovii*, *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, and *Shepherdia rotundifolia*. The herbaceous layer is moderate in terms of species diversity and sparse to low in terms of cover. Commonly associated graminoids include the short bunchgrass *Pleuraphis jamesii*. Forbs commonly include *Artemisia ludoviciana*.

Globally

This association has a sparse to open canopy of *Juniperus osteosperma* with between 1 and 25% cover. *Pinus edulis* is either absent or present in very low amounts in the canopy, although *Juniperus osteosperma* and *Pinus edulis* seedlings may be present. There is no shrub layer, but scattered short and dwarf-shrubs may total 10% cover in more heavily vegetated stands. Common species include *Atriplex confertifolia*, *Artemisia bigelovii*, *Artemisia nova*, *Artemisia tridentata* ssp. *wyomingensis*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Gutierrezia sarothrae*, *Glossopetalon spinescens* var. *meionandrum*, *Ephedra viridis*, *Eriogonum microthecum*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Opuntia erinacea*, *Opuntia polyacantha*, *Shepherdia rotundifolia*, and *Yucca harrimaniae*. The herbaceous layer is dominated by *Leymus salinus* with between 1 and 25% cover. Herbaceous cover is sparse but diverse. Additional graminoids present include *Achnatherum hymenoides*, *Pleuraphis jamesii*, *Poa fendleriana*, and *Poa secunda*. Forbs also provide sparse cover and include *Arenaria hookeri*, *Arenaria fendleri*, *Calochortus gunnisonii*, *Cymopterus bulbosus*, *Cymopterus purpureus*, *Eriogonum umbellatum*, *Leptodactylon pungens*, *Lepidium montanum*, *Oenothera pallida*, *Phlox austromontana*, *Petradoria pumila*, *Phlox hoodii*, *Sphaeralcea coccinea*, *Streptanthella longirostris*, *Stenotus acaulis*, and *Xylorhiza venusta*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Short shrub/sapling	<i>Atriplex confertifolia</i> , <i>Chrysothamnus viscidiflorus</i> , <i>Ericameria nauseosa</i> , <i>Shepherdia rotundifolia</i>
Short shrub/sapling	<i>Ephedra viridis</i>
Herb (field)	<i>Artemisia bigelovii</i> , <i>Gutierrezia sarothrae</i>
Herb (field)	<i>Artemisia ludoviciana</i> , <i>Petradoria pumila</i>
Herb (field)	<i>Leymus salinus</i> , <i>Pleuraphis jamesii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Herb (field)	<i>Leymus salinus</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Ovis canadensis

CONSERVATION STATUS RANK

Global Rank & Reasons: G3 (26-Jan-2006). The Colorado Natural Heritage Program tracks this association and has given it a rank of S3. It may be somewhat more common in Utah, as there is more potential habitat, but it is unlikely that there are more than 100 viable occurrences worldwide. All stands tend to be small, generally less than five ha.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

There may be some difficulty in clearly distinguishing *Pinus edulis* - *Juniperus* spp. / *Leymus salinus* Woodland (CEGL002340) from this association, in which case they may need to be combined. In particularly sparse stands, it may also be difficult to distinguish *Leymus salinus* Shale Sparse Vegetation (CEGL002745) from this association.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: There is rockfall on one site.

Capitol Reef National Park Data: The description is based on 1986 field data (5 plots: CARE.9029, CARE.9042, CARE.9043, CARE.9189, CARE.9190).

Local Description Authors: J. Von Loh, mod. by D. Clark

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Baker 1982b, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984,

***Juniperus osteosperma* / *Pleuraphis jamesii* Woodland Utah Juniper / James' Galleta Woodland**

CODE	CEGL002362
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	<i>JUNIPERUS OSTEOSPERMA</i> WOODLAND ALLIANCE (A.536) Utah Juniper Woodland Alliance

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

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This woodland association occurs on valley floors, ridges, and benches in northwestern Colorado and eastern Utah. Sites have gentle slopes (3-5%), occur between 1579 and 1860 m elevation, and may be oriented to any aspect. The unvegetated surface has high cover of litter and low exposure of bare soil. Soils are well-drained sands, sandy clays, or clay loams derived from shales, sandstones, or a mix of the two. Stands occur in relatively small patches, often in a mosaic with other pinyon-juniper / grass understory woodland types. Total vegetation cover rarely exceeds 60%. The tree canopy consists of *Juniperus osteosperma* with between 20 and 40% cover. *Pinus edulis* is generally absent.

Scattered shrubs, such as *Artemisia tridentata* ssp. *wyomingensis*, *Atriplex canescens*, *Ephedra viridis*, *Chrysothamnus viscidiflorus*, *Gutierrezia sarothrae*, and *Opuntia polyacantha*, may be present, but there is no developed shrub layer. The herbaceous stratum is sparse to moderately dense and is dominated by graminoids. *Pleuraphis jamesii* is dominant to codominant and is generally accompanied by other grasses such as *Achnatherum hymenoides*, *Bouteloua gracilis*, or *Hesperostipa comata*. Forbs are sparse in cover and inconsistent in composition among sites. Biological soil crusts may be well-developed in areas that are protected from grazing.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon in the park and was sampled along Halls Creek, north of Ackland Spring, along Lower Muley Twist, and along Hartnet Draw.

Globally

This association has been documented in northwestern Colorado and eastern Utah. It is likely to be widespread throughout the Colorado Plateau, including Arizona and New Mexico.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association occupies valley floors, interfluves, and ridge tops. Sites are gentle (2 to 3° slopes), occur between 1579 and 1860 m elevation, and are oriented to southern and southwestern aspects. The unvegetated surface has high cover of litter, low cover of small rocks and gravel, and low exposure of bare soil. Parent materials are Morrison, Navajo, or Carmel formation outcrops. Soils are well-drained sands, sandy clays, and loamy sands.

Globally

This woodland association occurs on valley floors, ridges, and benches in northwestern Colorado and eastern Utah. Sites have gentle slopes (3-5%), occur between 1579 and 1860 m elevation, and may be oriented to any aspect. The unvegetated surface has high cover of litter and low exposure of bare soil. Soils are well-drained sands, sandy clays, or clay loams derived from shales, sandstones, or a mix of the two.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is uncommon in the park. The total vegetation cover ranges from 24 to 60% cover. This woodland association is characterized by an open canopy, typically 2-5 m tall, of *Juniperus osteosperma* trees that range in cover from 15 to 25%, and the short bunchgrass *Pleuraphis jamesii* that ranges in cover from 5 to 15%. The shrub layer is moderately diverse in terms of species composition and provides sparse to low cover. Common short and dwarf-shrubs include *Atriplex canescens*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Gutierrezia sarothrae*, and *Opuntia polyacantha*. The herbaceous layer is low in terms of species diversity and sparse to low in terms of cover. Commonly associated graminoids include *Achnatherum hymenoides*, *Bouteloua gracilis*, and the annual *Vulpia octoflora*. Forbs are typically sparse in terms of cover but are moderately diverse.

Globally

This woodland association occurs in relatively small patches, often in a mosaic with other pinyon-juniper woodland types. Total vegetation cover rarely exceeds 60%. The tree canopy consists of *Juniperus osteosperma* with between 20 and 40% cover. *Pinus edulis* is absent or occurs only as scattered individuals. Scattered shrubs, such as *Artemisia tridentata* ssp. *wyomingensis*, *Atriplex canescens*, *Ephedra viridis*, *Chrysothamnus viscidiflorus*, *Gutierrezia sarothrae*, and *Opuntia polyacantha*, may be present, but there is no developed shrub layer. The herbaceous stratum is sparse to moderately dense and is dominated by graminoids. *Pleuraphis jamesii* is dominant to codominant and is generally accompanied by other grasses such as *Achnatherum hymenoides*, *Bouteloua gracilis*, or *Hesperostipa comata*. Forbs are sparse in cover and inconsistent in composition among sites.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Short shrub/sapling	<i>Atriplex canescens</i> , <i>Chrysothamnus viscidiflorus</i>
Short shrub/sapling	<i>Ephedra viridis</i>
Herb (field)	<i>Gutierrezia microcephala</i> , <i>Gutierrezia sarothrae</i>

Herb (field) *Bouteloua gracilis, Pleuraphis jamesii, Vulpia octoflora*

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Herb (field)	<i>Pleuraphis jamesii</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park
Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (22-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park
Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: One site occurs between two shallow drainages, and another is on a narrow ridge top. Cattle grazing occurred in the southern portion of the park prior to 1988.

Capitol Reef National Park Data: The description is based on 1986 and 2003 field data (3 plots: CARE.0409, CARE.9194, CARE.9423).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Juniperus osteosperma* / Sparse Understory Woodland** **Utah Juniper / Sparse Understory Woodland**

CODE	CEGL000732
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	<i>JUNIPERUS OSTEOSPERMA</i> WOODLAND ALLIANCE (A.536) Utah Juniper Woodland Alliance

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

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This widespread woodland association occurs in the Great Basin, Colorado Plateau and western Rocky Mountain regions where it occupies sites in which junipers have become established but that are too dry to support a developed understory of shrubs, forbs and grasses. Lack of soil moisture-holding capacity, southern or western aspects, old-growth conditions, or high cover by rocks or bedrock may all contribute to the development of these stands. Elevations range between 1400 and 2200 m, and stands occur on many types of soils, geology, slope, aspect and

landform. Total vegetation cover ranges from 10 to 70% and consists almost entirely of the *Juniperus osteosperma* canopy. Shrub cover and herbaceous cover each total less than 5%, and usually total 1% or less. Because of the sparseness of the understory, few species are expected throughout the range of this association other than *Ephedra viridis*, *Gutierrezia sarothrae*, and *Elymus elymoides*. Cryptobiotic crust cover may be high.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon and was sampled on Wagon Box Mesa and along the Red Canyon Trail within the park. It also occurs on the Carmel shales in the northern portion of the park along the Fold.

Globally

This association occurs widely in the Great Basin of Nevada and western Utah, as well as the Colorado Plateau and western Rocky Mountains of eastern Utah and western Colorado, and extends north to the Uinta Mountains.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on the midslopes of valley sides, on mesa- and ridge tops. Sites are gentle to moderately steep (3 to 12° slopes), occur between 1701 and 2204 m elevation, and are oriented to northern and slightly northeastern aspects. The unvegetated surface typically has high cover of litter and moderate cover by live vegetation basal area. Moderate cover of small rocks and gravel occurs at one site; exposure of bare soil is low. Downed wood is uncommon to common, with 15% cover in one stand. Cryptogams are variable, absent on one site, and provide 25% cover on another. Parent materials are Morrison, Carmel and Chinle formation shale exposures. Soils are well-drained to rapidly drained loamy sands to sandy clays.

Globally

This widespread woodland association occurs on slopes, ridges, benches and mesas at elevations ranging between 1400 and 2200 m (4600-7220 ft.). Slopes range from gentle to moderately steep, with a few examples on very steep slopes. Sites may be oriented to any aspect. In Colorado Plateau and Great Basin stands, substrates and soils tend to have poor water-holding capacity (hydrothermally altered volcanic tuff, clay or coarse sands) and are on warm south or west exposures. In some Colorado Plateau stands, the substrate is so rocky as to afford few places for shrubs or herbaceous species to grow, or the woodland is in an old-growth condition and juniper trees are using all of the available light and moisture. The unvegetated ground surface may have high cover of cryptobiotic crusts on sandy sites; shale sites usually have high cover of bare ground, and other sites may have high cover by rock, bedrock and gravel.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is uncommon within the park. The total vegetation cover ranges from 24 to 70% in these sparsely to densely vegetated stands. This woodland association is characterized by an open to relatively closed canopy, typically 2-5 m tall, of *Juniperus osteosperma* trees that range in cover from 15 to 65%. *Juniperus osteosperma* sapling trees are also present in the tall- and short-shrub layers of one stand, where they provide sparse to low cover. The shrub layer is low in terms of species diversity, provides low cover, and includes *Pinus edulis* saplings and the short and dwarf-shrubs *Purshia stansburiana*, *Ephedra viridis*, and *Gutierrezia sarothrae*. The herbaceous layer is moderately diverse in terms of species composition and provides sparse cover. The forb *Streptanthella longirostris* is abundant on one site. Areas in the northern portion of the park on Carmel shale may have cushion plants in the understory that are not recorded due to low percent cover.

Globally

This common woodland association is characterized by a canopy of *Juniperus osteosperma* with between 10 and 70% cover, sometimes less in very open stands. In many stands the total vegetation cover does not exceed 20%. *Pinus edulis* is generally absent from the canopy. Trees may be barely 2 m high on shale sites, or in old-growth stands the trees may approach 5 m in height. Scattered shrubs are usually present, but do not exceed 5% cover, and usually the total is 1% or less. Common species include *Ephedra viridis*, *Cercocarpus montanus*, *Artemisia tridentata* ssp. *wyomingensis*, *Gutierrezia sarothrae*, and *Opuntia* spp. Forbs and grasses total less than 5% (usually 1% or less) and may include *Pleuraphis jamesii*, *Achnatherum hymenoides*, *Petradoria pumila*, or *Elymus elymoides*. Cryptobiotic crusts may cover as much as 25% of the unvegetated area in stands with sandy substrates.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Tall shrub/sapling	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Tall shrub/sapling	<i>Purshia stansburiana</i>
Short shrub/sapling	<i>Juniperus osteosperma</i>
Short shrub/sapling	<i>Ephedra viridis</i>
Herb (field)	<i>Gutierrezia sarothrae</i>
Herb (field)	<i>Streptanthella longirostris</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Descurainia pinnata

Globally

Data are not available.

CONSERVATION STATUS RANK

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

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Milton and Purdy (1983) describe a pinyon-juniper / sparse understory woodland type at two sites in the Great Basin of Nevada and western Utah. The soils at these sites are derived from hydrothermally altered rocks. Juniper (*Juniperus osteosperma*) is the dominant tree; however, the scattered pinyon pine in these sites is *Pinus monophylla*, not *Pinus edulis* as occurs in the Colorado Plateau.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: There are several dead and downed trees in one plot due to blow-down. There is episodic erosion in one plot. Communities surrounding one plot have *Pinus edulis* trees, but the understory remains sparse.

Capitol Reef National Park Data: The description is based on 2003 field data (2 plots: CARE.0411, CARE.0525).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Milton and Purdy 1983,

Pinus edulis - (Juniperus monosperma, Juniperus osteosperma) / Hesperostipa comata **Woodland**

Two-needle Pinyon - (One-seed Juniper, Utah Juniper) / Needle-and-Thread Woodland

CODE	CEGL000797
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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516)

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 woodland association is known from western and south-central Colorado and eastern Utah. Stands occur on a variety of sites from flat or gentle lower slopes, benches, mesa tops to steep colluvial slopes to montane alluvial fans. Parent materials are frequently sandstone or shale. This woodland is characterized by the dominance or codominance of *Pinus edulis* in an open evergreen tree canopy. *Juniperus osteosperma* or *Juniperus monosperma* may codominate some stands, and *Juniperus scopulorum* may be present. The sparse to moderately dense herbaceous layer is dominated by the perennial bunchgrass *Hesperostipa comata*, with *Achnatherum hymenoides*, *Koeleria macrantha*, *Bouteloua gracilis*, *Pleuraphis jamesii*, and *Pascopyrum smithii* often present to common. Forb cover is generally sparse but may include *Heterotheca villosa*, *Hymenoxys* spp., *Artemisia dracuncululus*, *Oxytropis lambertii*, *Castilleja* sp., *Eriogonum jamesii*, and *Sphaeralcea coccinea*. Scattered shrubs and dwarf-shrubs may also be present, such as *Cercocarpus montanus*, *Quercus gambelii*, *Atriplex canescens*, *Artemisia frigida*, *Ephedra viridis*, or *Gutierrezia sarothrae*. *Opuntia polyacantha* and *Yucca glauca* are often present. Diagnostic of this woodland association is the dominance or codominance of *Pinus edulis* in the tree canopy and a *Hesperostipa comata*-dominated herbaceous layer.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon and was sampled on slopes and interfluves south of Desert Overlook and east of Wagon Box Mesa, south of Danish Hill, near Cedar Mesa campground, and around Bitter Creek Divide in the park.

Globally

This association is known from four counties (Montrose, San Miguel, Mesa, and Saguache) in western portion of Colorado (Isacson 1967, P. Lyon pers. comm.). It also occurs in southeastern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on all slope positions of ridges and on interfluves. Sites are flat to gentle (0 to 4° slopes), occur between 1585 and 2012 m elevation, and are oriented to all aspects. The unvegetated surface is unrecorded. Parent materials include sandstones and silty sandstones, sometimes deposited as rockfall or talus. Soils are well-drained to rapidly drained clay loams and sandy loams.

Globally

This woodland association occurs on slopes, benches and ridges with coarse-sandy, sometimes rocky soils. Elevations range between 1490 and 2156 m (4900-7070 ft.); slopes are level to steep and may be oriented to any aspect. The unvegetated soil surface may be rocky, gravelly, or mostly bare ground, or biological soil crusts can have high cover in areas that have been protected from grazing. The sandy or silty soils are generally derived from sandstone, less often from shale, alluvial or eolian deposits.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is uncommon within the park. The vegetation is characterized by an open canopy of *Pinus edulis* and *Juniperus osteosperma* trees, and the tall bunchgrass *Hesperostipa comata*. The shrub layer is diverse in terms of species composition and provides low to moderate cover. Common short and dwarf-shrubs include *Artemisia bigelovii*, *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Eriogonum corymbosum*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, *Shepherdia rotundifolia*, and *Yucca harrimaniae*. The remaining herbaceous layer is also diverse in terms of species composition and provides low to moderate cover. Commonly associated graminoids include *Achnatherum hymenoides*, *Aristida purpurea*, *Bouteloua gracilis*, and *Pleuraphis jamesii*. Forbs commonly present include *Chaetopappa ericoides*, *Lepidium montanum*, and *Sphaeralcea coccinea*. One stand has an abundance of cryptogam cover.

Globally

This woodland association occurs on sandy, sometimes rocky soils in the northern Colorado Plateau. Total vegetation cover ranges between 10% to at least 70%. This woodland association is characterized by an open to somewhat closed canopy, typically 2-5 m tall, of *Pinus edulis* and *Juniperus osteosperma* trees, and an understory dominated by the bunchgrass *Hesperostipa comata*. Scattered shrubs, such as *Ephedra viridis* and *Chrysothamnus viscidiflorus*, are present but do not form a layer. The herbaceous layer is diverse and provides up to 15% cover. *Achnatherum hymenoides* may be codominant with *Hesperostipa comata*, and *Pleuraphis jamesii* or *Bouteloua gracilis* may be present with low cover. Forbs are more diverse but contribute little cover and may include *Hymenoxys richardsonii*, *Sphaeralcea coccinea*, and *Mirabilis multiflora*. Cryptobiotic crusts are sometimes present.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Short shrub/sapling	<i>Atriplex confertifolia</i> , <i>Chrysothamnus viscidiflorus</i> , <i>Ericameria nauseosa</i> , <i>Sarcobatus vermiculatus</i> , <i>Shepherdia rotundifolia</i>
Short shrub/sapling	<i>Ephedra torreyana</i> , <i>Ephedra viridis</i>
Herb (field)	<i>Artemisia bigelovii</i> , <i>Eriogonum corymbosum</i> , <i>Gutierrezia sarothrae</i> , <i>Opuntia polyacantha</i> , <i>Yucca harrimaniae</i>
Herb (field)	<i>Psilostrophe sparsiflora</i> , <i>Sphaeralcea coccinea</i>
Herb (field)	<i>Achnatherum aridum</i> , <i>Achnatherum hymenoides</i> , <i>Bouteloua eriopoda</i> , <i>Bouteloua gracilis</i> , <i>Hesperostipa comata</i> , <i>Pleuraphis jamesii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Herb (field)	<i>Hesperostipa comata</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Descurainia pinnata*, *Tragopogon dubius*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G2? (14-Nov-1997). This is a rare, regionally endemic association. It is poorly known, with only five documented locations from four counties (Montrose, San Miguel, Mesa, and Saguache) in the western portion of Colorado (CONHP 1997). None of these stands are protected. There is some uncertainty about the accuracy of this rank (the actual rank may be lower) because both Isaacson (1967) and Colorado Natural Heritage Program field investigators (P. Lyons pers. comm.) suggest it may be more widespread on the western slope of Colorado and may extend into Utah. This association occurs in a relatively common environmental setting, being found on flat or gently inclining slopes or benches of sandstone origin (CONHP 1997). Existing stands have been degraded by overgrazing, non-native species invasion, and possibly fire suppression. As of 2006, this association has been found regularly in national park units in southern and eastern Utah, as well as western Colorado. However, stands tend to be small, isolated, and affected by grazing.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Juniperus monosperma-codominated stands are restricted to south-central Colorado.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Several stands experience light to moderate grazing.

Capitol Reef National Park Data: The description is based on 1986, 1988 and 2005 field data (7 plots: CARE.9031, CARE.9037, CARE.9069, CARE.9136, CARE.9193, CARE.9320, CARE.9351, CARE_AA.0850).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: D. Clark, mod. J. Coles and K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data, CONHP unpubl. data 2003, Driscoll et al. 1984, Isaacson 1967, Western Ecology Working Group n.d.

***Pinus edulis* - (*Juniperus osteosperma*) / *Bouteloua gracilis* Woodland Two-needle Pinyon - (Utah Juniper) / Blue Grama Woodland**

CODE	CEGL000778
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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516) 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 known from mountains and mesas in the southern Colorado Plateau, Mogollon Rim and extending north into southern Utah and probably western Colorado. Elevations normally range from 1700-2400 m (5575-7875 ft.). Sites are variable but generally are relatively dry and rocky. Stands occur on flat to moderate slopes along drainages and on mesa tops, on gentle to moderate (10-40%) rocky slopes of foothills, and at the base of cinder cones. The substrates are variable and range from deep, coarse-textured soils derived from cinder to finer-textured soils derived from sandstone, shale and limestone. The vegetation is characterized by an open to moderately dense tree canopy (10-65% cover) codominated by *Pinus edulis* and *Juniperus osteosperma* trees that are between 1 and 5 m tall. *Pinus edulis* may be present with relatively small cover in some stands. *Juniperus deppeana* may replace *Juniperus osteosperma* in southern stands. Other species of *Juniperus*, such as *Juniperus scopulorum*, may be present in higher elevation stands. Shrub cover is sparse (<10% cover). If *Quercus gambelii* is present, it has less than 5% cover. Other associated shrubs may be present in low cover, such as *Cercocarpus montanus*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Ericameria nauseosa*, *Eriogonum microthecum*, *Rhus trilobata*, or *Yucca* spp. The herbaceous layer is typically moderately dense and is dominated by the warm-season, perennial short grass *Bouteloua gracilis*. Associated graminoids include *Aristida* spp., *Achnatherum hymenoides*, *Bouteloua curtipendula*, *Elymus elymoides*, *Koeleria macrantha*, *Hesperostipa comata*, *Hesperostipa neomexicana*, and *Pleuraphis jamesii*. *Muhlenbergia montana* is absent or scarce (<1% cover). Forb cover is typically low but may be moderately diverse.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon and was sampled along the Hartnet Draw, in Upper Cathedral Valley, west of Upper South Desert Overlook, in Paradise Flats, near Fruita and south of the Burr Trail switchbacks (above the Fold).

Globally

This woodland association is known from mountains and mesas in the southern Colorado Plateau and Mogollon Rim of northern Arizona and extends into southern Utah and probably into western Colorado and possibly into western New Mexico.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on all slope positions of ridges, colluvial slopes, on interfluves, and on steps-in-slope. Sites are gentle to moderately steep (1 to 10° slopes), occur between 1707 and 2378 m elevation, and are oriented to all aspects. The unvegetated surface has low to moderate cover of litter and moderate to high cover of

gravel and rocks. Cover by live vegetation basal area is moderate. Parent materials are variable and include sandstones and shale of the Morrison, Summerville, Navajo, Wingate and Moenkopi formations, often deposited as colluvium and pediment. Soils are rapidly drained sandy loams and loamy sands.

Globally

This woodland association is known from mountains and mesas in the southern Colorado Plateau, Mogollon Rim and extending north into southern Utah and probably western Colorado. Elevations normally range from 1700-2400 m (5575-7875 ft.). Sites are variable but generally are relatively dry and rocky. Stands occur on flat to moderate slopes along drainages and on mesa tops, on gentle to moderate (10-40%) rocky slopes of foothills, and at the base of cinder cones. The substrates are variable and range from to deep, coarse-textured soils derived from cinder, to sandy loams derived from sandstone or fine-textured soils derived from limestone or shale.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is uncommon within the park. The total vegetation cover ranges from 7 to 70%. This woodland association is characterized by an open canopy, typically 1-5 m tall, of *Pinus edulis* and *Juniperus osteosperma* trees that each range in cover from 0 to 15%, and *Bouteloua gracilis* that ranges in cover from 1 to 25%. The shrub layer is moderately diverse in terms of species composition and is comprised of short and dwarf-shrubs and succulents that provide low to moderate cover. Common short and dwarf-shrubs include *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Eriogonum microthecum*, *Gutierrezia sarothrae*, and *Opuntia polyacantha*. The remaining herbaceous layer is moderately diverse in terms of species composition and provides low to moderate cover. Commonly associated bunch grasses include *Achnatherum hymenoides*, *Aristida purpurea*, *Hesperostipa comata*, and *Pleuraphis jamesii*. Forbs occasionally present include *Chamaesyce fendleri* and *Hymenoxys richardsonii*.

Globally

This plant association is characterized by an open to moderately dense tree canopy (10-65% cover) codominated by *Pinus edulis* and *Juniperus osteosperma* trees that are between 1 and 5 m tall. *Pinus edulis* may be present with relatively small cover in some stands. *Juniperus deppeana* may replace *Juniperus osteosperma* in southern stands. Other species of *Juniperus*, such as *Juniperus scopulorum*, may be present in higher elevation stands. Shrub cover is sparse (<10% cover). If *Quercus gambelii* is present, it has less than 5% cover. Other associated shrubs may be present, such as scattered *Artemisia tridentata*, *Brickellia californica*, *Cercocarpus montanus*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Ericameria nauseosa*, *Eriogonum corymbosum*, *Eriogonum microthecum*, *Fallugia paradoxa*, *Gutierrezia sarothrae*, *Opuntia* spp., *Purshia stansburiana*, *Rhus trilobata*, *Ribes cereum*, or *Yucca* spp. The herbaceous layer is typically moderately dense and is dominated by the warm-season, perennial short grass *Bouteloua gracilis*. Associated graminoids include *Aristida* spp., *Achnatherum hymenoides*, *Bouteloua curtipendula*, *Elymus elymoides*, *Koeleria macrantha*, *Hesperostipa comata*, *H. neomexicana*, and *Pleuraphis jamesii*. *Muhlenbergia montana* is absent or has <1% cover. Forb cover is typically low but may be diverse. Species such as *Artemisia dracunculus*, *Eriogonum* spp., *Hymenoxys richardsonii*, and *Oxytropis lambertii* are common.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Short shrub/sapling	<i>Atriplex canescens</i> , <i>Atriplex confertifolia</i> , <i>Chrysothamnus viscidiflorus</i>
Short shrub/sapling	<i>Ephedra viridis</i>
Herb (field)	<i>Artemisia bigelovii</i> , <i>Artemisia frigida</i> , <i>Gutierrezia sarothrae</i> , <i>Opuntia fragilis</i>
Herb (field)	<i>Artemisia campestris</i> , <i>Hymenopappus filifolius</i> , <i>Hymenoxys richardsonii</i> , <i>Lesquerella intermedia</i> , <i>Phacelia rafaensis</i>
Herb (field)	<i>Achnatherum aridum</i> , <i>Achnatherum hymenoides</i> , <i>Aristida purpurea</i> , <i>Bouteloua gracilis</i> , <i>Bromus tectorum</i> , <i>Carex geophila</i> , <i>Hesperostipa comata</i> , <i>Pleuraphis jamesii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus deppeana</i> , <i>Juniperus osteosperma</i> , <i>Juniperus scopulorum</i> , <i>Pinus edulis</i>
Herb (field)	<i>Bouteloua gracilis</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Descurainia pinnata*, *Salsola tragus*

Globally

Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

The two *Pinus edulis* / *Bouteloua gracilis* plant associations are treated as phases in Stuever and Hayden (1997a). In the USNVC we are including stands with southern Great Plains, Chihuahua Desert floristic affinities in *Pinus edulis* - (*Juniperus monosperma*) / *Bouteloua gracilis* Woodland (CEGL002151), and stands with the Colorado Plateau and Great Basin floristic affinities in *Pinus edulis* - (*Juniperus osteosperma*) / *Bouteloua gracilis* Woodland (CEGL000778). Both of these associations may include stands codominated by *Juniperus deppeana* in their southern extent. Stuever and Hayden (1997a) also described a *Juniperus deppeana* phase (recognized by its dominance in the stand) and hill slope phase, which occurs on slopes >15% and may have low cover of grasses (<5% cover). More survey is needed to fully understand the distribution and ecological relationships between these 3 species of *Juniperus* and *Pinus edulis*.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Some stands are exposed to high winds and have blow-down of pinyon pine and Utah juniper trees. One stand has stunted Utah juniper trees. Stands experience light to moderate grazing. One stand recorded no grazing for 40 years (now 60 years).

Capitol Reef National Park Data: The description is based on 1986, 1988, and 2003 field data (13 plots: CARE.0450, CARE.0453, CARE.0480, CARE.0481, CARE.9066, CARE.9067, CARE.9137, CARE.9159, CARE.9413, CARE.9415, CARE.9418, CARE.9419, CARE.9430).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: K.A. Schulz, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, Dick-Peddie 1986, Driscoll et al. 1984, Dwyer and Pieper 1967, Hansen et al. 2004c, Jameson 1962, Kennedy 1983a, Ladyman and Muldavin 1996, Larson and Moir 1987, Little 1987, Moir and Carleton 1987, Muldavin et al. 1998a, Powell 1988a, Stuever and Hayden 1997a, USFS 1982, Western Ecology Working Group n.d., Wright et al. 1973, Wright et al. 1979

***Pinus edulis* - *Juniperus osteosperma* / *Achnatherum hymenoides* Woodland Two-needle Pinyon - Utah Juniper / Indian Ricegrass Woodland**

CODE	CEGL002364
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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516) 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 currently is documented only from Capitol Reef National Park in southeastern Utah; this summary is derived from plots sampled in the park in 1986. It occurs on basin floors and hill slopes. Sites are gentle (0 to 4%), occur between 1768 and 1860 m (5800-6100 ft.) elevation, and are oriented to southwestern aspects. Parent materials include Moenkopi Formation (shale) outcrops and basalt boulders. Soils are rapidly drained and fine-textured. Total vegetation cover generally does not exceed 50%. The open canopy consists of *Pinus edulis* and *Juniperus osteosperma* trees that range in cover from 6 to 50%, with a bunchgrass understory dominated by *Achnatherum hymenoides* that ranges in cover to 25%. Shrubs do not have high enough cover to constitute a layer (<5% total cover) but are often present; common species include scattered individuals of *Ephedra viridis*, *Fraxinus anomala*, *Gutierrezia sarothrae*, and *Opuntia polyacantha*. The herbaceous layer is moderate in terms of species diversity and sparse to low in terms of cover. The most conspicuous associated graminoid is *Andropogon gerardii*.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon in the park and was sampled in Frying Pan Canyon and upper Pleasant Creek.

Globally

This association has been documented only from Moenkopi Formation outcrops in the central part of Capitol Reef National Park in southeastern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed growing on basin floors and hill slopes. Sites are gentle (2° slopes), occur between 1768 and 1860 m elevation, and are oriented to southwestern aspects. The unvegetated surface is unrecorded. Parent materials are Moenkopi Formation outcrops and basalt boulders. Soils are likely to be rapidly drained and fine-textured.

Globally

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

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is uncommon, occurring primarily on Moenkopi shale in the central portion of the park. The vegetation is characterized by an open canopy of *Pinus edulis* and *Juniperus osteosperma* trees and the tall bunchgrass *Achnatherum hymenoides*. The shrub layer is moderately diverse in terms of species composition and provides sparse to low cover. The common tall, short, and dwarf-shrubs include *Ephedra viridis*, *Fraxinus anomala*, *Gutierrezia sarothrae*, and *Opuntia polyacantha*. The herbaceous layer is moderate in terms of species diversity and sparse to low in terms of cover. Commonly associated graminoids include *Andropogon gerardii* and *Muhlenbergia pungens*. Forbs are typically sparse in terms of cover but are moderately diverse and include *Artemisia ludoviciana*.

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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Tall shrub/sapling	<i>Fraxinus anomala</i>
Short shrub/sapling	<i>Ephedra viridis</i>
Herb (field)	<i>Gutierrezia sarothrae</i> , <i>Opuntia polyacantha</i>
Herb (field)	<i>Artemisia ludoviciana</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Andropogon gerardii</i> , <i>Muhlenbergia pungens</i>

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park
Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (22-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef 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

Capitol Reef National Park Inventory Notes: One site occurs on a Moenkopi Formation hill covered with basalt boulders and alluvium. There are signs of moderate grazing on one site.

Capitol Reef National Park Data: The description is based on 1986 field data (2 plots: CARE.9121, CARE.9134).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Pinus edulis - Juniperus osteosperma / Amelanchier utahensis* Woodland
Two-needle Pinyon - Utah Juniper / Utah Serviceberry Woodland**

CODE	CEGL002329
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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516) Two-needle Pinyon - (Juniper species) Woodland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Foothill Limber Pine-Juniper Woodland (CES306.955)
Colorado Plateau Pinyon-Juniper Woodland (CES304.767)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association is characteristic of rocky slopes in the Colorado Plateau and extends into the southern Rocky Mountains in western Colorado and northeastern Arizona. Elevations and aspects are variable. Stands occurring at lower elevations (1406-2006 m) on the Colorado Plateau and northwestern Colorado tend to occur on northerly aspects, whereas stands occurring in west-central and southwestern Colorado occur at higher elevations (2481-2510 m) and have southerly aspects. Stands throughout the range may be on gentle to steep slopes (7-160%). Soils are rapidly drained, but texture and parent materials vary from clay to sandy loam and from marine shale to sandstone and granite. The unvegetated ground surface is composed primarily of exposed bedrock, rocks, gravel and bare ground. This woodland association has an open to relatively closed tree canopy and sparse to dense total vegetation cover. *Juniperus osteosperma* and *Pinus edulis* comprise the tree canopy, but individually do not exceed 25% cover. There is a tall-shrub stratum with as much as 25% cover dominated by *Amelanchier utahensis*. Other shrubs that may be present with low cover include *Artemisia tridentata*, *Cercocarpus montanus*, *Fraxinus anomala*, *Ephedra viridis*,

Fendlera rupicola, *Quercus gambelii*, *Rhus trilobata*, and *Symphoricarpos oreophilus*. Dwarf-shrubs may include *Yucca harrimaniae*, *Gutierrezia sarothrae*, and *Chrysothamnus viscidiflorus*. The herbaceous layer has sparse to low cover and contains graminoids, such as *Achnatherum hymenoides*, *Carex geyeri*, *Leymus salinus*, and *Poa fendleriana*, and forbs, such as *Antennaria parvifolia*, *Erigeron peregrinus*, *Eriogonum ovalifolium*, *Heterotheca villosa*, *Lathyrus lanszwertii*, *Lepidium montanum*, *Phlox austromontana*, and *Streptanthella longirostris*. Disturbed stands may contain *Bromus tectorum*.

DISTRIBUTION

Capitol Reef National Park

This association is rare in the park and is represented by a single plot sampled on Dry Bench.

Globally

This association is found in the Colorado Plateau in northeastern Arizona and southeastern Utah and extends east into the southern Rocky Mountains of western Colorado.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This association was sampled once on a high slope. The site slopes steeply (23° slopes), is oriented to the north, and lies at 2184 m elevation. Bare soil and litter cover most of the unvegetated surface, with low cover by gravel, bedrock, wood and large rocks. The soil is a rapidly drained sandy clay loam derived from the Carmel Formation.

Globally

This association is characteristic of rocky slopes in the Colorado Plateau and extends into the southern Rocky Mountains in western Colorado and northeastern Arizona. Elevations and aspects are variable. Stands occurring at lower elevations (1406-2006 m) on the Colorado Plateau and northwestern Colorado tend to occur on northerly aspects, whereas stands occurring in west-central and southwestern Colorado occur at higher elevations (2481-2510 m) and have southerly aspects. Stands throughout the range may be on gentle to steep slopes (7-160%). Soils are rapidly drained, but texture and parent materials vary from clay to sandy loam and from marine shale to sandstone and granite. The unvegetated ground is composed primarily of exposed bedrock, rocks, gravel and bare ground.

VEGETATION DESCRIPTION

Capitol Reef National Park

This association was sampled once on a high slope. The site slopes steeply (23° slopes), is oriented to the north, and lies at 2184 m elevation. Bare soil and litter cover most of the unvegetated surface, with low cover by gravel, bedrock, wood and large rocks. The soil is a rapidly drained sandy clay loam derived from the Carmel Formation.

Globally

This woodland association has an open to relatively closed tree canopy and sparse to dense total vegetation cover. The dominant tree species, *Juniperus osteosperma* and *Pinus edulis*, are typically between 2 and 10 m tall and individually do not exceed 25% cover. There is a tall-shrub stratum with up to 25% cover dominated by *Amelanchier utahensis*. Other shrubs that may be present with low cover (<5% cover) include *Artemisia tridentata*, *Coleogyne ramosissima*, *Cercocarpus montanus*, *Eriogonum microthecum*, *Fraxinus anomala*, *Ephedra viridis*, *Fendlera rupicola*, *Quercus gambelii*, *Purshia mexicana*, *Rhus trilobata*, and *Symphoricarpos oreophilus*. Dwarf-shrubs may include *Yucca harrimaniae*, *Gutierrezia sarothrae*, and *Chrysothamnus viscidiflorus*. The herbaceous layer has sparse to low cover and contains graminoids, such as *Aristida purpurea*, *Achnatherum hymenoides*, *Carex geyeri*, *Leymus salinus*, *Pleuraphis jamesii*, and *Poa fendleriana*, and forbs, such as *Antennaria parvifolia*, *Artemisia ludoviciana*, *Astragalus moencoppensis*, *Collinsia parviflora*, *Cryptantha flava*, *Erigeron peregrinus*, *Erigeron utahensis*, *Eriogonum ovalifolium*, *Heterotheca villosa*, *Hymenopappus filifolius*, *Lathyrus lanszwertii*, *Lepidium montanum*, *Phlox austromontana*, and *Streptanthella longirostris*. Disturbed stands may contain *Bromus tectorum*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Tall shrub/sapling	<i>Amelanchier utahensis</i> , <i>Quercus gambelii</i>
Tall shrub/sapling	<i>Cercocarpus montanus</i>
Short shrub/sapling	<i>Symphoricarpos oreophilus</i>

Herb (field) *Poa fendleriana*

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Tall shrub/sapling	<i>Amelanchier utahensis</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park
Data are not available.

Globally

Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (11-Jan-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park
Data are not available.

Globally

Amelanchier utahensis is a common constituent of plant communities on rocky slopes in the Colorado Plateau. There is some overlap with *Pinus edulis* - *Juniperus osteosperma* / (*Shepherdia rotundifolia*, *Amelanchier utahensis*) Wooded Shrubland (CEGL002334), and as more information becomes available, woodlands with *Amelanchier utahensis* as a significant component should be re-analyzed.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: This plot is on the Navajo-Carmel interface, but most of the soil comes from the Carmel Formation. The *Amelanchier* is spread throughout the community, while the oak is in widely spaced clumps. *Cercocarpus* is also a significant presence. No shrub is strongly dominant. There is a lone ponderosa pine in the plot and is the only one in this vicinity.

Capitol Reef National Park Data: The description is based on field data collected in 1987 and in 2005 during accuracy assessment (2 plots: CARE.9701, CARE_AA.0516).

Local Description Authors: J. Coles

Global Description Authors: J. Drake and J. Coles, mod. K.A. Schulz

REFERENCES: 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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516) 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 ft.) 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 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

Capitol Reef National Park

This association is rare and was sampled in the central fin area of the Onion Beds and in the Fold southwest of Bitter Creek Divide. It occurs sporadically throughout the Navajo domes of the Waterpocket Fold.

Globally

This association occurs in southern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on channel beds and blowouts on steps-in-slope. Sites are flat to gentle (0 to 2° slopes), occur between 1707 and 2103 m elevation, and are oriented to western aspects. The unvegetated surface has moderate cover of litter and exposure of bare soil. There is low cover by small rocks and gravel, and downed wood is uncommon. Parent materials are variable and include sandstones, including Navajo and Wingate formations, and shale that have eroded and deposited in bedrock cracks and as eolian deposits. Soils are rapidly drained loamy sands.

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

Capitol Reef National Park

This woodland association is rare within the park. The total vegetation cover ranges from 28 to 70%. This woodland association is characterized by an open canopy, typically 2-5 m tall, of *Pinus edulis* and *Juniperus osteosperma* trees that each range in cover from 5 to 15%, and *Arctostaphylos patula* shrubs that range in cover from 15 to 25%. The associated shrub layer is high in species diversity and provides moderate cover. Common tall shrubs include *Amelanchier utahensis*, *Fraxinus anomala*, and *Purshia stansburiana*. The short- and dwarf-shrub layer includes *Cercocarpus intricatus*, *Eriogonum microthecum*, *Opuntia polyacantha*, *Shepherdia rotundifolia*, and *Yucca harrimaniae*. The herbaceous layer is low to moderate in terms of species diversity and provides sparse to low cover. Graminoids commonly present include *Achnatherum hymenoides* and *Muhlenbergia pungens*. Forbs commonly present include *Comandra umbellata* and *Penstemon eatonii*.

Globally

This woodland association typically has an open tree canopy (10-30% cover) 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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Tall shrub/sapling	<i>Amelanchier utahensis</i> , <i>Fraxinus anomala</i>
Tall shrub/sapling	<i>Purshia mexicana</i>
Short shrub/sapling	<i>Shepherdia rotundifolia</i>
Short shrub/sapling	<i>Arctostaphylos patula</i> , <i>Cercocarpus intricatus</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Muhlenbergia pungens</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Short shrub/sapling	<i>Arctostaphylos patula</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum

Globally

Data are not available.

CONSERVATION STATUS RANK

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

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

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 a variation of the woodland type because of the ecological values of the trees.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: One stand along a stream above waterpockets was lightly grazed by cattle until 1988. One site is a unique community at the base of narrow fins of sandstone. This site is flat and windswept, surrounded by slickrock with no vegetation.

Capitol Reef National Park Data: The description is based on 1986 and 2003 field data (2 plots: CARE.0557, CARE.9035).

Local Description Authors: J. Von Loh, mod. D. Clark

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 bigelovii* Woodland Two-needle Pinyon - Utah Juniper / Bigelow Sagebrush Woodland**

CODE	CEGL002118
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)

FORMATION Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
ALLIANCE *PINUS EDULIS* - (*JUNIPERUS* SPP.) WOODLAND ALLIANCE (A.516)
Two-needle Pinyon - (Juniper species) Woodland Alliance

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

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association occurs in western Colorado and eastern Utah, usually on mesa tops and canyon rims. Sites can have gentle to steep slopes and with varying local aspects but have been most commonly observed on sites whose general aspect is north or east. This association has been found at sites between 1476 and 2104 m (4840-6900 ft.) elevation and mostly on sandstone. Soils are shallow, well-drained to rapidly drained loamy sands, sandy loams, or silt loams. The unvegetated ground surface is typically composed of litter, bedrock, and bare soil. This woodland association generally has sparse to moderate total vegetation cover. There is an open tree canopy 2-5 m tall dominated by *Pinus edulis* and *Juniperus osteosperma* with 2-20% cover each. The shrub layer is also open and, besides the abundance of *Artemisia bigelovii*, is usually mixed in composition. *Artemisia bigelovii* is the most abundant shrub with 2-10% cover. Other typical shrubs are *Echinocereus triglochidiatus*, *Ephedra torreyana*, *Ephedra viridis*, *Eriogonum corymbosum*, *Fraxinus anomala* (which can be present in the tree canopy, as well), and *Gutierrezia sarothrae*. The herbaceous layer typically has less than 5% cover and contains species such as *Achnatherum hymenoides*, *Elymus elymoides*, *Pleuraphis jamesii*, *Arenaria fendleri*, *Erodium cicutarium*, *Heterotheca villosa*, and *Tetranneuris acaulis*.

DISTRIBUTION

Capitol Reef National Park

This association is rare and was sampled near Miners Mountains and above the Egyptian Temple within the park.

Globally

This Colorado Plateau woodland association is found in western Colorado and southeastern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on midslopes of valleys and interfluves. Sites are gentle (2 to 3° slopes), occur between 1829 and 2104 m elevation, and are oriented to northern aspects. The unvegetated surface is unrecorded. Parent materials are variable and include sandstones and shale. Soils are well-drained to rapidly drained and coarse-textured.

Globally

This association is most commonly found on mesa tops and canyon rims but has been found on valley midslopes with rocky or ledgy substrates. Slopes can vary in steepness (sampled plots are between 1 and 35°) and local aspect but have been most commonly observed on sites whose general aspect is north or east. This association has been found at sites between 1476 and 2104 m elevation and mostly on sandstone substrates. Soils are shallow, well-drained to rapidly drained loamy sands, sandy loams, or silt loams. The unvegetated ground surface is typically composed of litter, bedrock, and bare soil. Large and small rocks can be present but are rarely abundant; fractures in the underlying bedrock control the density and distribution of woody vegetation. Parent materials include Dakota, Cedar Mesa, Kayenta Formation and Wingate Formation sandstones.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is rare within the park. The vegetation is characterized by an open canopy of *Pinus edulis* and *Juniperus osteosperma* trees and *Artemisia bigelovii* shrubs. The associated shrub layer is composed of short and dwarf-shrubs that are low in terms of species diversity, provides sparse to low cover, and includes *Ephedra torreyana*, *Atriplex confertifolia*, *Gutierrezia sarothrae*, *Chrysothamnus viscidiflorus*, and *Eriogonum corymbosum*. The herbaceous layer is moderate in terms of species diversity and provides sparse to low cover. Graminoids provide low cover and include the perennial grasses *Achnatherum hymenoides*, *Bouteloua gracilis*, and *Elymus elymoides*. Forbs are diverse and sparse with no common species.

Globally

This association generally has sparse to moderate total vegetation cover. There is an open tree canopy 2-5 m tall

dominated by *Pinus edulis* and *Juniperus osteosperma*. These tree species can vary in abundance from 2-20% cover each. The shrub layer has sparse to low cover and, besides the abundance of *Artemisia bigelovii*, is variable in composition. *Artemisia bigelovii* is the most abundant shrub with 2-10% cover. Other typical components of the shrub stratum include *Chrysothamnus viscidiflorus*, *Echinocereus triglochidiatus*, *Ephedra torreyana*, *Ephedra viridis*, *Eriogonum corymbosum*, *Fendlera rupicola*, *Fraxinus anomala* (which can be present in the tree canopy, as well), *Gutierrezia sarothrae*, and *Yucca baccata*. Occasional *Artemisia tridentata* ssp. *wyomingensis*, *Atriplex canescens*, *Cercocarpus intricatus*, *Grayia spinosa*, *Purshia stansburiana*, *Rhus trilobata*, and *Tetradymia spinosa* may be present in some stands. The herbaceous layer is sparse, typically less than 5% cover, and contains graminoid species such as *Achnatherum hymenoides*, *Elymus elymoides*, and *Pleuraphis jamesii*. Forbs include *Arenaria fendleri*, *Erodium cicutarium*, *Heterotheca villosa*, *Machaeranthera grindelioides*, *Streptanthus cordatus*, and *Tetranneuris acaulis*. Stands of this community sampled at higher elevation have northern aspects and more dense vegetation cover.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Short shrub/sapling	<i>Atriplex confertifolia</i> , <i>Chrysothamnus viscidiflorus</i> , <i>Eriogonum corymbosum</i> , <i>Gutierrezia sarothrae</i>
Short shrub/sapling	<i>Artemisia bigelovii</i> , <i>Ephedra torreyana</i>
Herb (field)	<i>Bouteloua gracilis</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Herb (field)	<i>Artemisia bigelovii</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Erodium cicutarium

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (15-Dec-2004).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

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 bigelovii* dwarf-shrublands with scattered pinyon and juniper trees, but they are considered a variation of the woodland type because of the ecological values of the trees.

CLASSIFICATION CONFIDENCE:

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Data are not available.

Capitol Reef National Park Data: The description is based on 1986 field data (2 plots: CARE.9336, CARE.9342).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Drake, mod. J. Coles and K.A. Schulz

REFERENCES: 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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516) 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, ridge tops, 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 ft.). 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 sandstone or limestone 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 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

Capitol Reef National Park

This association is uncommon and was sampled in the Onion Beds, Divide Canyon North, in the vicinity of Burr Trail, and in Paradise Flats within the park.

Globally

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

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This association occurs on mesas, upper slopes of hills and ridges, and on interfluves. Sites are gentle to moderately steep (2 to 18° slopes), occur between 1811 and 2378 m elevation, and are oriented to many aspects. The unvegetated surface typically has sparse litter. Cover by small rocks and gravel ranges from moderate to high, and large rocks provide moderate cover on one site. Downed wood is uncommon, not exceeding 5% cover. Parent materials are variable and include sandstones and shale of the Chinle and Moenkopi formations and the Ferron Sandstone Member. Soils are well-drained to rapidly drained sandy loams and loams.

Globally

This association occurs on the higher areas of local topographical features such as canyon rims, mesas, hills, ridge tops, 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 ft.). 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

Capitol Reef National Park

This woodland association is uncommon within the park. The vegetation is characterized by an open canopy, typically 2-5 m tall, of *Pinus edulis* and *Juniperus osteosperma* trees that range in cover from 1 to 15% and 1 to 45%, respectively, and *Artemisia nova* short shrubs that range in cover from 1 to 15%. The associated shrub layer is composed of shrubs that are low in species diversity, provides sparse to low cover, and includes *Ephedra viridis*. The herbaceous layer is sparse to low in species diversity and typically provides sparse cover. The common perennial bunchgrass is *Achnatherum hymenoides*. Forbs are diverse and sparse with no one species being common.

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 as much as 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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Short shrub/sapling	<i>Artemisia nova</i>
Short shrub/sapling	<i>Ephedra viridis</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Herb (field)	<i>Artemisia nova</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Descurainia pinnata

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (11-Jan-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE:

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: One stand is lightly grazed by cattle. One site is on shallow soils at the boundary of Moenkopi and Chinle deposits. One stand has large pinyon-juniper trees with no herbaceous understory. One site has unusual reddish, mineralized sandstone.

Capitol Reef National Park Data: The description is based on 1986 and 2003 field data (4 plots: CARE.0470, CARE.0524, CARE.0565, CARE.9421).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Drake, mod. J. Coles and K.A. Schulz

REFERENCES: Western Ecology Working Group n.d.

***Pinus edulis* - *Juniperus osteosperma* / *Artemisia pygmaea* Woodland Two-needle Pinyon - Utah Juniper / Pygmy Sagebrush Woodland**

CODE	CEGL002365
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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516) 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 has only been described from Capitol Reef National Park. This summary is derived from plot data collected in the park in 1986, 2003 and 2004. It occurs on benches and on canyon rims. Sites slope gently (less than 7%) to the north or east between 1749 and 2134 m elevation. Gravel covers most of the unvegetated surface. Parent materials are variable and include Carmel and Moenkopi shales and pediment deposits. Soils are rapidly drained silty clays and loams. Total vegetation cover ranges widely, from 17 to 110%. The vegetation is characterized by an open canopy, typically 2-10 m tall, of *Pinus edulis* and *Juniperus osteosperma* that contribute up to 35% cover, and the dwarf-shrub *Artemisia pygmaea* with 5 to 15% cover. Sapling *Pinus edulis* and *Juniperus osteosperma* are generally present. The shrub layer also includes *Eriogonum corymbosum* and *Shepherdia rotundifolia*. The herbaceous layer is moderately diverse in terms of species composition and provides sparse to low cover. Common perennial grasses include *Achnatherum hymenoides*, *Aristida purpurea*, *Bouteloua gracilis*, and *Pleuraphis jamesii*. Forbs typically provide less than 1% total cover with no consistent species.

DISTRIBUTION

Capitol Reef National Park

This association is rare and was sampled on low slopes of benches and on canyon rims near the Upper South Desert Overlook and south of the Burr Trail switchbacks.

Globally

This association has only been described from Capitol Reef National Park in southern Utah. Stands are likely to be rare and relatively small, but the range may include parts of Nevada, Colorado, Arizona and New Mexico.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on low slopes of benches and on canyon rims. Sites are gentle (4° slopes), occur between 1749 and 2134 m elevation, and are oriented to northern and eastern aspects. The unvegetated surface has low cover of litter, low to moderate cover of large rocks, and moderate to high cover of small rocks and gravel. Exposure of bare soil is low. Parent materials are variable and include Carmel and Moenkopi formation shale and pediment deposits. Soils are rapidly drained silty clays and loams.

Globally

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

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is rare in the park. The total vegetation cover ranges from 17 to 110% cover. This woodland association is characterized by an open canopy, typically 2-10 m tall, of *Pinus edulis* and *Juniperus osteosperma* trees that range in cover from 5 to 15%, and the dwarf-shrub *Artemisia pygmaea* that ranges in cover from 5 to 15%. Sapling *Pinus edulis* and *Juniperus osteosperma* trees each provide 5 to 15% cover in one stand. The shrub layer is diverse in terms of species composition and is comprised of short and dwarf-shrubs and succulents that provide low to moderate cover, including *Eriogonum corymbosum* and *Shepherdia rotundifolia*. The herbaceous layer is moderately diverse in terms of species composition and provides sparse to low cover. Common perennial grasses include *Achnatherum hymenoides*, *Aristida purpurea*, *Bouteloua gracilis*, and *Pleuraphis jamesii*. Forbs typically provide less than 1% total cover with no species common.

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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Short shrub/sapling	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Short shrub/sapling	<i>Shepherdia rotundifolia</i>
Herb (field)	<i>Artemisia pygmaea</i> , <i>Eriogonum corymbosum</i>
Herb (field)	<i>Bouteloua gracilis</i> , <i>Pleuraphis jamesii</i>

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (24-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef 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

Capitol Reef National Park Inventory Notes: One stand experiences light grazing. One stand is quite small. One stand has become established on yellow to red Moenkopi-derived soils.

Capitol Reef National Park Data: The description is based on 1986, 2003, and 2004 field data (3 plots: CARE.0446, CARE.0610, CARE.9405).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Pinus edulis* - *Juniperus osteosperma* / *Atriplex* spp. Woodland [Provisional]
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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516) 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° slopes) and occur on plateau slopes, valley sides, midslopes of hills, and on ridge tops 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 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*, *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 as much as 27% cover.

DISTRIBUTION

Capitol Reef National Park

This association is rare and was sampled near Cedar Mesa campground, along the Notom Road and in Halls Creek drainage north of Lake Mead.

Globally

This association is described from Capitol Reef National Park in southern Utah and Black Canyon of the Gunnison National Park in 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

Capitol Reef National Park

This association occurs on plateau slopes, valley sides and hogbacks. Sites slope gently (1 to 9°), between 1583 and 1705 m elevation, and are oriented to all aspects. The unvegetated surface has low cover of litter, gravel and bedrock and high exposure of bare soil. Cryptogam cover can be up to 27%. Parent materials are variable and include Dakota Formation sandstones and Morrison Formation (Brushy Basin Member) shale. Soils are rapidly drained silts or sands.

Globally

This 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° slopes) and occur on plateau slopes, valley sides, midslopes of hills, and on ridge tops 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

Capitol Reef National Park

This woodland association is rare within the park. The total vegetation cover ranges from 18 to 75% cover. This woodland association is characterized by an open canopy, typically 2-5 m tall, of *Juniperus osteosperma* trees that range cover from 15 to 25% and the short shrub *Atriplex canescens* that ranges in cover from 1 to 5%. Sapling *Juniperus osteosperma* trees provide 1 to 5% cover in one stand, and seedling *Pinus edulis* and *Juniperus osteosperma* trees are each present in one stand. The associated shrub layer includes scattered individuals of *Mahonia fremontii*, *Atriplex confertifolia*, *Atriplex cuneata*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Gutierrezia sarothrae*, and *Opuntia polyacantha* that provide sparse cover. The herbaceous layer provides sparse to low cover. Common graminoids include *Bromus tectorum* and *Pleuraphis jamesii*. Forbs typically provide less than 1% total cover, and *Eriogonum inflatum* is often present. Cryptogams provide up to 27% cover.

Globally

This woodland has an open to moderate (15-25% cover) tree canopy 2-5 m tall 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*, *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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Tree subcanopy	<i>Juniperus osteosperma</i>
Tall shrub/sapling	<i>Mahonia fremontii</i>
Short shrub/sapling	<i>Atriplex canescens</i> , <i>Atriplex confertifolia</i> , <i>Atriplex cuneata</i> , <i>Chrysothamnus viscidiflorus</i>
Short shrub/sapling	<i>Ephedra viridis</i>
Herb (field)	<i>Gutierrezia sarothrae</i> , <i>Opuntia polyacantha</i>

Globally

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

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (23-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Stands experience moderate to heavy grazing. Drought during 2004 and preceding years is having a major effect on trees and shrubs in the form of dead and dying branches and foliage.

Soils are deep and sandy but may have a layer of pebbles from eroded Dakota sandstone conglomerate.

Capitol Reef National Park Data: The description is based on 1988 and 2004 field data as well as 2005 accuracy assessment data (5 plots: CARE.0611, CARE.0612, CARE.9428, CARE_AA.0287, CARE_AA.1344).

Local Description Authors: J. Von Loh, mod. D. Clark and J. Coles

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Western Ecology Working Group n.d.

***Pinus edulis* - *Juniperus osteosperma* / *Bromus tectorum* Semi-natural Woodland
Two-needle Pinyon - Utah Juniper / Cheatgrass Semi-natural Woodland**

CODE	CEGL002367
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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516) 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)
Great Basin Pinyon-Juniper Woodland (CES304.773)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This woodland association has only been described from Capitol Reef National Park in southern Utah and Black Canyon of the Gunnison National Park in western Colorado. Stands are found on mesas, canyon sides, ridges, hill slopes, often on steep colluvial midslopes, valley bottoms and high stream terraces. Sites are typically moderate to steep, but range from 4 to 38° slopes, occur between 1555 and 2274 m elevation, and are often oriented to warmer southerly aspects. The unvegetated ground surface is generally bedrock, rock and gravel with moderate cover of bare ground and relatively low cover of litter. Soils in bottomland and stream terrace sites are typically well-drained fine sand derived from alluvium. It occurs in areas that experienced more than a century of concentrated domestic livestock grazing. The vegetation is characterized by an open to relatively closed canopy, typically 5-10 m tall, of *Pinus edulis* and *Juniperus osteosperma* trees that range in cover from 15 to 50%. *Juniperus osteosperma* cover tends to be more abundant than *Pinus edulis*, but either can dominate. The shrub layer is diverse but sparse to low in cover, providing less than 15% cover per stratum. Common shrubs include *Amelanchier alnifolia*, *Amelanchier utahensis*, *Artemisia tridentata* ssp. *wyomingensis*, *Brickellia californica*, *Cercocarpus montanus*, *Ericameria nauseosa*, *Opuntia fragilis*, *Opuntia polyacantha*, *Quercus gambelii*, *Ribes inerme*, *Symphoricarpos oreophilus*, and *Symphoricarpos rotundifolius*. The herbaceous layer has sparse to low cover (typically <15%) and has low diversity, being characteristically dominated by *Bromus tectorum*. Common graminoids with low cover include *Achnatherum hymenoides*, *Carex geyeri*, *Poa fendleriana*, *Sporobolus cryptandrus*, and *Sporobolus airoides*. Forbs are of

moderate diversity and include *Agoseris glauca* var. *laciniata*, *Allium* sp., *Antennaria rosea*, *Arabis* spp., *Arenaria fendleri*, *Astragalus* sp., *Balsamorhiza sagittata*, *Chaenactis douglasii*, *Collinsia parviflora*, *Descurainia pinnata*, *Eriogonum lonchophyllum*, *Heterotheca villosa*, *Lomatium simplex*, *Machaeranthera canescens*, *Phlox longifolia*, and *Senecio* spp.

DISTRIBUTION

Capitol Reef National Park

This association is rare and was sampled along Lower Muley Twist Canyon.

Globally

This association has only been described from Capitol Reef National Park in southern Utah and Black Canyon of the Gunnison National Park in western Colorado. It is likely to occur in disturbed pinyon-juniper woodlands throughout the Colorado Plateau, southern Rocky Mountain foothills, and Great Basin.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on terraces above creeks. The site is gentle (2° slope), occurs at 1555 m elevation, and is oriented to the northwestern aspect. The unvegetated surface is unrecorded. Parent materials are variable and include sandstones and shale that have eroded and deposited as alluvium. Soils are well-drained fine sands.

Globally

This association has only been described from Capitol Reef National Park in southern Utah and Black Canyon of the Gunnison National Park in western Colorado. Stands are found on mesas, canyon sides, ridges, hill slopes, often on steep colluvial midslopes, valley bottoms and high stream terraces. Sites are typically moderate to steep, but range from 4 to 38° slopes and occur between 1555 and 2274 m elevation, and are often oriented to warmer southerly aspects. The unvegetated ground surface is generally bedrock, rock and gravel with moderate cover of bare ground and relatively low cover of litter. Soils in bottomland and stream terrace sites are typically well-drained fine sand derived from alluvium. It occurs in areas that experienced more than a century of concentrated domestic livestock grazing.

VEGETATION DESCRIPTION

Capitol Reef National Park

This altered woodland association is rare within the park. The vegetation is characterized by an open canopy of *Pinus edulis* and *Juniperus osteosperma* trees and the annual exotic grass *Bromus tectorum*. The shrub layer is moderately diverse, contains tall-, short-, and dwarf-shrub species, and provides low to moderate cover. The tall-shrub layer includes *Amelanchier alnifolia* and *Quercus gambelii*, while common short and dwarf-shrubs include *Ericameria nauseosa*, *Brickellia californica*, and *Opuntia polyacantha*. The remaining herbaceous layer is diverse and provides low to moderate cover. Common perennial graminoids include *Sporobolus cryptandrus* and *Sporobolus airoides*. The most abundant forbs include *Machaeranthera canescens* and the annual exotic *Salsola tragus*.

Globally

The vegetation is characterized by an open to relatively closed canopy, typically 5-10 m tall, of *Pinus edulis* and *Juniperus osteosperma* trees that range in cover from 15 to 50%. *Juniperus osteosperma* cover tends to be more abundant than *Pinus edulis*, but either can dominate. The shrub layer is diverse but sparse to low in cover, providing less than 15% cover per stratum. Common shrubs include *Amelanchier alnifolia*, *Amelanchier utahensis*, *Artemisia tridentata* ssp. *wyomingensis*, *Brickellia californica*, *Cercocarpus montanus*, *Ericameria nauseosa*, *Opuntia fragilis*, *Opuntia polyacantha*, *Quercus gambelii*, *Ribes inerme*, *Symphoricarpos oreophilus*, and *Symphoricarpos rotundifolius*. The herbaceous layer has sparse to low cover (typically <15%) and has low diversity, being characteristically dominated by *Bromus tectorum*. Common graminoids with low cover include *Achnatherum hymenoides*, *Carex geyeri*, *Poa fendleriana*, *Sporobolus cryptandrus*, and *Sporobolus airoides*. Forbs are of moderate diversity and include *Agoseris glauca* var. *laciniata*, *Allium* sp., *Antennaria rosea*, *Arabis* spp., *Arenaria fendleri*, *Astragalus* sp., *Balsamorhiza sagittata*, *Chaenactis douglasii*, *Collinsia parviflora*, *Descurainia pinnata*, *Eriogonum lonchophyllum*, *Heterotheca villosa*, *Lomatium simplex*, *Machaeranthera canescens*, *Phlox longifolia*, and *Senecio* spp.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Short shrub/sapling	<i>Brickellia californica</i>
Herb (field)	<i>Machaeranthera canescens</i> , <i>Salsola tragus</i>
Herb (field)	<i>Bromus tectorum</i> , <i>Sporobolus cryptandrus</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park
Bromus tectorum, *Salsola tragus*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (ruderal) (23-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park
Data are not available.

Globally

This association has only been described from Capitol Reef National Park and Black Canyon of the Gunnison National Park. It has likely been under-sampled throughout its range because of its highly disturbed nature.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: The stand experienced heavy grazing until 1988.
Capitol Reef National Park Data: The description is based on 1986 field data (1 plot: CARE.9187).
Local Description Authors: J. Von Loh, mod. D. Clark
Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Western Ecology Working Group n.d.

***Pinus edulis* - *Juniperus osteosperma* / *Cercocarpus intricatus* Woodland**
Two-needle Pinyon - Utah Juniper / Littleleaf Mountain-mahogany Woodland

CODE	CEGL000779
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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516) Two-needle Pinyon - (Juniper species) Woodland Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)
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 occurs on dry sandstone ridge tops, mesa edges, outcrops, colluvial slopes, slickrock hills,

benches and knolls at moderate elevations of 1484 to 2470 m (4870-8100 ft.) on the Colorado Plateau and in extreme northwestern Colorado, adjacent Utah, and possibly Wyoming. South and southwest aspects are common, and slopes can be variable in steepness. Exposed bedrock and large rock may cover over 50% of the stand, with vegetation growing in the cracks. These sandstone-derived soils are generally poorly developed, coarse-textured and skeletal. Bare soil is common. The vegetation is characterized by a short (2-10 m), open tree canopy (10-25% cover) codominated by *Pinus edulis* and *Juniperus osteosperma*, and by the dominance of *Cercocarpus intricatus* in the relatively sparse short-shrub layer (5-25% cover). *Pinus edulis* and *Juniperus osteosperma* vary in cover between 1 and 15%, though higher covers are possible. The shrubs *Amelanchier utahensis*, *Arctostaphylos patula*, *Gutierrezia sarothrae*, *Mahonia fremontii*, *Quercus gambelii*, or *Yucca* spp. are often present in many stands. Herbaceous cover is sparse (<5% cover) and is composed of scattered forbs and grasses such as species of *Cryptantha*, *Penstemon*, and *Opuntia*, *Achnatherum hymenoides*, *Bouteloua gracilis*, *Elymus elymoides*, *Pleuraphis jamesii*, and *Poa fendleriana*.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon and was sampled in the Southern Fin of the Onion Beds, Upper and Lower Sheets Gulch, Spring Canyon, CoHab Canyon, near Chimney Rock and in Upper Deep Creek.

Globally

This plant association is found on the Colorado Plateau and in extreme northwestern Colorado, adjacent Utah, and possibly Wyoming.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on steps-in-slope in canyons, all topographic positions on slopes, and on interfluves. Sites are gentle to moderately steep (1 to 21° slopes), occur between 1585 and 2470 m elevation, and are oriented to all aspects. The unvegetated surface has moderate to high cover of litter and moderate exposure of sand on one site in an atypical setting for the association. Parent materials are variable and include sandstones and shale of the Dakota Formation, Navajo Formation, Wingate Formation, Morrison Formation, Carmel Formation, and Chinle Formation. Soils are rapidly drained loamy sands and sands.

Globally

This woodland association occurs on dry, sandstone ridge tops, mesa edges, outcrops, colluvial slopes, slickrock hills, benches and knolls at moderate elevations (1484 -2470 m) on the Colorado Plateau and in extreme northwestern Colorado, adjacent Utah, and possibly Wyoming. South and southwest aspects are common, and slopes can vary from gentle to steep. Exposed bedrock and large rock may cover over 50% of the stand, with vegetation growing in soil that has collected in joints and cracks. These sandstone-derived soils are generally poorly developed, coarse-textured and skeletal. Soils are rapidly drained sandy loams, sands, or silt loams derived from colluvium derived from a variety of parent materials, including Carmel Formation, Cedar Mesa sandstone, Chinle Formation, Dakota Formation, Kayenta Formation, Morrison Formation, Navajo Formation, or Wingate Formation. Bare soil is common.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is uncommon to common within the park. The total vegetation cover ranges from 30 to 80%. This woodland association is characterized by an open canopy, typically 2-10 m tall, of *Pinus edulis* and *Juniperus osteosperma* trees that range in cover from 15 to 25%, and the short shrub *Cercocarpus intricatus* that ranges in cover from 5 to 15%. The shrub layer is moderately diverse in terms of species composition and provides low to moderate cover. Commonly associated tall shrubs include *Amelanchier utahensis* and *Mahonia fremontii*. The associated short- and dwarf-shrub layers commonly include *Artemisia bigelovii*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Eriogonum microthecum*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, *Shepherdia rotundifolia*, and *Purshia stansburiana*. The herbaceous layer is low to moderate in terms of species composition and typically provides sparse cover. Occasionally present graminoids include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Elymus elymoides*, and *Pleuraphis jamesii*. Forbs may include *Heterotheca villosa* and *Hymenopappus filifolius*.

Globally

The association is characterized by an open tree canopy (10-25% cover) codominated by *Pinus edulis* and *Juniperus osteosperma*, and by the dominance of *Cercocarpus intricatus* in the relatively sparse short-shrub layer (5-25%

cover). The tree canopy may be between 2 and 10 m tall; *Pinus edulis* and *Juniperus osteosperma* vary in cover between 1 and 15%, with some stands having as much as 25% cover of *Pinus edulis*. Some stands may have an occasional emergent *Pinus ponderosa*, *Pseudotsuga menziesii*, or *Juniperus scopulorum* tree. Additionally, some sparse (<10% total cover), tree-dominated stands from extremely dry, rocky sites in the Colorado Plateau are included in this woodland association as a best fit. The shrub layer represents the mesic end of the pinyon-juniper / mixed shrub understory communities found on slickrock exposures. *Amelanchier utahensis*, *Arctostaphylos patula*, *Gutierrezia sarothrae*, *Mahonia fremontii*, *Quercus gambelii* (low cover), or *Yucca* spp. are often present in many stands. A variety of other shrubs and dwarf-shrubs may be present depending on location, including *Artemisia bigelovii*, *Brickellia microphylla*, *Cercocarpus montanus*, *Chrysothamnus viscidiflorus*, *Echinocereus triglochidiatus*, *Ephedra viridis*, *Eriogonum corymbosum*, *Fendlerella utahensis*, *Fraxinus anomala*, *Glossopetalon spinescens* var. *meionandrum*, *Holodiscus dumosus*, *Philadelphus microphyllus*, *Purshia stansburiana*, *Quercus turbinella*, or *Shepherdia rotundifolia*. *Coleogyne ramosissima* is typically absent. Herbaceous cover is sparse (<5% cover) and is composed of scattered forbs and grasses, such as species of *Cryptantha*, *Penstemon*, and *Opuntia*, *Achnatherum hymenoides*, *Bouteloua gracilis*, *Elymus elymoides*, *Pleuraphis jamesii*, and *Poa fendleriana*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Tall shrub/sapling	<i>Amelanchier alnifolia</i> , <i>Amelanchier utahensis</i>
Tall shrub/sapling	<i>Mahonia fremontii</i>
Short shrub/sapling	<i>Chrysothamnus viscidiflorus</i> , <i>Rhus trilobata</i> , <i>Shepherdia rotundifolia</i>
Short shrub/sapling	<i>Arctostaphylos patula</i> , <i>Cercocarpus intricatus</i> , <i>Ephedra viridis</i> , <i>Purshia mexicana</i> , <i>Purshia tridentata</i>
Herb (field)	<i>Artemisia bigelovii</i> , <i>Eriogonum corymbosum</i> , <i>Eriogonum microthecum</i> , <i>Gutierrezia sarothrae</i> , <i>Opuntia fragilis</i> , <i>Yucca harrimaniae</i>
Herb (field)	<i>Descurainia pinnata</i>
Herb (field)	<i>Achnatherum hymenoides</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Tall shrub/sapling	<i>Amelanchier utahensis</i>
Tall shrub/sapling	<i>Cercocarpus intricatus</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Elymus elymoides</i> , <i>Poa fendleriana</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Descurainia pinnata*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G3 (30-Dec-2000). The plant association is limited to a small geographic area and is documented from a narrow elevational band on sandstone substrates in extreme northwestern Colorado and possibly adjacent Utah. There are 11 documented stands in Colorado with size ranging from 4-450 acres. Although most occurrences are considered in good to excellent condition, those in excellent condition tend to be small. Grazing and woodcutting are the primary threats where stands are accessible.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Compare this association with *Juniperus osteosperma* / *Cercocarpus intricatus* Woodland (CEGL000733) that is very similar, but lacks *Pinus edulis*. 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 intricatus* shrublands with scattered pinyon and juniper trees but is considered a variation of the woodland type because of the ecological values of the trees.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: One stand occupies a unique topographic setting of a sandy bottom bounded by tall, thin sandstone fins. Several stands are on slickrock. One stand has some cryptobiotic crust.

Capitol Reef National Park Data: The description is based on 1986 and 2003 field data (12 plots: CARE.0555, CARE.9016, CARE.9082, CARE.9091, CARE.9109, CARE.9122, CARE.9124, CARE.9135, CARE.9225, CARE.9324, CARE.9331, CARE.9368).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: A.E. Black, mod. K.A. Schulz, J. Drake, J. Coles

REFERENCES: Baker 1983b, Baker 1983c, Baker 1984a, Baker and Kennedy 1985, Bourgeron and Engelking 1994, CONHP 2003, Cogan et al. 2004, Driscoll et al. 1984, Western Ecology Working Group n.d., Zimmerman 1978

***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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516) Two-needle Pinyon - (Juniper species) Woodland Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Pinyon-Juniper Woodland (CES306.835)
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 ft.) in Utah and from 2200 to 2260 m (7200-7400 ft.) 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

Capitol Reef National Park

This association is rare and was sampled on Billings Pass.

Globally

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

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on midslopes of ridges and upper slopes on mountains. Sites are moderately steep (24° slopes), occur between 2703 and 2770 m elevation, and are oriented to southern aspects. The unvegetated surface has low to moderate cover of litter, moderate cover of large rocks, and low to moderate exposure of bare soil. Downed wood is common, with up to 12% cover. Parent materials are boulder deposits that exist as rockfall and colluvium. Soils are rapidly drained clay loams and loamy sands.

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

Capitol Reef National Park

This woodland association is rare and occupies slopes near Billings Pass within and adjacent to the park. The total vegetation cover ranges from 13 to 80% in these sparsely to moderately vegetated stands. This woodland association is characterized by an open canopy, typically 5-10 m tall, of *Pinus edulis* and *Juniperus osteosperma* trees that range in cover from 5 to 25% and 1 to 15%, respectively, and *Cercocarpus ledifolius* tall shrubs that range in cover from 5 to 25%. The associated short- and dwarf-shrub layer is low in terms of species composition, typically provides sparse to low cover, and includes *Artemisia tridentata* ssp. *vaseyana*, *Ericameria nauseosa*, and *Gutierrezia sarothrae*. The herbaceous layer is somewhat diverse in terms of species composition but provides sparse to low cover, less than 10% total cover. Common graminoids include *Achnatherum hymenoides* and *Elymus elymoides*. Forbs present in one stand include *Chenopodium album* and *Descurainia californica*. Seedling *Pinus edulis* and *Juniperus osteosperma* trees 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 *Petrorhiza pumila*. Seedling *Pinus edulis* and *Juniperus* spp. are often present.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Tall shrub/sapling	<i>Cercocarpus ledifolius</i>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>vaseyana</i>
Herb (field)	<i>Gutierrezia sarothrae</i>
Herb (field)	<i>Chenopodium album</i> , <i>Descurainia californica</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>

Tall shrub/sapling *Cercocarpus ledifolius*

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park
Chenopodium album, Descurainia pinnata

Globally

Data are not available.

CONSERVATION STATUS RANK

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

CLASSIFICATION COMMENTS

Capitol Reef National Park
Data are not available.

Globally

This association may be ecotonal, as it tends to occur at the upper end of the range of pinyon-juniper woodlands. However, it covers extensive areas where it does occur and may be considered a legitimate ecological type.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: This association occupies stable slopes. There is some soil and rock build-up on the uphill side of trees and shrubs. Grazing and browsing by elk is evident. Large curl-leaf mountain-mahogany forms a monoculture on the upper slope above one stand.

Capitol Reef National Park Data: The description is based on 2004 field data (2 plots: CARE.0714, CARE.0716).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

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

***Pinus edulis - Juniperus osteosperma / Coleogyne ramosissima* Woodland**

Two-needle Pinyon - Utah Juniper / Blackbrush Woodland

CODE	CEGL000781
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	<i>PINUS EDULIS - (JUNIPERUS SPP.)</i> WOODLAND ALLIANCE (A.516) 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 has been described from valley bottoms, terraces, benches, slopes, mesa rims, elevated plains and rolling terrain sometimes interrupted by bedrock. It occurs extensively across the Colorado Plateau from southwestern Colorado through southern Utah into Arizona and probably Nevada. Sites are on flat to moderate slopes (0-20%) between 1070 and 1890 m (3500-6200 ft.) elevation on all aspects. Bare soil covers most of the unvegetated surface, although cryptogam cover can be as high as 45%. Soils are typically shallow, rocky sandy loams derived from sandstone, eolian sands, alluvium or limestone. A few stands occur on deep or clay-textured soils derived from shale. Stands of this association can vary greatly in appearance, ranging from sparsely vegetated (<10% total cover) to relatively dense (80% cover). Sparsely vegetated stands also tend to have dwarfed trees not exceeding 2 m in height. Typically, stands have an open (5-25% cover) tree canopy 3-6 m tall that contains both *Pinus edulis*

and *Juniperus osteosperma*, although one or the other tree may dominate. The shrub layer has 5 to 55% cover and is dominated by *Coleogyne ramosissima*. In Arizona, *Mortonia sempervirens* may be codominant. Other common shrub species may include *Agave utahensis*, *Cercocarpus montanus*, *Ephedra viridis*, *Glossopetalon spinescens* var. *aridum*, *Glossopetalon spinescens*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, *Purshia stansburiana*, *Quercus turbinella*, *Yucca baccata*, *Yucca harrimaniae*, and *Yucca elata* var. *utahensis*. The sparse herbaceous layer is composed of graminoids such as *Achnatherum hymenoides*, *Achnatherum speciosum*, *Elymus elymoides*, *Poa fendleriana*, *Bouteloua curtipendula*, and *Aristida* species. *Bromus rubens*, *Bromus tectorum*, and *Vulpia octoflora* may be present to abundant in disturbed sites. Forbs are typically variable and scattered, contributing little cover. *Lappula occidentalis*, *Lepidium montanum*, *Chaenactis stevioides*, *Psilostrophe sparsiflora*, and *Streptanthella longirostris* are among the many species that have been recorded. Scattered cacti are often present, including *Opuntia erinacea*, *Opuntia phaeacantha*, *Opuntia polyacantha*, *Echinocereus triglochidiatus*, and *Echinocereus engelmannii*.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon to common and was sampled on mesas at Brimhall Trailhead and in Lower Muley Twist.

Globally

This association occurs extensively across the Colorado Plateau from southwestern Colorado through southern Utah into Arizona. It is likely to occur in California and Nevada. More survey work is needed to assess the range.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association occurs on flats along mesa and canyon rims on hogbacks and ledgy slopes. Sites tend to be gentle (2-3°), occur between 1400 and 1646 m elevation, and are oriented to any aspect. The unvegetated surface of one stand has high exposure of bedrock and bare soil and low cover of litter. Parent materials are variable and include eolian deposits derived from Dakota or Navajo sandstones and the Morrison Formation (Salt Wash Member). Soils are rapidly drained clay loams and sands.

Globally

This woodland association has been described from valley bottoms, terraces, benches, slopes, mesa rims, elevated plains and rolling terrain sometimes interrupted by bedrock. It likely occurs extensively across the Colorado Plateau from southwestern Colorado through southern Utah into Nevada. Sites are on flat to moderate slopes (0-20%) between 1070 and 1890 m (3500-6200 ft.) elevation on all aspects. Bare soil covers most of the unvegetated surface, although cryptogam cover can be as high as 45%. Soils are typically shallow, rocky sandy loams derived from sandstone, eolian sands, alluvium or limestone. A few stands occur on deep or clay-textured soils derived from shale. Parent materials are variable and include eolian deposits derived from Cedar Mesa, Dakota or Navajo sandstones and the Morrison Formation (Salt Wash Member), Kayenta Formation, and Moenkopi Formation.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is uncommon to common in the southern portion of the park. The total vegetation cover ranges from 15 to 45%. This woodland is characterized by an open canopy, typically 1-2 m tall, of stunted *Juniperus osteosperma* trees that range in cover from 5 to 15% and the short shrub *Coleogyne ramosissima* covering between 5 and 15%. *Pinus edulis* trees occur sporadically in this association. The most common associated shrubs include *Cercocarpus intricatus*, *Ephedra viridis*, and *Ericameria nauseosa*. The herbaceous layer provides sparse to low cover. The most common bunchgrass is *Pleuraphis jamesii*. Forbs are uncommon and are mostly weedy annuals.

Globally

Stands of this association can vary greatly in appearance, ranging from sparsely vegetated (<10% total cover) to relatively dense (80% cover). Sparsely vegetated stands also tend to have dwarfed trees not exceeding 2 m in height. Typically, stands have an open (5-25% cover) tree canopy 3-6 m tall that contains both *Pinus edulis* and *Juniperus osteosperma*, although one or the other tree may dominate. The shrub layer has 5 to 55% cover and is dominated by *Coleogyne ramosissima*. In some parts of the range, *Mortonia sempervirens* may be codominant. Other shrub species present may include *Agave utahensis*, *Cercocarpus montanus*, *Ephedra viridis*, *Glossopetalon spinescens* var. *aridum*, *Glossopetalon spinescens*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, *Purshia stansburiana*, *Quercus turbinella*, *Yucca baccata*, *Yucca harrimaniae*, and *Yucca elata* var. *utahensis*. The sparse herbaceous layer is

composed of graminoids such as *Achnatherum hymenoides*, *Achnatherum speciosum*, *Elymus elymoides*, *Poa fendleriana*, *Bouteloua curtipendula*, and *Aristida* species. *Bromus rubens*, *Bromus tectorum*, and *Vulpia octoflora* may be present to abundant in disturbed sites. Forbs are typically variable and scattered, contributing little cover. *Lappula occidentalis*, *Lepidium montanum*, *Chaenactis stevioides*, *Psilostrophe sparsiflora*, and *Streptanthella longirostris* are among the many species that have been recorded. Scattered cacti are often present, including *Opuntia erinacea*, *Opuntia phaeacantha*, *Opuntia polyacantha*, *Echinocereus triglochidiatus*, and *Echinocereus engelmannii*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Short shrub/sapling	<i>Coleogyne ramosissima</i> , <i>Ericameria nauseosa</i>
Short shrub/sapling	<i>Cercocarpus intricatus</i> , <i>Ephedra viridis</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Short shrub/sapling	<i>Coleogyne ramosissima</i>
Short shrub/sapling	<i>Mortonia sempervirens</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus rubens, *Bromus tectorum*

Globally

Bromus rubens, *Bromus tectorum*

CONSERVATION STATUS RANK

Global Rank & Reasons: G3 (19-Sep-2000). This late-seral woodland association occurs extensively across the Colorado Plateau in southwestern Colorado and southern Utah into Arizona and probably Nevada. Introduced annual grasses such as *Bromus rubens* may threaten this woodland because the dry annual grasses provide fine fuels that allow fire to spread. *Coleogyne ramosissima* is very sensitive to fire. A hot fire will completely remove this shrub from a site for decades. More survey work is needed to assess the entire range of this type.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: One stand experiences moderate grazing. There are small patches of this community scattered along the rim above Halls Creek. Utah juniper trees are stunted due to growing in bedrock cracks. *Coleogyne ramosissima* occurs where sands are deeper. Pinyon-juniper and other shrubs grow where bedrock is shallow and there are cracks to root in.

Capitol Reef National Park Data: The description is based on 1986 and 2003 field data, as well as accuracy assessment data collected in 2005 (5 plots: CARE.0563, CARE.9185, CARE_AA.0186, CARE_AA.0873, CARE_AA.0904).

Local Description Authors: J. Von Loh, mod. D. Clark and J. Coles

Global Description Authors: K.A. Schulz, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, FEIS 1996, Larson and Moir 1987, Stuever and Hayden 1997a, Warren et al. 1982, Western Ecology Working Group n.d.

***Pinus edulis* - *Juniperus osteosperma* / Cushion Plant Woodland**

Two-needle Pinyon - Utah Juniper / Cushion Plant Woodland

CODE	CEGL002375
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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516) 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 has only been described from Capitol Reef National Park in southern Utah and may be confined to the immediate area because of the suite of sensitive herbaceous species that defines the community. This summary is derived from plot data collected in the park in 1987 and 1988. The association occurs on high slopes; sites slope gently to the north between 2073 and 2195 m elevation. Parent materials include a variety of sedimentary rocks, giving rise to coarse-textured, rapidly drained soils that often have a surface cap of fine gravel. Total vegetation cover rarely exceeds 50%. The *Pinus edulis* and *Juniperus osteosperma* canopy ranges between 15 and 35% cover. *Juniperus osteosperma* is absent from one stand. The understory is often technically sparse in cover; there is no developed shrub layer, but there are generally scattered individuals of *Artemisia bigelovii*, *Eriogonum microthecum*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, and *Shepherdia rotundifolia* present. The herbaceous layer is diverse in terms of species composition but provides sparse to low cover. Forbs, particularly sensitive cushion plants, define this community and include *Arenaria eastwoodiae*, *Enceliopsis nudicaulis*, *Erigeron compactus*, *Erigeron pumilus*, *Eriogonum alatum*, *Frasera albomarginata*, *Heterotheca villosa*, *Hymenopappus filifolius*, *Paronychia sessiliflora*, *Polygala subspinosa*, *Stenotus armerioides*, *Tetraneuris acaulis*, *Tetraneuris torreyana*, and *Townsendia incana*. Graminoids include occasional tufts of *Achnatherum hymenoides* and *Aristida purpurea*.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon and was sampled on high slopes and interfluves adjacent to South Desert Overlook, above Hartnet Draw and on Miners Mountain south of the Fremont River.

Globally

This association has only been described from Capitol Reef National Park in southern Utah and may be confined there because of the limited suite of rare herbaceous species that define the type.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on high slopes and interfluves. Sites are gentle (2° slopes), occur between 2073 and 2195 m elevation, and are oriented to north aspects. The unvegetated surface is unrecorded. Parent materials are variable and include sandstones and shale. Soils are well-drained to rapidly drained and coarse-textured.

Globally

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

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is uncommon within the park and is habitat for sensitive plant species. The vegetation is characterized by an open canopy of *Pinus edulis* and *Juniperus osteosperma* trees. *Juniperus osteosperma* is absent from one stand. The shrub layer is moderately diverse in terms of species composition and is comprised of short and dwarf-shrubs and succulents that provide low to moderate cover, including *Artemisia bigelovii*, *Eriogonum microthecum*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, and *Shepherdia rotundifolia*. The herbaceous layer is

diverse in terms of species composition and provides sparse to low cover. Forbs, particularly cushion plants, are diverse in terms of species composition and include *Arenaria eastwoodiae*, *Enceliopsis nudicaulis*, *Erigeron compactus*, *Erigeron pumilus*, *Eriogonum alatum*, *Frasera albomarginata*, *Heterotheca villosa*, *Hymenopappus filifolius*, *Paronychia sessiliflora*, *Polygala subspinosa*, *Stenotus armerioides*, *Tetraneuris acaulis*, *Tetraneuris torreyana*, and *Townsendia incana*. Graminoids commonly present include *Achnatherum hymenoides* and *Aristida purpurea*.

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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Short shrub/sapling	<i>Shepherdia rotundifolia</i>
Herb (field)	<i>Gutierrezia sarothrae</i>
Herb (field)	<i>Lesquerella intermedia</i> , <i>Parthenium ligulatum</i>
Herb (field)	<i>Bouteloua gracilis</i>

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (23-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef 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

Capitol Reef National Park Inventory Notes: The stands in the northern portion of the park experience light grazing.

Capitol Reef National Park Data: The description is based on 1987 and 1988 field data (4 plots: CARE.9337, CARE.9350, CARE.9401, CARE.9404).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Pinus edulis* - *Juniperus osteosperma* / *Ephedra torreyana* - *Artemisia bigelovii* Woodland
Two-needle Pinyon - Utah Juniper / Torrey's Joint-fir - Bigelow Sagebrush Woodland**

CODE	CEGL002369
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)

PHYSIOGNOMIC GROUP Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
ALLIANCE *PINUS EDULIS* - (*JUNIPERUS* SPP.) WOODLAND ALLIANCE (A.516)
Two-needle Pinyon - (Juniper species) Woodland Alliance

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

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This open woodland association currently is documented only from Capitol Reef National Park in southeastern Utah, where it is common and widespread; this summary is derived from plots sampled in the park in 1986, 1988 and 2003. Stands occur on low ridges, hills, and benches with gentle slopes (not exceeding 15%) between 1677 and 1982 m (5500-6500 ft.) elevation. Aspect is not important in determining the distribution of this association. The unvegetated surface is mostly covered by gravel and rocks; this fact is diagnostic of the community along with the species composition. Most stands occur in areas where lenses of sandstone are interbedded among thin layers of shale, as occurs in the Chinle, Morrison, Moenkopi and Carmel formations. Soils are shallow, rapidly drained silt loams, sandy clays, and sandy loams. Total vegetation cover ranges from 4 to 70%. The vegetation is characterized by an open canopy, typically 1-5 m tall, of *Pinus edulis* and *Juniperus osteosperma* trees that range in cover from 1 to 30%, and a diverse shrub understory that includes *Artemisia bigelovii* and *Ephedra torreyana* as dominants or codominants. Other shrubs present include *Fraxinus anomala*, *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Eriogonum corymbosum*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, and *Shepherdia rotundifolia*. The herbaceous layer is moderate in species diversity but typically provides little cover. Common graminoids include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Elymus elymoides*, *Hesperostipa comata*, and *Pleuraphis jamesii*. Forbs may include *Lepidium montanum*, *Phacelia crenulata*, *Sphaeralcea coccinea*, and *Thelesperma subnudum*.

DISTRIBUTION

Capitol Reef National Park

This association is abundant and was sampled west of the Lower Muley Twist Trail, in The Hartnet Draw, on the canyon rim above the South Desert, near Chimney Rock, northeast of Spring Canyon, on upper Johnson Mesa, on Danish Hill, west of Notom in the Fold, in Oak Creek, near Cedar Mesa campground, near Bitter Creek Divide, along Bitter Creek, and along the western park boundary just north of the Burr Trail within the park.

Globally

Data are not available.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association occurs on midslopes of ridges and hills, interfluves, and steps-in-slope. Sites are gentle (1 to 8° slopes), occur between 1677 and 1982 m elevation, and are oriented to all aspects. The unvegetated surface has sparse to low cover by litter and moderate to high cover by rocks and gravel. There is low exposure of bare soil in one stand. Parent materials are variable and include sandstones and shale, including the Chinle, Morrison, Moenkopi and Carmel formations. Soils are rapidly drained silts, sandy clays, and sandy loams.

Globally

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

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is abundant within the park. The total vegetation cover ranges from 4 to 70%. This woodland association is characterized by an open canopy, typically 1-5 m tall, of *Pinus edulis* and *Juniperus osteosperma* trees that range in cover from 0 to 5% and 1 to 25%, respectively, and *Artemisia bigelovii* and *Ephedra torreyana* shrubs that range in cover from 0 to <1% and 0 to 5%. The shrub layer is moderately diverse in terms of species composition and provides sparse to moderate cover. The tall shrub *Fraxinus anomala* is occasionally present. The associated short- and dwarf-shrub layers commonly include *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*,

Ephedra viridis, *Eriogonum corymbosum*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, and *Shepherdia rotundifolia*. The herbaceous layer is moderate in species diversity and typically provides sparse to low cover. Common graminoids include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Elymus elymoides*, *Hesperostipa comata*, and *Pleuraphis jamesii*. Forbs may include *Lepidium montanum*, *Phacelia crenulata*, *Sphaeralcea coccinea*, and *Thelesperma subnudum*.

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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Tall shrub/sapling	<i>Fraxinus anomala</i>
Short shrub/sapling	<i>Atriplex canescens</i> , <i>Atriplex confertifolia</i> , <i>Chrysothamnus viscidiflorus</i> , <i>Ericameria nauseosa</i> , <i>Eriogonum corymbosum</i>
Short shrub/sapling	<i>Artemisia bigelovii</i> , <i>Ephedra torreyana</i> , <i>Ephedra viridis</i>
Herb (field)	<i>Atriplex gardneri</i> , <i>Eriogonum shockleyi</i> , <i>Gutierrezia microcephala</i> , <i>Gutierrezia sarothrae</i> , <i>Opuntia polyacantha</i>
Herb (field)	<i>Cryptantha fulvocanescens</i> , <i>Helianthella microcephala</i> , <i>Lepidium montanum</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Bouteloua gracilis</i> , <i>Hesperostipa comata</i> , <i>Leymus salinus</i> , <i>Pleuraphis jamesii</i>

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Descurainia pinnata*, *Sonchus asper*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (23-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef 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

Capitol Reef National Park Inventory Notes: Soils are shallow, and on one site they overlay Moenkopi Formation shale exposures. One stand had many dead trees due to drought and exposure to desiccation. Stands, in general, are lightly grazed by cattle; one stand experienced heavy grazing.

Capitol Reef National Park Data: The description is based on 1986, 1988, and 2003 field data (20 plots: CARE.0455, CARE.0456, CARE.0572, CARE.9041, CARE.9044, CARE.9046, CARE.9068, CARE.9080, CARE.9083, CARE.9087, CARE.9100, CARE.9127, CARE.9179, CARE.9204, CARE.9220, CARE.9306, CARE.9321, CARE.9345, CARE.9352, CARE.9432).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Pinus edulis* - *Juniperus osteosperma* / *Ephedra viridis* Woodland
Two-needle Pinyon - Utah Juniper / Mormon-tea Woodland**

CODE	CEGL002370
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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516) 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)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association occurs on dry middle and upper slopes of ridges and canyons, as well as on colluvial slopes and benches in eastern Utah and northwestern Colorado. Sites are moderate to steep (25-65% slope), mostly on south- or west-facing slopes between 1558 and 2204 m elevation. Soils are coarse, rocky and generally are derived from sedimentary rocks. The tree canopy is characterized by the codominance of *Juniperus osteosperma* and *Pinus edulis* trees that are 2-5 m tall with as much as 40% cover. The shrub layer is generally sparse and is dominated by *Ephedra viridis*, which contributes approximately 10% cover. Few other shrubs are present, and because of the low diagnostic value of *Ephedra viridis*, these associated shrubs have very low cover: *Amelanchier utahensis*, *Artemisia tridentata*, *Cercocarpus intricatus*, *Glossopetalon spinescens* var. *meionandrum*, *Shepherdia rotundifolia*, *Artemisia bigelovii*, and *Mahonia fremontii* may be present. Associated graminoids provide low cover and include *Pseudoroegneria spicata*, *Poa secunda*, and *Pleuraphis jamesii*. Forbs are diverse but inconsistent among stands and contribute little cover.

DISTRIBUTION

Capitol Reef National Park

This vegetation type was sampled along the access road to Oak Creek Canyon, north of Red Canyon, on top of and east of Wagon Box Mesa, and along the Burr Trail above the switchbacks. It is also found on Tarantula Mesa.

Globally

This association is documented from scattered sites in the southern part of Capitol Reef National Park in southern Utah and the canyons of the Yampa and Green rivers in Dinosaur National Monument in northeastern Utah and northwestern Colorado. It is likely to occur in xeric, rocky sites throughout the pinyon-juniper zone of the Colorado Plateau.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This two-needle pinyon - Utah juniper / Mormon-tea woodland occupies a variety of topographic positions and landforms, including interfluves, slopes, mesa tops, and benches. The habitat is gradual to moderately steep (1-28% slope), with mostly southeast to northeast-facing slopes (one sample occurred on a northwest aspect) between 1558 and 2204 m elevation. The unvegetated surfaces have high exposure of pebbles or biological soil crusts. Parent materials are variable and include sandstones and shale. Several sites were covered with large rocks and boulders.

Globally

This association is known from dry, rocky colluvial slopes and canyons in southern Utah and northwestern Colorado. It occupies steep colluvial and other xeric slopes in canyons and hogbacks. Slopes are moderate to steep (15 to 32°), are generally oriented to the south or west, and lie between 1558 and 2204 m (5100-7230 ft.) elevation. Soils are rocky and are derived mainly from sedimentary rocks.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland is characterized by the codominance of the canopy trees (2-5 m tall) *Juniperus osteosperma*, which contributes 5 to 65% cover and *Pinus edulis*, which contributes 15 to 25% cover. The woodland vegetation is also characterized by the short shrub *Ephedra viridis*, which contributes 0 to 5% cover. The shrub layer provides sparse to low cover, including *Amelanchier utahensis*, *Artemisia tridentata*, *Shepherdia rotundifolia*, *Artemisia bigelovii*, and *Mahonia fremontii*. Associated graminoids provide low cover and include *Achnatherum hymenoides*, *Bromus tectorum*, and *Leymus salinus*. Forbs have low cover.

Globally

This xeric woodland is characterized by a canopy of mixed *Pinus edulis* and *Juniperus osteosperma* with between 10 and 40% cover. Some stands on extremely steep slopes may have less than 10% tree cover but are so sparsely vegetated that they can still be considered a wooded vegetation type. The understory is clearly dominated by *Ephedra viridis* (5-15% cover); if other shrubs such as *Fraxinus anomala*, *Atriplex* spp., *Glossopetalon spinescens* var. *meionandrum*, *Purshia stansburiana*, or *Cercocarpus intricatus* are present, they have 1% or less cover. The herbaceous layer is generally sparse and poorly developed because of the moving substrate, but a few stable stands have as much as 10% cover by grasses. Species present vary from stand to stand but may include *Hesperostipa comata*, *Pleuraphis jamesii*, *Phlox hoodii*, *Tetranneuris acaulis*, *Koeleria macrantha*, *Achnatherum hymenoides*, *Phlox austromontana*, *Artemisia dracuncululus*, *Pseudoroegneria spicata*, and *Poa secunda*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Short shrub/sapling	<i>Ephedra viridis</i>
Herb (field)	<i>Poa secunda</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G3 (5-Jun-2006). Although this association appears to be rare, it is likely to be somewhat common but overlooked, because of its lack of attention-grabbing diagnostic species.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Data are not available.

Capitol Reef National Park Data: The description is based on 2003 field data (Plot: CARE.0417).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Pinus edulis* - *Juniperus osteosperma* / *Hesperostipa neomexicana* Woodland
Two-needle Pinyon - Utah Juniper / New Mexico Needlegrass Woodland**

CODE	CEGL002371
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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516) 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)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This rare, open woodland association currently is documented only from Capitol Reef National Park in southeastern Utah; this summary is derived from plots sampled in the park in 1986. It occurs on low ridges with gentle slopes at 2012 m (6600 ft.) elevation and a northeastern aspect. Parent materials include sandstones and shale. Soils are well-drained and fine-textured. Total vegetation cover does not exceed 50%. The vegetation is characterized by an open canopy of *Pinus edulis* and *Juniperus osteosperma* trees ranging in cover from 15 to 50% and an understory dominated by the bunchgrass *Hesperostipa neomexicana* with 10 to 25% cover. Shrubs are too sparse to form a layer (<5% total cover), but scattered individuals of *Chrysothamnus viscidiflorus* and *Opuntia* spp. occur. The herbaceous layer provides low cover. Commonly associated graminoids are predominantly bunch grasses, including *Achnatherum hymenoides* and *Hesperostipa comata*. Forbs provide sparse to low cover.

DISTRIBUTION

Capitol Reef National Park

Location of this association is unknown other than it is somewhere on the Torrey 15-minute quadrangle topographic map. It was sampled by Romme in 1987, but precise location data could not be found. Pinyon pine and Utah juniper are widespread throughout the park. New Mexico needlegrass is known from canyon bottoms, benches, and mesas from desert shrub to pinyon-juniper woodland habitat at Deer Point and Hickman Bridge.

Globally

This association has been documented only from the central part of Capitol Reef National Park in southeastern Utah. It may occur in adjacent parts of northern Arizona, northern New Mexico and southern Colorado within the range of *Hesperostipa neomexicana*.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on interfluves. The site is gentle (3° slope), occurs at 2012 m elevation, and is oriented to a northeastern aspect. The unvegetated surface is unrecorded. Parent materials are variable and include sandstones and shale. Soils are well-drained and fine-textured.

Globally

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

VEGETATION DESCRIPTION

Capitol Reef National Park

This association is rare within the park. The vegetation is characterized by an open tree canopy of *Pinus edulis* and *Juniperus osteosperma* trees, and the tall bunchgrass *Hesperostipa neomexicana*. The shrub layer is sparse to low in terms of cover and includes several succulents in the species composition. Short and dwarf-shrubs provide sparse to low cover and include *Chrysothamnus viscidiflorus*. The herbaceous layer provides low cover and is relatively diverse in terms of species composition. Commonly associated graminoids are predominantly tall bunch grasses, including *Achnatherum hymenoides* and *Hesperostipa comata*. Forbs provide sparse to low cover.

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

Capitol Reef National Park

Stratum

Tree canopy

Short shrub/sapling

Species

Juniperus osteosperma, *Pinus edulis*

Chrysothamnus viscidiflorus

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (23-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef 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

Capitol Reef National Park Inventory Notes: There is light grazing, including evidence of horses (information from Romme's data; most likely grazing no longer occurs in the area).

Capitol Reef National Park Data: The description is based on 1986 field data (1 plot: CARE.9433).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Pinus edulis* - *Juniperus osteosperma* / *Muhlenbergia pungens* Woodland**

Two-needle Pinyon - Utah Juniper / Sandhills Muhly Woodland

CODE	CEGL002373
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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516) Two-needle Pinyon - (Juniper species) Woodland Alliance

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

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This rare, open 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 1988. It occurs on the lower and middle slopes of ridges, on benches, terraces and dunes. Sites are gentle (4% slopes), occur between 1927 and 2134 m (6325-7000 ft.) elevation, and tend to be oriented to eastern and southeastern aspects. Parent materials include eolian deposits. Soils are rapidly drained sands. The total vegetation cover generally does not exceed 50%. The vegetation is characterized by an open canopy of *Pinus edulis* and *Juniperus osteosperma* trees that range in cover from 10-35% and an understory dominated by the ring-forming grass *Muhlenbergia pungens* with as much as 25% cover. Shrubs do not form a layer (<5% total cover), but scattered individuals of *Artemisia frigida*, *Gutierrezia sarothrae*, and *Opuntia polyacantha* may be present. Associated herbaceous species commonly include *Achnatherum hymenoides*, *Abronia elliptica*, *Arenaria eastwoodiae*, *Streptanthella longirostris*, and *Townsendia incana*. One stand above Deep Creek Canyon has moderate cover of biological soil.

DISTRIBUTION

Capitol Reef National Park

This association is rare and was sampled on sandy terraces and sand dune areas on Longleaf Flats, above Deep Creek Canyon, and on Meeks Mesa within the park.

Globally

This association is known only from scattered sites in Capitol Reef National Park in southeastern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on low slopes, midslopes, and steps-in-slope on terrace and dune deposits of sand. Sites are gentle (2° slopes), occur between 1927 and 2134 m elevation, and are oriented to eastern and southeastern aspects. The unvegetated surface is unrecorded, although one site had 1% exposed rock. Parent materials are variable and include sandstones and shale that have eroded and become wind-transported into eolian deposits. Soils are rapidly drained sands.

Globally

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

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is rare in the park. The vegetation is characterized by an open canopy of *Pinus edulis* and *Juniperus osteosperma* trees, and the ring-forming grass *Muhlenbergia pungens*. The shrub layer is low to moderate in terms of species composition and is comprised of short and dwarf-shrubs and succulents that provide sparse to low cover. Common dwarf-shrubs include *Artemisia frigida*, *Gutierrezia sarothrae*, and *Opuntia polyacantha*. The remaining herbaceous layer is diverse in terms of species composition and provides sparse to low cover. The tall bunchgrass *Achnatherum hymenoides* is commonly present. Forbs are moderately diverse in terms of species composition and include *Abronia elliptica*, *Arenaria eastwoodiae*, *Streptanthella longirostris*, and *Townsendia incana*. One stand above Deep Creek Canyon has moderate cover of biological soil.

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

Capitol Reef National Park

Stratum

Tree canopy
Herb (field)
Herb (field)

Species

Juniperus osteosperma, *Pinus edulis*
Gutierrezia sarothrae, *Leptodactylon pungens*, *Opuntia polyacantha*
Achnatherum hymenoides, *Muhlenbergia pungens*

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park
Arceuthobium divaricatum, Descurainia pinnata

Globally
Data are not available.

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

CLASSIFICATION COMMENTS
Capitol Reef 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
Capitol Reef National Park Inventory Notes: Data are not available.
Capitol Reef National Park Data: The description is based on 1986 and 1988 field data (3 plots: CARE.9108, CARE.9125, CARE.9403).
Local Description Authors: J. Von Loh, mod. D. Clark
Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Pinus edulis - Juniperus osteosperma / Opuntia fragilis* Woodland**
Two-needle Pinyon - Utah Juniper / Brittle Prickly-pear Woodland

CODE	CEGL002374
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	<i>PINUS EDULIS - (JUNIPERUS SPP.) WOODLAND ALLIANCE</i> (A.516) 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, open 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 2003 and 2004. It is restricted to eolian deposits on benches and valley floors on sites that slope gently (5-15%), occur between 2067 and 2298 m elevation, and are oriented to southeastern aspects. Sand and litter cover most of the unvegetated surface, although biological soil crusts provide up to 40% cover. Parent materials include Wingate and Navajo sandstone eroded and re-deposited as eolian sands. Soils are rapidly drained sands, sandy loams, and loamy sands. Total vegetation cover generally does not exceed 50% and is characterized by an open canopy, typically 2-10 m tall, of *Pinus edulis* and *Juniperus osteosperma* that range in cover from 15 to 40%, and an understory dominated by *Opuntia fragilis* that ranges in cover from 15 to 55%. Associated shrubs include *Picrothamnus desertorum* and *Ericameria nauseosa*. The herbaceous layer is diverse in terms of species composition and provides sparse to moderate cover. Common graminoids include *Achnatherum hymenoides*, *Bouteloua gracilis*, and *Muhlenbergia pungens*. Forbs typically provide less than 1% total cover per species.

DISTRIBUTION

Capitol Reef National Park

This association is rare and was sampled on eolian deposits west of George Peak and around Paradise Flats. It also occurs in the Waterpocket Fold north of Spring Canyon, Longleaf Flats and Blow Outs Flats.

Globally

This association is known only from scattered sites in Capitol Reef National Park in southeastern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on eolian deposits on steps-in-slope and valley floors. Sites are gentle (3 to 9° slopes), occur between 2067 and 2298 m elevation, and are oriented to southeastern aspects. The unvegetated surface has low to moderate cover of litter and exposure of bare soil and sand. Cryptogam cover is low to moderate, not exceeding 40% cover. Parent materials are Carmel shale or Wingate or Navajo sandstone that have eroded and distributed as eolian deposits. Soils are well-drained to rapidly drained sands, sandy loams and loamy sands.

Globally

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

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is rare within the park. The total vegetation cover ranges from 33 to 155% in these moderately to densely vegetated stands. This woodland association is characterized by an open canopy, typically 2-10 m tall, of *Pinus edulis* and *Juniperus osteosperma* trees that range in cover from 15 to 25% and 0 to 25%, respectively, and the dwarf-shrub *Opuntia fragilis* that ranges in cover from 15 to 55%. The shrub layer is moderately diverse in terms of species composition and is comprised of short and dwarf-shrubs that provide low to moderate cover, including *Picrothamnus desertorum* and *Ericameria nauseosa*. The herbaceous layer is diverse in terms of species composition and provides sparse to moderate cover. Common graminoids include *Achnatherum hymenoides*, *Bouteloua gracilis*, and *Muhlenbergia pungens*. Forbs typically provide less than 1% total cover per species. Cryptogam cover can be up to 40%.

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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Short shrub/sapling	<i>Ericameria nauseosa</i>
Herb (field)	<i>Opuntia fragilis</i> , <i>Picrothamnus desertorum</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Bouteloua gracilis</i> , <i>Muhlenbergia pungens</i>

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Descurainia pinnata

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (23-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef 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

Capitol Reef National Park Inventory Notes: One stand experiences light grazing. Trees are located near Navajo sandstone domes. One stand has large trees and some seedlings present.

Capitol Reef National Park Data: The description is based on 2003 and 2004 field data (3 plots: CARE.0505, CARE.0655, CARE.0656).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Pinus edulis* - *Juniperus osteosperma* / *Petradoria pumila* Woodland
Two-needle Pinyon - Utah Juniper / Grassy Rock-goldenrod Woodland**

CODE	CEGL002332
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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516) Two-needle Pinyon - (Juniper species) Woodland Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Pinyon-Juniper Woodland (CES304.767)
Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association is found in eastern Utah and western Colorado on upper topographic positions between 1841 and 2195 m (6050-7200 ft.) elevation. It occurs on level to gently sloping sites on any aspect with thin soils over sandstone or shale bedrock. Litter, bedrock, and bare soil are the most common components of the ground cover.

This woodland association has a short, open tree canopy dominated by evergreen tree species. Total vegetation cover is relatively sparse to moderate. The dominant tree species are *Pinus edulis* and *Juniperus osteosperma*; either species can have cover between 1 and 25%. The shrub layer is absent to moderate and has low diversity. *Ephedra viridis*, *Gutierrezia sarothrae*, and succulents, such as *Echinocereus triglochidiatus*, *Opuntia erinacea*, *Opuntia fragilis*, and *Yucca harrimaniae* are the most common species. The herbaceous layer has low cover, as well, but tends to have greater diversity. Common grasses, such as *Achnatherum hymenoides*, *Bromus tectorum*, *Elymus elymoides*, and *Poa fendleriana*, provide sparse cover. The forb *Petradoria pumila* is the most abundant herbaceous species and is characteristic of this association. Other forbs include *Arenaria fendleri*, *Descurainia pinnata*, *Eriogonum alatum*, *Heterotheca villosa*, *Streptanthus cordatus*, and *Tetraneuris acaulis*.

DISTRIBUTION

Capitol Reef National Park

This association is rare and was sampled on high slopes of mesas and interfluvies on Wagon Box Mesa and just south of the Burr Trail near the park boundary.

Globally

This association is found in western Colorado and eastern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on high slopes of mesa rims and on interfluves. Sites are nearly level (2° slopes), occur between 2012 and 2195 m elevation, and are oriented to eastern aspects. The unvegetated surface is unrecorded. Parent materials are variable and include sandstones and shale. Soils are well-drained to rapidly drained and fine-textured.

Globally

This association is found on canyon rims, mesa tops, and interfluves between 1841 and 2195 m elevation. It occurs on level to gently sloping sites and on any aspect. Soils are thin and usually well to rapidly drained over sandstone or shale bedrock. Litter, bedrock, and bare soil are the most common components of the ground cover.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is rare within the park. The vegetation is characterized by an open canopy of *Pinus edulis* and *Juniperus osteosperma* trees and the forb *Petradoria pumila*. The shrub layer is moderately diverse and is comprised of short and dwarf-shrubs and succulents that provide low to moderate cover, including *Ephedra viridis* and *Sclerocactus parviflorus*. The remaining herbaceous layer is diverse in terms of species composition and provides sparse to low cover. Grasses are uncommon. Forbs, including cushion plants, are moderately diverse in terms of species composition and include *Arenaria eastwoodiae*, *Cryptantha flavoculata*, *Eriogonum alatum*, *Frasera albomarginata*, *Heterotheca villosa*, *Hymenopappus filifolius*, *Lesquerella rectipes*, *Penstemon angustifolius*, *Physaria acutifolia*, *Stenotus armerioides*, *Streptanthus cordatus*, *Tetraneuris acaulis*, *Thelesperma subnudum*, and *Townsendia incana*.

Globally

This woodland association has a short, open tree canopy dominated by evergreen tree species. Total vegetation cover is moderate to sparse, including some tree-dominated stands with <10% total vegetation cover as a best fit. The dominant tree species are *Pinus edulis* and *Juniperus osteosperma*, which range between 2 and 10 m tall, and either species can have cover between 1 and 25% in the tree canopy. The shrub layer is absent to moderate and has low diversity. *Ephedra viridis*, *Gutierrezia sarothrae*, and succulents, such as *Echinocereus triglochidiatus*, *Opuntia erinacea*, *Opuntia fragilis*, and *Yucca harrimaniae*, are the most common species. The herbaceous layer has low cover, as well, but tends to have greater diversity. Common grasses, such as *Achnatherum hymenoides*, *Bromus tectorum*, *Elymus elymoides*, and *Poa fendleriana*, provide sparse cover. The forb *Petradoria pumila* is the most abundant herbaceous species and is characteristic of this association. Other forbs that may be present include *Arenaria fendleri*, *Descurainia pinnata*, *Eriogonum alatum*, *Heterotheca villosa*, *Streptanthus cordatus*, and *Tetraneuris acaulis*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Herb (field)	<i>Petradoria pumila</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Herb (field)	<i>Petradoria pumila</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Descurainia pinnata*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (11-Jan-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

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 are considered a variation of the woodland type because of the ecological values of the trees.

CLASSIFICATION CONFIDENCE:

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: The stands experience light grazing.

Capitol Reef National Park Data: The description is based on 1986 field data (2 plots: CARE.9011, CARE.9151).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Drake, mod. K.A. Schulz

REFERENCES: 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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516) 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 documented only from Capitol Reef National Park in southeastern Utah; this summary is derived from plots sampled in 1986 and 2005. It occurs on pediment surfaces cut into ridges and hills between 1950 and 2020 m (6400-6625 ft.) 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 as much as 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 sparse forbs.

DISTRIBUTION

Capitol Reef National Park

This association is rare and was sampled on a high slope along Highway 24 just west of Fruita. It also occurs in the northern portion of the park on basalt boulder-covered mesas. Sampled sites include the vicinity of Polk Creek.

Globally

This association has been documented only from Capitol Reef National Park in southeastern Utah (near Fruita and at the northern end of the park).

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on high slopes and tops of ridges, hills and pediments of Moenkopi shale covered by a coarse boulder alluvium derived from basalt. Sites slope gently and lie between 1950 and 2020 m elevation. Exposed soil, boulders and gravel cover most of the unvegetated surface, with lesser cover by litter. Soils are rapidly drained and fine-textured.

Globally

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

VEGETATION DESCRIPTION

Capitol Reef National Park

This pinyon-juniper woodland association is rare within the park. Total vegetation cover is generally sparse (not exceeding 30%) because most of the surface is covered by rocks. This woodland association is characterized by an open canopy of *Pinus edulis* and *Juniperus osteosperma* with between 5 and 15% cover. *Pleuraphis jamesii* dominates the herbaceous layer with between 5 and 10% cover. A diversity of scattered shrubs are present but do not contribute enough cover to constitute a layer. Recorded species include *Atriplex confertifolia*, *Gutierrezia sarothrae*, *Shepherdia rotundifolia*, *Chrysothamnus viscidiflorus*, and *Ephedra torreyana*. The remaining herbaceous layer may include *Achnatherum hymenoides*, *Bouteloua gracilis*, and *Hesperostipa comata* with low to moderate cover. Forbs are moderately diverse in terms of species composition but provide sparse cover.

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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Herb (field)	<i>Pleuraphis jamesii</i>

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (23-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef 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

Capitol Reef National Park Inventory Notes: The stand experiences light grazing. Sites are coated with a basalt-derived alluvium with many boulders and some exposed Moenkopi siltstone.

Capitol Reef National Park Data: The description is based on 1986 field data and data collected during accuracy assessment in 2005 (2 plots: CARE.9079, CARE_AA.1646).

Local Description Authors: J. Von Loh, mod. D. Clark and J. Coles

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Pinus edulis* - *Juniperus osteosperma* / *Psathyrostachys juncea* Semi-natural Woodland
Two-needle Pinyon - Utah Juniper / Russian Wildrye Semi-natural Woodland**

CODE	CEGL002368
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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516) 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 semi-natural woodland association currently is documented only from sites in and adjacent to Capitol Reef National Park in southeastern Utah; this summary is derived from plots sampled in the park in 2003. It occurs on alluvial flats, on sites with gentle (7%) slopes at 2043 m elevation and a southeastern aspect. The unvegetated surface has high exposure of bare soil and moderate cover of dead wood. Litter is sparse, less than 10% cover. Parent materials are mixed, and the soils are well-drained sandy loams derived from alluvium. This association was created following BLM treatments of sagebrush flats to enhance grazing potential. Total vegetation cover ranges from 22 to 50% and is characterized by an open canopy, typically 2-5 m tall, of young *Juniperus osteosperma* trees that range in cover from 5 to 15% and understory dominated by the perennial exotic bunchgrass *Psathyrostachys juncea* that ranges in cover from 15 to 25%. The shrub layer is sparse and includes *Artemisia tridentata* ssp. *wyomingensis* and *Chrysothamnus viscidiflorus*. Numerous non-native forbs have invaded these treated areas. The only remaining native herbaceous flora in the area is the forb *Mirabilis multiflora*.

DISTRIBUTION

Capitol Reef National Park

This association is rare in the park but common throughout the Onion Beds area on BLM-managed lands. It was sampled on White Canyon Flat.

Globally

This association is currently known only from Capitol Reef National Park and adjacent BLM lands in southeastern Utah (the Onion Beds and White Canyon Flat). It is likely to be widespread in the Colorado Plateau as this type of treatment has been prevalent in BLM sagebrush communities for decades. Similar stands have been documented from BLM lands in the Black Ridge area near Colorado National Monument.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on alluvial flats. The site is gentle (4° slope), occurs at 2043 m elevation, and is oriented to the southeastern aspect. The unvegetated surface has high exposure of bare soil and moderate cover of downed wood. Litter is sparse, less than 10% cover. Parent materials are variable and include sandstones and shale that have eroded and deposited as alluvium. Soils are well-drained sandy loams. This association is the result of BLM treatments of sagebrush flats to enhance grazing potential.

Globally

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

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is rare within the park but is common adjacent to the park in the Onion Beds area. The total vegetation cover ranges from 22 to 50% in this sparsely to moderately vegetated stand. This woodland association is characterized by an open canopy, typically 2-5 m tall, of *Juniperus osteosperma* trees that range in cover from 5 to 15% and the perennial exotic bunchgrass *Psathyrostachys juncea* that ranges in cover from 15 to 25%. The shrub layer is sparse in terms of species diversity and provides sparse to low cover. The short shrubs include *Artemisia tridentata* and *Chrysothamnus viscidiflorus*. The remaining herbaceous layer at the site is comprised only of the forb *Mirabilis multiflora*, which provides sparse cover. Numerous non-native forbs have invaded these treated areas.

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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Short shrub/sapling	<i>Chrysothamnus viscidiflorus</i>
Short shrub/sapling	<i>Artemisia tridentata</i>

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Psathyrostachys juncea

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (ruderal) (23-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef 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

Capitol Reef National Park Inventory Notes: The stand has been chained, clear-cut, and burned then planted to Russian wildrye. Grazing occurs and the site is affected by sheet erosion resulting in pedestalling of plants. There are patchy big sagebrush shrubs. Pinyon pine are absent from the stand.

Capitol Reef National Park Data: The description is based on 2003 field data (1 plot: CARE.0465).

Local Description Authors: J. Von Loh, mod. D. Clark

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)
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

Capitol Reef National Park

This association is common and was sampled at The Notch, West Cottonwood Wash, east of Wagon Box Mesa, in the Hartnet, west of Notom, on Miners Mountain, along the Dry Bench Trail, near Red Canyon, east of Cedar Mesa campground, Divide Canyon, north of the Burr Trail (west of the switchbacks), and south of Deer Point within the park.

Globally

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

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on all topographic positions on slopes of ridges and hills, and on benches, interfluves, and steps-in-slope. Sites are gentle (1 to 13° slopes), occur between 1616 and 2165 m elevation, and are oriented predominantly to eastern aspects. The unvegetated surface has low to moderately high cover by litter and moderate to high cover by rocks and gravel. One stand has high exposure of bedrock. Exposure of bare soil is often moderate. Parent materials are variable and include sandstones and shale of the Moenkopi Formation, Kayenta Formation, and Morrison Formation. Soils are rapidly drained to well-drained sandy loams and sands.

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 ft.). 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

Capitol Reef National Park

This woodland association is common within the park. The total vegetation cover ranges from 11 to 70%. This woodland association is characterized by an open canopy, typically 1-5 m tall, of *Pinus edulis* and *Juniperus osteosperma* trees that range in cover from 0 to 35% and 5 to 25%, respectively, and *Purshia stansburiana* shrubs that range in cover from 1 to 5%. The shrub layer is moderately diverse in terms of species composition and provides sparse to moderate cover. The tall shrubs *Amelanchier utahensis* and *Fraxinus anomala* are occasionally present. The associated short- and dwarf-shrub layers commonly include *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Eriogonum corymbosum*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, and *Shepherdia rotundifolia*. The herbaceous layer is moderate in species diversity and typically provides sparse to low cover. Common graminoids include *Achnatherum hymenoides*, *Aristida purpurea*, *Hesperostipa comata*, and *Pleuraphis jamesii*. Forbs may include *Heterotheca villosa*, *Pedicularis centranthera*, *Penstemon eatonii*, and *Townsendia incana*.

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*, *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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Tall shrub/sapling	<i>Amelanchier utahensis</i> , <i>Fraxinus anomala</i>
Short shrub/sapling	<i>Atriplex canescens</i> , <i>Atriplex confertifolia</i> , <i>Chrysothamnus viscidiflorus</i> , <i>Ericameria nauseosa</i> , <i>Shepherdia rotundifolia</i> , <i>Symphoricarpos oreophilus</i> , <i>Tetradymia glabrata</i>
Short shrub/sapling	<i>Artemisia bigelovii</i> , <i>Artemisia tridentata</i> , <i>Ephedra torreyana</i> , <i>Ephedra viridis</i> , <i>Mahonia fremontii</i> , <i>Purshia mexicana</i>
Herb (field)	<i>Eriogonum corymbosum</i> , <i>Glossopetalon spinescens</i> var. <i>meionandrum</i> , <i>Gutierrezia microcephala</i> , <i>Gutierrezia sarothrae</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Achnatherum scribneri</i> , <i>Pleuraphis jamesii</i> , <i>Polypogon monspeliensis</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Tall shrub/sapling	<i>Amelanchier utahensis</i>
Tall shrub/sapling	<i>Purshia stansburiana</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Descurainia pinnata*, *Polypogon monspeliensis*

Globally

Bromus tectorum, *Descurainia pinnata*, *Erodium cicutarium*

CONSERVATION STATUS RANK

Global Rank & Reasons: G4? (1-Feb-1996).

CLASSIFICATION COMMENTS

Capitol Reef 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. Other shrubs in mixed understory stands include *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

Capitol Reef National Park Inventory Notes: Soils of one site occur in isolated pockets. One stand is dissected by erosion channels. One stand has Stansbury cliffrose and roundleaf buffaloberry shrubs with lots of crown die-out, possibly due to drought. Stands in general are lightly to moderately grazed by cattle.

Capitol Reef National Park Data: The description is based on 1986, 1988, 2003 and 2005 field data (24 plots: CARE.0431, CARE.0501, CARE.0526, CARE.0552, CARE.9072, CARE.9120, CARE.9126, CARE.9128, CARE.9150, CARE.9155, CARE.9170, CARE.9186, CARE.9206, CARE.9207, CARE.9208, CARE.9217, CARE.9304, CARE.9354, CARE.9426, CARE. 9427, CARE.9444, CARE_AA.0198, CARE_AA.0766, CARE_AA.1545).

Local Description Authors: J. Von Loh, mod. D. Clark

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, Isaacson 1967, Kartesz 1999, Larson and Moir 1987, Moir and Carleton 1987, Northcutt 1978, Stuever and Hayden 1997a, USFS 1982, USFS 1985c,

***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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516) 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 ft.) 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

Capitol Reef National Park

This association is known from two sites in upper Deep Creek.

Globally

This association is documented from the Sandia and Jemez ranges in New Mexico, from Mesa Verde in southwestern Colorado, and from Dinosaur National Monument in northwestern Colorado.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This association occurs infrequently on moderate south-facing slopes around 2500 m elevation. Stands tend to be on ridges. Large rocks or litter covers most of the unvegetated surface. Soils tend to be shallow and sandy, with much exposed bedrock and broken rock at the surface.

Globally

This association is common at middle elevations in the pinyon-juniper woodland zone of western Colorado and northwestern New Mexico. Stands 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 ft.) and aspect is variable. Soils are often shallow, coarse and rocky, and sometimes have outcrops of underlying sandstone or limestone.

VEGETATION DESCRIPTION

Capitol Reef National Park

This association is limited to ridges at higher elevations within the park. The tree canopy of this woodland is dominated by *Pinus edulis* and *Juniperus scopulorum* with between 20 and 30% cover. The dominant shrub is *Purshia tridentata* with at least 15% cover. *Artemisia nova* is commonly associated with a few percent cover. Herbaceous species are sparse, with *Bouteloua gracilis* and *Elymus elymoides* commonly present. Scattered *Pinus ponderosa* emerge through the canopy with a few percent cover.

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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus scopulorum</i> , <i>Pinus edulis</i>
Short shrub/sapling	<i>Artemisia nova</i> , <i>Purshia tridentata</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Short shrub/sapling	<i>Artemisia nova</i> , <i>Purshia tridentata</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (1-Feb-1996).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Some stands of this association in northwestern Colorado have a shrub layer 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

Capitol Reef National Park Inventory Notes: Plot is located near a small ridgeline that slopes north toward Deep Creek and more gradually southward into a small valley. The slope is very bouldery, the rocks mostly half-buried.

Capitol Reef National Park Data: The description is based on field data collected in 2005 during accuracy assessment (2 plots: CARE_AA.0958, CARE_AA.0414).

Local Description Authors: J. Coles

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, Western Ecology Working Group n.d.

***Pinus edulis - Juniperus osteosperma / Quercus havardii* var. *tuckeri* Woodland**

Two-needle Pinyon - Utah Juniper / Tucker Sand Shinnery Oak Woodland

CODE	CEGL002497
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	<i>PINUS EDULIS - (JUNIPERUS SPP.)</i> WOODLAND ALLIANCE (A.516) 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 on deep accumulations of eolian and alluvial sands on canyon and valley floors, in intermittent washes, and on dunes and sand sheets on plateaus and benches in southeastern Utah. It is located on level to gently sloping (0-11%) sites between 1445 and 1868 m (4740-6130 ft.) elevation. Aspect apparently does not influence the distribution of this association, although it does influence the vegetative composition somewhat. Bare soil and sand cover most of the unvegetated surface, although there is sometimes low cover of bedrock or gravel, and biological soil crusts can provide up to 30% cover. Geologic substrates include various sandstones, which for the most part have eroded and been re-deposited as eolian sands. Soils are rapidly drained, moderately deep loamy sands, sandy loams, and sands. Total vegetation cover ranges from 21% to more than 100%. The open tree canopy of *Pinus edulis* and *Juniperus osteosperma* is typically 2-5 m tall and ranges in cover from 10 to 50%. *Fraxinus anomala* may occasionally occur as a canopy tree with sparse cover. The understory is dominated by clumps of *Quercus havardii* var. *tuckeri* that range in cover from 5 to 65%. Associated shrubs vary depending on the aspect and the amount of soil moisture available; cooler, more mesic stands include *Amelanchier utahensis*, *Cercocarpus intricatus*, *Cercocarpus montanus*, *Mahonia fremontii*, and *Shepherdia rotundifolia*. In drier stands, these shrubs are mostly replaced by *Artemisia bigelovii*, *Ephedra viridis*, *Eriogonum microthecum*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, and *Yucca harrimaniae*. The herbaceous layer is more consistent in species composition yet provides only sparse cover. Common graminoids include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Muhlenbergia pungens*, and *Pleuraphis jamesii*. Forbs often present include species typical of sandy sites: *Cryptantha flava*, *Tetranneuris acaulis*, *Lepidium montanum*, and *Streptanthella longirostris*.

DISTRIBUTION

Capitol Reef National Park

This association is rare and was sampled on valley floors and stream terraces in Halls Creek south and west of Bitter Creek Divide.

Globally

This association is apparently restricted to southeastern Utah. It may also occur in some parts of southern Colorado.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association occupies stream terraces and valley floors. Sites are moderately steep (7 to 23° slopes), occur between 1578 and 1642 m elevation, and are oriented to northeastern and southeastern aspects. The unvegetated surface has moderate to high cover of litter and live vegetation basal area. There is low to moderate exposure of bare soil. Downed wood is uncommon but can be as high as 5% cover. Parent materials are Carmel Formation shale and Entrada sandstone that have eroded and become wind-transported. Soils are rapidly drained sandy loams.

Globally

This woodland association occurs on canyon and valley floors, in intermittent washes, on dunes and sand sheets on plateaus and benches in southeastern Utah. It is located on level to gently sloping (0-11%) sites between 1445 and 1868 m (4740-6130 ft.) elevation. Aspect apparently does not influence the distribution of this association. Bare soil and sand cover most of the unvegetated surface, although there is sometimes low cover of bedrock or gravel, and biological soil crusts can provide as much as 30% cover. Geologic substrates include Navajo, Moab Tongue, Cedar Mesa or Entrada sandstones, which for the most part have eroded and been re-deposited as eolian sands as well as shale of the Tidwell Member and Carmel Formation. Soils are rapidly drained, moderately deep loamy sands, sandy loams, and sands.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is rare within the park. The total vegetation cover ranges from 37 to 135% in these moderately to densely vegetated stands. This woodland association is characterized by an open canopy, typically 5-10 m tall, of *Pinus edulis* and *Juniperus osteosperma* trees that range in cover from 0 to 25% and 1 to 25%, respectively, and the short shrub *Quercus havardii* var. *tuckeri* that ranges in cover from 25 to 65%. A subcanopy layer of *Pinus edulis* and *Juniperus osteosperma* saplings provides sparse to low cover. The remaining shrub layer is

low in terms of species composition and is comprised of tall, short, and dwarf-shrubs and succulents that provide sparse to low cover. Common shrubs include *Amelanchier utahensis*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, and *Shepherdia rotundifolia*. The herbaceous layer is somewhat diverse in terms of species composition and provides sparse cover. The bunch grasses *Achnatherum hymenoides*, *Muhlenbergia pungens*, and *Pleuraphis jamesii* are commonly present. Forbs are moderately diverse in terms of species composition, provide sparse cover, and include *Comandra umbellata*. Cryptogams are typically present with up to 14% cover.

Globally

This woodland association is limited to sites with deep, loose sands. Total vegetation cover ranges from 21% to more than 100%. The open tree canopy of *Pinus edulis* and *Juniperus osteosperma* is typically 2-5 m tall and ranges in cover from 10 to 50%. *Fraxinus anomala* may occasionally occur as a canopy tree with sparse cover. The understory is dominated by large clumps of *Quercus havardii* var. *tuckeri* that range in cover from 2 to 65% in sand mounds between tree canopies. Associated shrubs vary depending on the aspect and the amount of soil moisture available; cooler, more mesic stands include *Amelanchier utahensis*, *Cercocarpus intricatus*, *Cercocarpus montanus*, *Mahonia fremontii*, and *Shepherdia rotundifolia*. In exposed, dry stands these shrubs are mostly replaced by *Artemisia bigelovii*, *Ephedra viridis*, *Eriogonum microthecum*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, and *Yucca harrimaniae*. The herbaceous layer is more consistent in species composition yet provides only sparse cover. Common graminoids include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Muhlenbergia pungens*, and *Pleuraphis jamesii*. Forbs often present include species typical of sandy sites: *Cryptantha crassisejala*, *Cryptantha flava*, *Lappula occidentalis*, *Lepidium montanum*, *Streptanthella longirostris*, and *Tetraneuris acaulis*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Tree subcanopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Tall shrub/sapling	<i>Amelanchier utahensis</i>
Short shrub/sapling	<i>Quercus havardii</i> var. <i>tuckeri</i> , <i>Shepherdia rotundifolia</i>
Herb (field)	<i>Gutierrezia sarothrae</i>
Herb (field)	<i>Muhlenbergia pungens</i> , <i>Pleuraphis jamesii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Tall shrub/sapling	<i>Fraxinus anomala</i>
Short shrub/sapling	<i>Quercus havardii</i> var. <i>tuckeri</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: G3? (10-Jan-2006). Because *Quercus havardii* var. *tuckeri* is restricted to southeastern Utah, this association is likely to have equally limited distribution in the Colorado Plateau. It may occur in some parts of southern Colorado. Between Arches, Canyonlands and Capitol Reef, the three national parks in which this association has been documented, there are nine small occurrences. Total number of occurrences on the Colorado Plateau is unlikely to exceed 100, and most occurrences will not exceed 5 hectares in size.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: The stands experience light to moderate grazing. Two stands support dense cryptobiotic crust. One stand encompasses the edge of the floodplain.

Capitol Reef National Park Data: The description is based on 2004 field data (3 plots: CARE.0606, CARE.0607, CARE.0608).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: 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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516) 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 ft.). 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

Capitol Reef National Park

This association is common to widespread and was sampled in Polk Creek, the Notch and Sheets Gulch within the northern half of the park.

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

Capitol Reef National Park

This woodland association was observed on the slopes of ridges and canyons sides, as well as on alluvial flats. Sites are moderately steep to steep (14-24°), occur between 1666 and 2273 m elevation, and are generally oriented to northern and eastern aspects. The unvegetated surface has low to moderate cover of litter and moderate cover of small rocks and gravel. Exposure of bare soil can be as much as 40%. Downed wood is typically uncommon but can

have 10% cover. Parent materials are typically reworked sediments of the Morrison and Chinle formations. Soils are moderately well-drained to rapidly drained loams, sandy loams, and sandy clays.

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 ft.). Because this is a relatively xeric woodland, bare soil and rocks may cover 70% of the unvegetated surface. Soils vary depending on substrate, including sandy loams, sandy clays, and silt loams.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is common within the park. The total vegetation cover ranges from 18 to 80%. This woodland is characterized by an open canopy, typically 2-5 m tall, of *Pinus edulis* and *Juniperus osteosperma* trees with a total cover between 5 and 35%, respectively, and *Shepherdia rotundifolia* that ranges in cover from 3 to 25%. *Pinus edulis* may be sparse or absent from some stands. The remaining shrub layer provides little cover and may include scattered shrubs of *Artemisia nova*, *Artemisia bigelovii*, *Chrysothamnus viscidiflorus*, *Rhus trilobata*, *Fraxinus anomala*, and *Mahonia fremontii*. The herbaceous layer usually contributes less than 5% total cover. A moderately diverse group of species is present, including the graminoids *Achnatherum hymenoides*, *Pleuraphis jamesii*, and *Bouteloua gracilis*.

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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Short shrub/sapling	<i>Shepherdia rotundifolia</i>
Short shrub/sapling	<i>Mahonia fremontii</i>
Herb (field)	<i>Artemisia nova</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Bouteloua gracilis</i> , <i>Pleuraphis jamesii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Short shrub/sapling	<i>Shepherdia rotundifolia</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Descurainia pinnata

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (12-Jan-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: One stand has an abundance of dead and downed trees; some died recently. Stands occupy steep slopes. *Shepherdia rotundifolia* grows in areas where there is more moisture. One plot is in an area characterized by a series of sandstone ledges with most of the plants growing on the flats where there is some soil development and others growing in cracks. Another plot is on undulating terrain with shallow gullies and exposed bedrock and conglomerate. A mix of shrubs, with buffaloberry having slightly higher cover, and no pinyon trees in some stands.

Capitol Reef National Park Data: The description is based on 2003 and 2004 field data as well as 2005 accuracy assessment data (5 plots: CARE.0445, CARE.0636, CARE.0660, CARE_AA.0689, CARE_AA.1425).

Local Description Authors: J. Von Loh, mod. D. Clark and J. Coles

Global Description Authors: J. Coles

REFERENCES: 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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516) 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. Biological cover is usually low to moderate, but some sites have 55-65% cover. Soils are always rapidly drained to moderately well-drained. Parent materials are also highly variable and can be sandstone, shale, or limestone. 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 50% canopy cover by one species. 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

Capitol Reef National Park

This association is uncommon and was sampled on 7176 Mesa, Jones Bench, south and southwest of Jones Bench, Wagon Box Mesa, north of Red Canyon Trail, and in the vicinity of Golden Throne.

Globally

This association is known to occur in western Colorado and eastern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on all topographic positions on slopes, steps-in-slope, benches, interfluves, and mesa tops within the park. Sites are gentle to moderately steep (1 to 17° slopes), occur between 1792 and 2291 m elevation, and are oriented to northeastern to southeastern aspects. The unvegetated surface has low to mostly high cover of litter and low to moderate cover by gravel. Exposure of bare soil is typically low. Cryptogams are absent to low in cover; however, one stand has 55% cover. Parent materials are variable and include Salt Wash Sandstone Member of the Morrison Formation, boulder deposits, Moenkopi Formation shale, and Curtis Formation. Soils are rapidly drained to moderately well-drained sandy loams, loamy sands, silty clays, and clay loams.

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°). The ground has variable amounts of litter and often has moderate to high amounts of gravel, rocks, and exposed bedrock. Biological cover is usually low to moderate, but some sites have 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 sandstone, shale, limestone, among others.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is uncommon within the park. The total vegetation cover ranges from 3 to 75% in these sparsely to moderately vegetated stands. This woodland association is characterized by an open canopy, typically 2-10 m tall, of *Pinus edulis* and *Juniperus osteosperma* trees that range in cover from 1 to 35% and <1 to 35%, respectively. The subcanopy of one stand has sparse cover of sapling *Pinus edulis* and *Juniperus osteosperma* trees. The shrub layer is moderately diverse in terms of species composition, contains tall, short, and dwarf-shrubs, and provides sparse to low cover. Common short and dwarf-shrubs include *Shepherdia rotundifolia*, *Eriogonum microthecum*, and *Opuntia polyacantha*. The herbaceous layer is low in species diversity and provides sparse cover. Common graminoids include *Achnatherum hymenoides*, *Bouteloua gracilis*, and *Pleuraphis jamesii*. The common forb is the annual *Descurainia pinnata*.

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 50% canopy cover by one species. 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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Tall shrub/sapling	<i>Cercocarpus montanus</i>
Short shrub/sapling	<i>Shepherdia rotundifolia</i>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> , <i>Ephedra viridis</i>
Herb (field)	<i>Chrysothamnus viscidiflorus</i> , <i>Fendlerella utahensis</i> , <i>Opuntia polyacantha</i>
Herb (field)	<i>Stenotus armerioides</i>
Herb (field)	<i>Bouteloua gracilis</i> , <i>Pleuraphis jamesii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Descurainia pinnata

Globally

Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (15-Dec-2004).

CLASSIFICATION COMMENTS

Capitol Reef 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

Capitol Reef National Park Inventory Notes: There is rapid runoff from soil surfaces resulting in erosion channels; some are deep. One stand has well-developed biotic crust. Tall trees shade the understory. One stand experienced a burn. One stand represents a relict area that has never been grazed.

Capitol Reef National Park Data: The description is based on 2003 field data (9 plots: CARE.0426, CARE.0504, CARE.0527, CARE.0533, CARE.0534, CARE.0577, CARE.0578, CARE.0579, CARE.8703).

Local Description Authors: J. Von Loh, mod. D. Clark

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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516) 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 ft.). 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 to 50% 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 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

Capitol Reef National Park

This association is uncommon and was sampled in Cedar Mesa and Red Canyon area, on the uplands above North and South Coleman canyons, on Dry Bench, on White Canyon Flat, and in Bear Canyon within the park and in the Onion Beds adjacent to the park.

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

Capitol Reef National Park

This woodland association was observed on alluvial flats, toe slopes of knolls, steps-in-slope, and slopes. Sites are gentle (0-8°), occur between 1729 and 2215 m elevation, and are oriented to all aspects. The unvegetated surface has low to moderate cover of litter and moderate to high exposure of bare soil. Parent materials are Brushy Basin Member of the Morrison Formation shale and sandstones eroded and distributed as alluvium. Soils are well-drained to rapidly drained sandy loams, loamy sands and silty clays.

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

Capitol Reef National Park

This woodland association is uncommon within the park. Total vegetation cover ranges from 25 to 80%. Stands are characterized by an open canopy, typically 2-5 m tall, of *Pinus edulis* and *Juniperus osteosperma* trees that range in cover from 10 to 40%, and *Artemisia tridentata* ssp. *wyomingensis* short shrubs that range in cover from 6 to 25%. Associated shrubs include *Amelanchier utahensis*, *Gutierrezia sarothrae*, *Quercus gambelii*, and *Opuntia polyacantha*. The herbaceous layer is typically sparse, except on one mechanically treated and planted site. Graminoids often include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Poa fendleriana*, and *Pleuraphis jamesii*. Forbs may include *Mirabilis multiflora*. Biological soil crusts are absent or sparse.

Globally

This woodland is characterized by a typically open tree canopy (usually 10-30% cover but ranges 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*, *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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Tree subcanopy	<i>Juniperus osteosperma</i>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> , <i>Ephedra viridis</i>
Herb (field)	<i>Gutierrezia microcephala</i>
Herb (field)	<i>Bouteloua gracilis</i> , <i>Psathyrostachys juncea</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus monosperma</i> , <i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>vaseyana</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Psathyrostachys juncea, *Sisymbrium altissimum*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (1-Feb-1996).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

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 a variation of the woodland type because of the ecological values of the trees.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Stands have been affected by drought, fire, bark beetle infestations and chaining. Many stands contain dead trees, and some stands are described as "park-like and open." One stand has Russian wildrye introduction. Stands experience light to moderate grazing by cattle, and there is evidence of only minor erosion in most plots.

Capitol Reef National Park Data: The description is based on 1986 and 2003 field data, as well as 2005 data collected during accuracy assessment (23 plots: CARE.0463, CARE.0464, CARE.0502, CARE.9174, CARE.9205, CARE_AA.0014, CARE_AA.0109, CARE_AA.0189, CARE_AA.0308, CARE_AA.0391, CARE_AA.0497, CARE_AA.0590, CARE_AA.0610, CARE_AA.0628, CARE_AA.0629, CARE_AA.0813, CARE_AA.0849, CARE_AA.0942, CARE_AA.0960, CARE_AA.1027, CARE_AA.1197, CARE_AA.1571, CARE_AA.1581).

Local Description Authors: J. Von Loh, mod. D. Clark and J. Coles

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, NVNHP 2003, Stuever and Hayden 1997a, Tiedemann 1978, USFS 1983a, USFS 1985a, USFS 1985e, Warren et al. 1982, Wright et al. 1979

***Pinus edulis* - *Juniperus* spp. / *Cercocarpus montanus* - Mixed Shrubs Woodland
Two-needle Pinyon - Juniper species / 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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516) 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 ft.). 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 as much as 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

Capitol Reef National Park

This association is uncommon and was sampled on Jones Bench, in the Onion Beds area, near Studhorse Peaks, just west of Buck Point, and on lower Dry Bench.

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

Capitol Reef National Park

This woodland association occupies upper colluvial or talus slopes, steps-in-slope, and low slopes of interfluves. Sites are gentle to steep (1 to 26° slopes), occur between 1893 and 2226 m elevation, and are oriented to predominantly northwestern aspects. The unvegetated surface has sparse to high cover of litter and moderate cover of gravel. Exposure of bare soil is low to high. Downed wood is uncommon, not exceeding 3% cover. Parent materials are Moenkopi and Chinle formation shale and rockfall or boulder deposits. Soils are rapidly drained clay loams and sandy loams.

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 ft.). Stands occur on gentle to steep (3 to 36°) 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

Capitol Reef National Park

This woodland association is uncommon within the park. The total vegetation cover ranges from 8 to 110%. This woodland association is characterized by an open canopy, typically 2-10 m tall, of *Pinus edulis* and *Juniperus osteosperma* trees that range in cover from 1 to 45% and <1 to 45%, respectively, and the tall shrub *Cercocarpus montanus* that ranges in cover from 1 to 15%. The remaining tall-shrub layer is low in species composition, provides low cover, and includes *Amelanchier utahensis* and *Mahonia fremontii*. Short and dwarf-shrubs commonly present providing sparse to low cover include *Chrysothamnus viscidiflorus*, *Ephedra viridis*, and *Shepherdia rotundifolia*. The herbaceous layer is low in terms of species composition and typically sparse, less than 5% total cover. The most common graminoid present is the tall bunchgrass *Achnatherum hymenoides*. The common forb is *Stenotus armerioides*.

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*, *Andropogon gerardii*, *Aristida purpurea*, *Bouteloua curtipendula*, *Bouteloua gracilis*, *Bouteloua hirsuta*, *Carex rossii*, *Hesperostipa comata*, *Koeleria macrantha*, *Leymus 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 *Tetranneuris*. 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 as much as 27% cover and are generally well-developed.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Tall shrub/sapling	<i>Amelanchier utahensis</i> , <i>Quercus gambelii</i>
Tall shrub/sapling	<i>Cercocarpus montanus</i> , <i>Mahonia fremontii</i>
Short shrub/sapling	<i>Ephedra viridis</i>
Herb (field)	<i>Opuntia polyacantha</i>
Herb (field)	<i>Plantago patagonica</i>
Herb (field)	<i>Poa fendleriana</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus monosperma</i> , <i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Short shrub/sapling	<i>Cercocarpus montanus</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Descurainia pinnata

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

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 a variation of the woodland type because of the ecological values of the trees.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Stands are found on Chinle slopes below Kayenta cliffs east of the Onion Beds. There is erosion related to runoff from steep slopes. There is light grazing of some stands by cattle.
Capitol Reef National Park Data: The description is based on 1986 and 2003 field data (7 plots: CARE.0535, CARE.0556, CARE.0575, CARE.0576, CARE.9162, CARE.9165, CARE.9313).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: K.A. Schulz, mod. J. Drake and J. Coles

REFERENCES: Baker 1983b, Baker 1984a, Baker and Kennedy 1985, Bourgeron and Engelking 1994, Bradley et al. 1992, CONHP unpubl. data 2003, Cogan et al. 2004, Driscoll et al. 1984, Erdman 1962, Erdman 1969, Hess and Wasser 1982, Isaacson 1967, Johnston 1987, Kennedy 1983a, Larson and Moir 1987, Marr et al. 1979, Medina 1986, Moir 1963, Moir and Carleton 1987, Moir and Ludwig 1979, Pase and Lindenmuth 1971, Stuever and Hayden 1997a, USFS 1981a, USFS 1981b, USFS 1983a, USFS 1985d, USFS 1985e, USFS 1985g, Vories 1974, Wright et al. 1979

***Pinus edulis* - *Juniperus* spp. / *Leymus salinus* Woodland**

Two-needle Pinyon - Juniper species / Salinas Lyme Grass 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	<i>PINUS EDULIS</i> - (<i>JUNIPERUS</i> SPP.) WOODLAND ALLIANCE (A.516) 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 ft.). 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 re-deposited 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

Capitol Reef National Park

This association is rare and was sampled on narrow ridges with saddles, midslopes, and high slopes east of Wagon Box Mesa west of the head of Brimhall 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

Capitol Reef National Park

This woodland association was observed on high slopes of thin ridges and midslopes of ridges. Sites are gentle (2 to 4° slopes), occur between 1707 and 1921 m elevation, and are oriented to northeastern and southeastern aspects. The unvegetated surface is unrecorded, although one site had 5% exposed bedrock. Parent materials are variable and include sandstones (Kayenta Formation at one site) and shale. Soils are rapidly drained sandy clays and sands.

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 ft.), 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 re-deposited with other rocks as alluvium or colluvium. Soils are rapidly drained and include sandy clay loams, clay loams and sandy loams.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is rare within the park. The vegetation is characterized by an open canopy of *Pinus edulis* and *Juniperus osteosperma* trees and the tall bunchgrass *Leymus salinus*. The shrub layer is moderately diverse and is comprised of short and dwarf-shrubs and succulents that provide sparse to low cover. Common short and dwarf-shrubs include *Atriplex canescens*, *Chrysothamnus viscidiflorus*, *Echinocereus triglochidiatus*, *Ephedra viridis*, and *Gutierrezia sarothrae*. The remaining herbaceous layer is diverse in terms of species composition and provides sparse to low cover. The bunchgrass *Achnatherum hymenoides* is commonly present. Forbs are moderately diverse in terms of species composition and include *Eriogonum ovalifolium*, *Sphaeralcea parvifolia*, and *Stanleya pinnata*.

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*, *Streptanthella longirostris*, and *Tetaneuris acaulis*. *Bromus tectorum* is common in stands that have experienced disturbance from roads or grazing.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Short shrub/sapling	<i>Chrysothamnus viscidiflorus</i> , <i>Ericameria nauseosa</i>
Short shrub/sapling	<i>Ephedra viridis</i>
Herb (field)	<i>Echinocereus triglochidiatus</i> , <i>Gutierrezia sarothrae</i>
Herb (field)	<i>Leymus salinus</i>

Globally

<u>Stratum</u>	<u>Species</u>
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Tree canopy *Juniperus osteosperma, Pinus edulis*
Herb (field) *Leymus salinus*

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park
Bromus tectorum

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

Capitol Reef National Park
Data are not available.

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

Capitol Reef National Park Inventory Notes: The stands experience moderate grazing.
Capitol Reef National Park Data: The description is based on 1986 field data (3 plots: CARE.9156, CARE.9157, CARE.9195).
Local Description Authors: J. Von Loh, mod. D. Clark
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	<i>PINUS EDULIS - (JUNIPERUS SPP.) WOODLAND ALLIANCE (A.516)</i> 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 mesa tops, 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*, *Bouteloua gracilis*, *Carex geyeri*, *Carex rossii*, *Elymus elymoides*, *Festuca arizonica*, *Koeleria macrantha*, *Muhlenbergia montana*, *Poa fendleriana*, and *Schizachyrium scoparium*.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon and was sampled in North Coleman Canyon, south of Cedar Mesa campground, in the Lamp Stand area, near Studhorse Peaks, and in the Onion Beds within and adjacent to the park.

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

Capitol Reef National Park

This woodland association was observed on midslopes of interfluvies. The site is moderately steep (12° slope), occurs at 1768 m elevation, and is oriented to the southeastern aspect. The unvegetated surface has moderate cover of litter and large rocks and gravel. Downed wood is common, with around 7% cover. Parent materials are Carmel Formation shale eroded to boulders and gravel. Soils are rapidly drained sandy loams.

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 mesa tops, 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

Capitol Reef National Park

This woodland association is uncommon within the park. The total vegetation cover ranges from 25 to 150% in these moderately to densely vegetated stands. This woodland association is characterized by an open canopy, typically 5-10 m tall, of *Pinus edulis*, *Juniperus osteosperma*, and *Juniperus scopulorum* trees that range in cover from 5 to 25%, 5 to 45%, and 35 to 45%, respectively, and the tall shrubs *Quercus gambelii* or *Quercus X pauciloba* that range in cover from 5 to 25% or 55 to 65%, respectively. The subcanopy layer, typically 2-5 m tall, of sapling *Juniperus osteosperma* and *Pinus edulis* trees is present in three stands and provides sparse cover. The remaining tall-shrub layer is low in species composition, provides low cover, and includes *Amelanchier utahensis*. Short and dwarf-shrubs commonly present providing low to moderate cover include *Mahonia fremontii*, *Opuntia polyacantha*, *Quercus gambelii*, and *Shepherdia rotundifolia*. The herbaceous layer is low in terms of species composition and sparse, less than 5% total cover. *Poa fendleriana* may be present, as may the forbs *Arabis* sp., *Pedicularis centranthera*, and

Penstemon sp.

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 in 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*, *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*, *Tetranneuris acaulis*, or *Vicia americana*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

Stratum

Species

Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Tree subcanopy	<i>Juniperus osteosperma</i> , <i>Juniperus scopulorum</i> , <i>Pinus edulis</i>
Tall shrub/sapling	<i>Quercus gambelii</i> , <i>Quercus x pauciloba</i> , <i>Rhus trilobata</i>
Short shrub/sapling	<i>Amelanchier utahensis</i> , <i>Symphoricarpos longiflorus</i>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> , <i>Ephedra torreyana</i> , <i>Ephedra viridis</i>
Herb (field)	<i>Opuntia polyacantha</i> , <i>Symphoricarpos longiflorus</i>
Herb (field)	<i>Pedicularis centranthera</i>
Herb (field)	<i>Poa fendleriana</i>

Globally

Stratum

Species

Tree canopy	<i>Juniperus monosperma</i> , <i>Juniperus osteosperma</i> , <i>Juniperus scopulorum</i> , <i>Pinus edulis</i>
Tall shrub/sapling	<i>Amelanchier utahensis</i> , <i>Quercus gambelii</i>
Tall shrub/sapling	<i>Cercocarpus montanus</i>
Short shrub/sapling	<i>Symphoricarpos oreophilus</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Descurainia pinnata

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Stand occupies wash banks on elevated terraces and one basin. One stand experiences rockfall. There is some grazing of stands by cattle.

Capitol Reef National Park Data: The description is based on 2003, 2004, and 2005 field data (6 plots: CARE.0551, CARE.0609, CARE.0632, CARE.0705, CARE.0707, CARE_AA.1462).

Local Description Authors: J. Von Loh, mod. D. Clark

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, 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	<i>PINUS LONGAEOVA</i> WOODLAND ALLIANCE (A.518) Intermountain Bristlecone Pine Woodland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland (CES304.790)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This rare woodland association is known only from a small area in Capitol Reef National Park in southern Utah; this summary is derived from data collected there. Small stands of this woodland occur on high slopes of scree or talus. Sites are gentle to moderately steep (1 to 21° slopes), occur between 2683 and 2731 m elevation, and are oriented to southeastern 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. Soils are rapidly drained sandy loams. 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 moderately diverse, provides sparse to low cover, and includes *Juniperus osteosperma*, *Juniperus scopulorum*, *Pinus edulis*, 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 *Amelanchier utahensis*, *Arctostaphylos patula*, *Ericameria nauseosa*, *Eriogonum corymbosum*, and *Purshia tridentata*. The herbaceous layer is diverse but rarely provides cover exceeding 5%. Graminoids are low in diversity and provide sparse cover, although *Leymus salinus* covers in excess of 1% in one stand. Forbs are moderate to high in diversity but provide sparse cover, typically less than 1%. The most abundant forbs are *Oxytropis oreophila* and *Tetranneuris acaulis*.

DISTRIBUTION

Capitol Reef National Park

This association is rare, occupying high-elevation exposures of Carmel shale in the northwestern corner of the park. It was sampled near Deep Creek in the vicinity of Billings Pass.

Globally

This association is known only from high-elevation exposures of Carmel shale in the northwestern part of Capitol Reef National Park in southern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was sampled on high slopes of scree or talus and on interfluves. Sites are gentle to moderately steep (1 to 21° slopes), occur between 2683 and 2731 m elevation, and are oriented to southeastern 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. Soils are rapidly drained sandy loams.

Globally

This association is known only from Capitol Reef National Monument. Until other data become available, there is no global information.

VEGETATION DESCRIPTION

Capitol Reef National Park

This intermountain bristlecone pine woodland association is rare in the park. It occurs only in the northwestern corner of the park at the higher elevations. The total vegetation cover ranges from 27 to 65%. This woodland 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 moderately diverse, provides sparse to low cover, and includes *Juniperus osteosperma*, *Juniperus scopulorum*, *Pinus edulis*, and *Pseudotsuga menziesii*. The shrub layer is diverse and provides sparse to low cover with no one shrub consistently present in stands. Tall and short shrubs that occasionally provide low cover within stands include *Amelanchier utahensis*, *Arctostaphylos patula*, *Ericameria nauseosa*, *Eriogonum corymbosum*, and *Purshia tridentata*. The herbaceous layer is diverse but rarely provides cover exceeding 5% total cover. Graminoids are low in diversity and provide sparse cover; *Leymus salinus* provides cover in excess of 1% in one stand. Forbs are moderate to high in diversity but provide sparse cover, typically less than 1%. The most abundant forbs are *Oxytropis oreophila* and *Tetranneuris acaulis*.

Globally

This association is known only from Capitol Reef National Monument. Until other data become available, there is no global information.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Juniperus scopulorum</i> , <i>Pinus edulis</i> , <i>Pinus longaeva</i>
Tall shrub/sapling	<i>Amelanchier utahensis</i>
Short shrub/sapling	<i>Ericameria nauseosa</i>
Short shrub/sapling	<i>Arctostaphylos patula</i> , <i>Purshia tridentata</i>
Herb (field)	<i>Oxytropis oreophila</i> , <i>Tetranneuris acaulis</i>
Herb (field)	<i>Leymus salinus</i>

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus rubens

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (23-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef 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

Capitol Reef National Park Inventory Notes: Stands are subject to light grazing from wildlife and occasionally cattle. One stand occupies a steep slope and has a sparse shrub understory. Associated woodlands include quaking aspen and ponderosa pine stands.

Capitol Reef National Park Data: The description is based on 1986, 1988, and 2003 field data (4 plots: CARE.0536, CARE.9148, CARE.9416, CARE.9443).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Pinus ponderosa* - *Pseudotsuga menziesii* / *Purshia tridentata* Woodland
Ponderosa Pine - Douglas-fir / Antelope Bitterbrush Woodland**

CODE	CEGL000214
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	<i>PINUS PONDEROSA</i> - <i>PSEUDOTSUGA MENZIESII</i> WOODLAND ALLIANCE (A.533) Ponderosa Pine - Douglas-fir Woodland Alliance

ECOLOGICAL SYSTEM(S): Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest (CES306.805)
Northern Rocky Mountain Foothill Conifer Wooded Steppe (CES306.958)
Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This dry woodland association is documented from stands growing on hills and mountains on the eastern slope of the Cascade Range in Washington and on high plateaus in the northern Colorado Plateau of Utah. Stands occur on warm, well-drained sites on upper slopes, shoulders and ridge tops with poor soils, and often with much bedrock exposure. A few stands occur on well-drained outwash deposits in valley bottoms. Sites are moderately steep (7 to 16° slopes), occasionally greater than 50%. Elevations range between 610 and 1465 m (2000–4800 ft.) in Washington but are close to 2745 m (9000 ft.) in Utah. Soils are shallow, stony, rapidly drained sandy loams and loamy sands derived from colluvium, alluvium or granitic till. Total vegetation cover ranges from 10 to 60%, but in general stands are relatively sparsely vegetated. The canopy is open (less than 40% cover) and consists of a mix of *Pinus ponderosa* and *Pseudotsuga menziesii*, occasionally with scattered *Pinus contorta*. The sparse subcanopy may also contain *Pinus edulis* and *Juniperus scopulorum*. Shrubs form a discontinuous, patchy layer dominated by *Purshia tridentata*. Associated shrubs include *Artemisia nova*, *Arctostaphylos uva-ursi*, *Mahonia repens*, *Amelanchier* spp., *Ceanothus velutinus*, *Spiraea betulifolia*, and *Symphoricarpos oreophilus*. The herbaceous layer is typically sparse, rarely with more than 10% total cover. Documented species include *Achillea millefolium*, *Balsamorhiza sagittata*, *Carex geyeri*, *Elymus elymoides*, *Lomatium triternatum*, *Apocynum androsaemifolium*, *Packera multilobata*, *Phlox austromontana*, and *Poa fendleriana*.

DISTRIBUTION

Capitol Reef National Park

This association is rare and was sampled near the summit of Billings Pass and on slopes of Upper Deep Creek in the same area.

Globally

This association is known from eastern Washington as well as southeastern Utah. It may also occur in eastern

Oregon, California and southern British Columbia.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on the upper and middle slopes and a saddle or step-in-slope below Billings Pass. Sites are moderately steep (7 to 16° slopes), occur between 2735 and 2769 m elevation, and are oriented to northeastern and southwestern aspects. The unvegetated surface has high cover of litter, and one stand has high exposure of bare soil. There is low cover of rocks and gravel. Downed wood is uncommon. Parent materials are Carmel Formation exposures and boulder rockfall derived from the cliffs. Soils are rapidly to well-drained sandy loams and loamy sands

Globally

This woodland association is documented from stands growing on hills and mountains on the eastern slope of the Cascade Range in Washington and on high plateaus in the northern Colorado Plateau of Utah. Sites are relatively warm and dry on upper slopes, shoulders and ridge tops with poor soils, and often with much bedrock exposure. A few sites occur on well-drained outwash deposits in valley bottoms. Sites are moderately steep (7 to 16° slopes), with a few stands on slopes greater than 50%. Elevations range between 610 and 1465 m (2000-4800 ft.) in Washington but are close to 2745 m (9000 ft.) in Utah. The unvegetated surface has high cover of rock or litter. Soils are shallow, stony, rapidly drained sandy loams and loamy sands derived from colluvium, alluvium or granitic till.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is rare and occupies the slopes near Billings Pass within and adjacent to the park. The total vegetation cover ranges from 8 to 125% in these sparsely to densely vegetated stands. This woodland association is characterized by an open to relatively closed canopy, typically 20-35 m tall, of *Pinus ponderosa* and *Pseudotsuga menziesii* trees that range in cover from 1 to 35% and 5 to 45%, respectively, and *Purshia tridentata* short shrubs that range in cover from 1 to 25%. Associated canopy trees, typically 2-5 m tall, often provide sparse to low cover and include *Pinus edulis* and *Juniperus scopulorum*. The associated shrub layer is low to moderate in terms of species composition and typically provides sparse to low cover. Other short shrubs commonly present include *Artemisia nova* and *Symphoricarpos oreophilus*. The herbaceous layer is typically sparse, usually less than 5% total cover. No one herbaceous species provided cover in excess of 1% in sampled stands.

Globally

Total vegetation cover ranges from 10 to 60%, but in most stands are relatively sparsely vegetated. The canopy is open (less than 40% cover) and consists of a mix of *Pinus ponderosa* and *Pseudotsuga menziesii*, while a few stands may also contain scattered *Pinus contorta*. A sparse subcanopy may be present and is composed of the canopy species occasionally joined by *Pinus edulis* and *Juniperus scopulorum*. Shrubs form a discontinuous, patchy layer in canopy openings dominated by *Purshia tridentata* with between 5 and 20% cover. Associated shrubs are few and are inconsistent among sites. Some species reported include *Artemisia nova*, *Arctostaphylos uva-ursi*, *Mahonia repens*, *Amelanchier* spp., *Ceanothus velutinus*, *Spiraea betulifolia*, and *Symphoricarpos oreophilus*. The herbaceous layer is typically sparse, rarely with more than 10% total cover. Herbaceous species reported from Washington include *Achillea millefolium*, *Balsamorhiza sagittata*, *Carex geyeri*, *Elymus elymoides*, *Lomatium triternatum*, and *Apocynum androsaemifolium*. Utah stands typically include *Packera multilobata*, *Phlox austromontana*, and *Poa fendleriana*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pinus ponderosa</i> , <i>Pseudotsuga menziesii</i>
Tree subcanopy	<i>Juniperus scopulorum</i> , <i>Pinus edulis</i>
Short shrub/sapling	<i>Symphoricarpos oreophilus</i>
Short shrub/sapling	<i>Purshia tridentata</i>
Herb (field)	<i>Artemisia nova</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pinus ponderosa</i> , <i>Pseudotsuga menziesii</i>

Short shrub/sapling *Purshia tridentata*

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G3 (1-Feb-1996).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: There are signs of grazing by cattle and elk. One stand is between 100-200 years old and probably regenerated following fire. Slope and tall trees result in few short shrubs in one stand. In another stand a less dense canopy allows more understory species to establish. Quaking aspen and bristlecone pine stands are established nearby.

Capitol Reef National Park Data: The description is based on 2003 field data (3 plots: CARE.0537, CARE.0539, CARE.0584).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Kagan et al. 2000, Marsh et al. 1987, WNHP unpubl. data, Western Ecology Working Group n.d., Williams and Lillybridge 1983, Williams and Smith 1990

***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	<i>PINUS PONDEROSA</i> WOODLAND ALLIANCE (A.530) Ponderosa Pine Woodland Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This woodland association has been reported from the mountains and plateaus in Colorado, Utah and California. Elevation ranges from 1770-2590 m (5800-8500 ft.). 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*, *Elymus elymoides*, *Leymus salinus*, and *Poa fendleriana*. Forbs are sparse and may include *Achillea millefolium*, *Balsamorhiza sagittata*, and *Eriogonum racemosum*.

DISTRIBUTION

Capitol Reef National Park

This association is rare and was sampled in Upper Deep Creek and along the Dry Bench Trail west of Sandy Ranch. It occurs sporadically all along the Waterpocket Fold.

Globally

This coniferous woodland association has been reported from the Colorado Plateau (western Colorado and southern Utah) and the eastern Sierra Nevada.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on mid- and high slopes of plateaus and valleys, steps-in-slope (described as benches), and in channel beds. Sites are gentle (1 to 3° slopes), occur between 1890 and 2530 m elevation, and are oriented to many aspects. The unvegetated surface is unrecorded. Parent materials are sandstones that are exposed as slickrock and have eroded and distributed as eolian deposits. Soils are rapidly drained and sandy.

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 ft.). Sites are dry, warm, mid to lower slopes, benches and ridge tops 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, basalt, and andesite.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is rare and occupies the slopes, benches, and channel beds in the park. The vegetation is characterized by an open canopy of *Pinus ponderosa* trees, and *Arctostaphylos patula* shrubs. Additional canopy and subcanopy trees present provide sparse to moderate cover, including *Juniperus osteosperma*, *Juniperus scopulorum*, *Pinus edulis*, and *Pseudotsuga menziesii*. The associated shrub layer is moderate in terms of species composition and typically provides low to moderate cover. Tall shrubs commonly present include *Amelanchier utahensis* and *Fraxinus anomala*. Short and dwarf-shrubs include *Cercocarpus intricatus*, *Juniperus communis*, *Purshia tridentata*, and *Yucca harrimaniae*. The herbaceous layer has moderate diversity in terms of species composition but is typically sparse in terms of cover. Common graminoids include *Achnatherum hymenoides* and *Festuca ovina*. Forbs can provide low cover and include *Symphytotrichum chilense*, *Helianthella microcephala*, and *Heterotheca villosa*.

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*, *Elymus elymoides*, *Leymus salinus*, and *Poa fendleriana*. Forbs are sparse and may include *Achillea millefolium*, *Balsamorhiza sagittata*, *Heterotheca villosa*, and *Eriogonum racemosum*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus scopulorum</i> , <i>Pinus edulis</i> , <i>Pinus ponderosa</i> , <i>Pseudotsuga menziesii</i>
Tall shrub/sapling	<i>Amelanchier utahensis</i>
Short shrub/sapling	<i>Juniperus communis</i>
Short shrub/sapling	<i>Arctostaphylos patula</i> , <i>Cercocarpus intricatus</i> , <i>Purshia tridentata</i>
Herb (field)	<i>Yucca harrimaniae</i>

Herb (field) *Helianthella microcephala, Symphyotrichum chilense*
Herb (field) *Festuca ovina*

Globally

Stratum Species
Tree canopy *Juniperus scopulorum, Pinus ponderosa*
Short shrub/sapling *Arctostaphylos patula*

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This plant association is seral in California.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Stands are subject to light grazing by cattle. Sandy soils characterize stands, as do slickrock/bedrock exposures. One stand is in a waterpocket drainage.

Capitol Reef National Park Data: The description is based on 1986 field data (4 plots: CARE.9076, CARE.9090, CARE.9167, CARE.9168).

Local Description Authors: J. Von Loh, mod. D. Clark

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, 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	<i>PINUS PONDEROSA</i> WOODLAND ALLIANCE (A.530) Ponderosa Pine Woodland Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This woodland type is reported from mountains and plateaus in southern Utah and northern Arizona. Stands occur on rocky ridges and benches at elevations ranging from 2100-2750 m (6900-9000 ft.). Substrates are typically shallow, gravelly loam, clay loam or silt loam soils derived from basalt or 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) 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*, *Piptatherum micranthum*, *Poa fendleriana*, *Poa secunda*, *Eriogonum alatum*, *Eriogonum racemosum*, *Opuntia* spp., and *Penstemon caespitosus*.

DISTRIBUTION

Capitol Reef National Park

This association is rare and was sampled near Sand Creek and Mud Springs within and adjacent to the park.

Globally

This association occurs on mountains and plateaus in southern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on the midslopes of ridges. Sites are moderately steep (9 to 12° slopes), occur between 2598 and 2643 m elevation, and are oriented to southeastern aspects. The unvegetated surface has low to high cover of litter, and one stand has moderate exposure of bare soil. There is low to moderate cover of rocks and gravel. Downed wood is uncommon. Parent materials are sandstones and shale that have deposited as rockfall or boulder deposits. Soils are well-drained sandy clays and clay loams.

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 ft.). 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

Capitol Reef National Park

This woodland association is rare in the park. It occupies ridges in the northwestern corner of the park and adjacent U.S. Forest Service-managed lands. The total vegetation cover ranges from 10 to 50% in these sparsely to moderately vegetated stands. This woodland association is characterized by a very open canopy, typically 2-15 m tall, of *Pinus ponderosa* trees that range in cover from 1 to 15% and *Artemisia nova* short shrubs that range in cover from 1 to 5%. The associated shrub layer is low in terms of species composition and typically provides sparse to low cover. Other short shrubs commonly present include *Chrysothamnus viscidiflorus*, *Purshia tridentata*, *Symphoricarpos oreophilus*, and *Tetradymia canescens*. The herbaceous layer is diverse in terms of species composition but typically sparse, usually less than 5% total cover. Common graminoids include *Bouteloua gracilis*, *Elymus elymoides*, and *Poa fendleriana*. Forbs commonly present include *Descurainia pinnata* and *Erigeron* sp.

Globally

This association is characterized by a typically open (5-30% cover) to moderately dense (60%) tree canopy 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*, *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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pinus edulis, Pinus ponderosa</i>
Short shrub/sapling	<i>Symphoricarpos oreophilus</i>
Short shrub/sapling	<i>Artemisia nova, Purshia tridentata</i>
Herb (field)	<i>Petradoria pumila</i>
Herb (field)	<i>Bouteloua gracilis</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pinus ponderosa</i>
Herb (field)	<i>Artemisia nova</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Descurainia pinnata, Marrubium vulgare

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: There are signs of grazing by cattle and elk. One stand has burned historically and has been logged. One stand is described as having a mosaic of ponderosa pine, black sagebrush, and pinyon pine on the sampled hillside.

Capitol Reef National Park Data: The description is based on 2003 field data (2 plots: CARE.0587, CARE.0588).

Local Description Authors: J. Von Loh, mod. D. Clark

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* / *Artemisia tridentata* ssp. *vaseyana* Woodland Ponderosa Pine / Mountain Big Sagebrush Woodland**

CODE	CEGL002794
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	<i>PINUS PONDEROSA</i> WOODLAND ALLIANCE (A.530) Ponderosa Pine Woodland Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This open ponderosa pine woodland is described from the southern Rocky Mountains on sites at 2200 to 2865 m (7215-9400 ft.) elevation on dry, moderate to somewhat steep slopes with southerly to easterly aspects. Stands often occur adjacent to sagebrush shrublands. Soils are well-drained or rapidly drained sandy loams and loamy sands derived from granite or sandstone. The vegetation is characterized by an open tree canopy (10-30% cover) dominated by *Pinus ponderosa* with a moderately dense short-shrub layer dominated by *Artemisia tridentata* ssp. *vaseyana* (10-30% cover). Tree canopy may have low cover of *Pinus edulis*, *Juniperus osteosperma*, or *Juniperus scopulorum*. The shrub layer may be diverse. Associated shrubs and dwarf-shrubs may include *Amelanchier utahensis*, *Artemisia frigida*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, *Mahonia repens*, *Opuntia fragilis*, *Paxistima myrsinites*, *Purshia tridentata*, *Ribes cereum*, and *Symphoricarpos oreophilus*, usually with <5% cover each. The herbaceous layer ranges from sparse to moderately dense and is typically dominated by graminoids (to 40% cover). Common associates include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Elymus* spp., *Hesperostipa comata*, *Koeleria macrantha*, *Muhlenbergia montana*, *Poa secunda*, and introduced species *Bromus inermis*, *Bromus tectorum*, and *Poa pratensis*. Forbs are less significant and few species contribute >1% cover.

DISTRIBUTION

Capitol Reef National Park

This association is rare and was sampled south of Billings Pass on Thousand Lakes Mountain, adjacent to the park.

Globally

This association is known from the east side of Rocky Mountain National Park and Dinosaur National Park (Douglas Mountain) in Colorado and may extend into northern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on a moderate mountain slope with a southeastern aspect at 2804 m elevation. The most conspicuous ground cover element is boulders, but cover by litter, bare soil and gravel is similar. Downed wood is uncommon. Parent materials are sandstones and basalt that have deposited as boulders. Soils are well-drained.

Globally

This open ponderosa pine woodland is described from the southern Rocky Mountains on sites at 2200 to 2865 m (7215-9400 ft.) elevation on dry, moderate to somewhat steep slopes (10-49%) with southerly to easterly aspects. Stands often occur adjacent to sagebrush shrublands. Soils are well-drained or rapidly drained sandy loams and loamy sands derived from granite or sandstone. The ground cover is a mosaic of bedrock, gravel, sandy soils, organic litter and duff under trees and boulders. The presence of *Artemisia tridentata* with *Purshia tridentata* in the shrub layer indicates shallower soils than monotypic *Purshia tridentata* shrub layers. Fire will reduce both shrub species in favor of graminoids (Johnston and Huckaby 2001).

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association was recorded only in the northwestern corner of the environs of the mapping area. Total vegetation cover ranges up to 70% in these moderately to densely vegetated stands. This woodland association is characterized by an open canopy, up to 25m tall, of *Pinus ponderosa* trees that provide 15% cover. The dense shrub understory is dominated by *Artemisia tridentata* ssp. *tridentata* with significant cover by *Purshia tridentata* and *Symphoricarpos oreophilus*. The herbaceous layer is diverse in terms of species composition but typically sparse, usually less than 5% total cover. Common graminoids include *Elymus elymoides*, and *Poa fendleriana*. Forbs commonly present include *Castilleja linariifolia*.

Globally

This woodland association is characterized by an open tree canopy (10-30% cover) dominated by *Pinus ponderosa* with a moderately dense short-shrub layer dominated by *Artemisia tridentata* ssp. *vaseyana* (10-30% cover). Tree canopy may have low cover of *Pinus edulis*, *Juniperus osteosperma*, or *Juniperus scopulorum*. The shrub layer may

be diverse. Other shrubs and dwarf-shrubs may include *Amelanchier utahensis*, *Artemisia frigida*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, *Mahonia repens*, *Opuntia fragilis*, *Paxistima myrsinites*, *Purshia tridentata*, *Ribes cereum*, and *Symphoricarpos oreophilus*, usually with <5% cover each. The herbaceous layer ranges from sparse to moderately dense and is typically dominated by graminoids (to 40% cover). Common associates include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Elymus elymoides*, *Elymus scribneri*, *Elymus trachycaulus*, *Hesperostipa comata*, *Koeleria macrantha*, *Muhlenbergia montana*, *Poa secunda*, and the introduced species *Bromus inermis*, *Bromus tectorum*, and *Poa pratensis*. Forbs are less significant and few species contribute >1% cover. Possible forbs include *Antennaria* spp., *Achillea millefolium*, *Artemisia ludoviciana*, *Eriogonum umbellatum*, *Heterotheca villosa*, *Potentilla effusa*, and *Symphyotrichum campestre* var. *campestre*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus scopulorum</i> , <i>Pinus ponderosa</i>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>vaseyana</i> , <i>Purshia tridentata</i>
Herb (field)	<i>Elymus elymoides</i> , <i>Poa fendleriana</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pinus ponderosa</i>
Herb (field)	<i>Artemisia tridentata</i> ssp. <i>vaseyana</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

N/A

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (26-May-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Point is in a band of ARTTRI vas. understory ~30m wide and ~100m long in a PINPON-JUNSCO woodland. This community transitions to a PINPON woodland with SYMORE/ELYLAN - ELYELY understory ~15m south of point. Many volcanic boulders along this slope and small pebbles and needle litter covering the ground. Slope is gradual and stable, with no disturbances noted.

Capitol Reef National Park Data: The description is based on 2004 field data (1 observation point: CARE.9706).

Local Description Authors: J. Coles

Global Description Authors: K.A. Schulz

REFERENCES: Driscoll et al. 1984, Johnston and Huckaby 2001, Mauk and Henderson 1984, Western Ecology Working Group n.d.

***Pinus ponderosa* / *Cercocarpus ledifolius* Woodland Ponderosa Pine / Curl-leaf Mountain-mahogany Woodland**

CODE

CEGL000850

PHYSIOGNOMIC CLASS Woodland (II)
PHYSIOGNOMIC SUBCLASS Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
ALLIANCE *PINUS PONDEROSA* WOODLAND ALLIANCE (A.530)
Ponderosa Pine Woodland Alliance

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

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This woodland association occurs on benches, plateaus and ridges in the highlands of northwestern Colorado, southeastern Utah and eastern Oregon. Elevations of documented stands range from 1400 to 2590 m (4600-8500 ft.), on gentle to moderate slopes with north and east aspects. Exposed bedrock, large rocks and litter cover much of the unvegetated surface. Soils tend to be shallow, skeletal and extremely well-drained. This woodland association is characterized by an open canopy of *Pinus ponderosa* with a subcanopy or tall-shrub layer of *Cercocarpus ledifolius*. The *Cercocarpus* shrubs often take an "arboreal" form, in which individuals have a single trunk and a distinct canopy. Scattered *Pseudotsuga menziesii* or *Abies concolor* may also occur in the canopy, and the subcanopy layer may contain *Juniperus osteosperma*, *Juniperus scopulorum* and *Pinus edulis*. Shrubs other than *Cercocarpus ledifolius* tend to be sparse, but *Amelanchier utahensis*, *Purshia tridentata*, or *Artemisia tridentata* ssp. *vaseyana* may be present. The sparse herbaceous layer tends to be dominated by graminoids, including *Carex rossii*, *Leymus salinus*, *Hesperostipa comata*, *Elymus elymoides*, and *Poa fendleriana*. Forbs are inconsistent among sites and contribute little cover.

DISTRIBUTION

Capitol Reef National Park

This association is rare and was sampled northeast of Billings Point and in Upper Deep Creek.

Globally

This association has been documented in southern Utah and northwestern Colorado. It has also been reported from central Utah (Youngblood and Mauk 1985), the Blue Mountains of eastern Oregon (Dealy 1975, Johnson and Clausnitzer 1992), and possibly northeastern California (Dealy 1975).

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on midslopes and upper slopes of ridges. Sites are gentle to moderately steep (3 to 9° slopes), occur between 2500 and 2591 m elevation, and are oriented to northeastern aspects. The unvegetated surface has high cover of litter, low cover of large rocks, and low exposure of bare soil. Downed wood is common, up to 12% cover. Parent materials are volcanic exposures that have eroded to boulders deposited as rockfall and colluvium. Soils are rapidly drained sandy clays.

Globally

This woodland association occurs on benches, plateaus and mountain ridges in the highlands of northwestern Colorado and southeastern Utah. Elevations of documented stands range from 1400 to 1500m (4600-4920 ft.) in Oregon and 2070 to 2590 m (6800-8500 ft.) in Colorado and Utah. Sites occur on gentle to moderate slopes with north and east aspects. Exposed bedrock, large rocks and litter cover much of the unvegetated surface. Soils are derived from a variety of sources, including sandstone, andesite and basalt, but tend to be shallow, skeletal and extremely well-drained.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is rare in the park. It occupies slopes near Billings Point and in Upper Deep Creek within and adjacent to the park. The total vegetation cover ranges from 55 to 95%. This woodland association is characterized by an open canopy, typically 5-10 m tall, of *Pinus ponderosa* trees that range in cover from 1 to 5%, and *Cercocarpus ledifolius* tall shrubs that range in cover from 45 to 55%. Subcanopy trees, typically 2-5 m tall,

provide sparse to low cover and include *Pinus edulis* and *Juniperus scopulorum*. The associated shrub layer is low in terms of species composition, typically provides sparse to low cover, and includes the short shrubs *Artemisia tridentata* ssp. *vaseyana* and *Purshia tridentata*. The herbaceous layer is diverse in terms of species composition but provides sparse to low cover, less than 10% total cover. The common graminoids include *Carex rossii* and *Poa fendleriana*. Forbs provide only sparse cover. Seedling *Juniperus scopulorum* trees provide low cover in one stand.

Globally

This woodland association is characterized by an open canopy to 20 m tall of *Pinus ponderosa* with a subcanopy or tall-shrub layer of *Cercocarpus ledifolius* to 5 m tall. The *Cercocarpus* shrubs often take an "arboreal" form, in which individuals have a single trunk and a distinct canopy. Scattered *Pseudotsuga menziesii* or *Abies concolor* may also occur in the canopy, and the subcanopy layer may contain *Juniperus osteosperma*, *Juniperus scopulorum*, and *Pinus edulis*. Shrubs other than *Cercocarpus ledifolius* tend to be sparse but may include *Amelanchier utahensis*, *Purshia tridentata*, or *Artemisia tridentata* ssp. *vaseyana*. The sparse herbaceous layer tends to be dominated by graminoids, including *Carex rossii*, *Leymus salinus*, *Hesperostipa comata*, *Elymus elymoides*, and *Poa fendleriana*. Forbs are inconsistent among sites and contribute little cover.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pinus ponderosa</i>
Tree subcanopy	<i>Juniperus scopulorum</i> , <i>Pinus edulis</i>
Tall shrub/sapling	<i>Cercocarpus ledifolius</i>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>vaseyana</i> , <i>Purshia tridentata</i>
Herb (field)	<i>Carex rossii</i> , <i>Poa fendleriana</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pinus ponderosa</i>
Tall shrub/sapling	<i>Cercocarpus ledifolius</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Chenopodium album, *Descurainia pinnata*

Globally

Data are not available.

CONSERVATION STATUS RANK

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

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This is a distinct and well-documented woodland type. A few stands may intergrade with *Pseudotsuga menziesii* / *Cercocarpus ledifolius* Woodland (CEGL000897).

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: The curl-leaf mountain-mahogany is tree-sized. One stand occupies a large slope and aspect typified by a thin layer of soil spread over a base of volcanic boulders. Ponderosa pine are typically scattered but can form large clumps.

Capitol Reef National Park Data: The description is based on 1986 and 2004 field data (2 plots: CARE.0719, CARE.9402).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Bourgeron and Engelking 1994, Dealy 1971, Dealy 1975, Driscoll et al. 1984, Johnson and Clausnitzer 1992, Kagan et al. 2000, Western Ecology Working Group n.d., Youngblood and Mauk 1985

***Pinus ponderosa* / *Purshia tridentata* Woodland**
Ponderosa Pine / Antelope Bitterbrush Woodland

CODE	CEGL000867
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
ALLIANCE	<i>PINUS PONDEROSA</i> WOODLAND ALLIANCE (A.530) Ponderosa Pine Woodland Alliance

ECOLOGICAL SYSTEM(S): Northern Rocky Mountain Foothill Conifer Wooded Steppe (CES306.958)
Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This *Pinus ponderosa* woodland occurs in montane zones in the Rocky Mountains and in sheltered canyons and high plateaus in the Colorado Plateau, from Colorado to Montana west to Utah, Washington, Oregon, and California. Stands tend to occupy south-facing, moderate to somewhat steep slopes (10-49%) in the Rockies, whereas Colorado Plateau stands prefer northern and eastern slopes and benches. Elevations range from 2165 to 2760 m (7100-9040 ft.). 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*, *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

Capitol Reef National Park

This association is rare and was sampled near Sand Creek and Mud Springs in the northwestern corner of the park and on adjacent U.S. Forest Service-managed lands.

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

Capitol Reef National Park

This woodland association was observed on interfluves and steps-in-slope described as benches. Sites are gentle to moderately steep (2 to 15° slopes), occur between 2470 and 2613 m elevation, and are oriented to northeastern and southwestern aspects. The unvegetated surface has moderate to high cover of litter, and one stand has moderate cover of large rocks. Downed wood is uncommon. Parent materials are Navajo sandstone that have eroded and deposited as rockfall or boulder deposits and eolian deposits. Soils are well-drained sandy loams.

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 ft.). 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

Capitol Reef National Park

This woodland association is rare and occupies the benches and interfluves in the northwestern corner of the park. The total vegetation cover ranges from 32 to 70%. This woodland association is characterized by an open canopy, typically 10-35 m tall, of *Pinus ponderosa* trees that range in cover from 5 to 55%, and *Purshia tridentata* shrubs that range in cover from 1 to 35%. Subcanopy trees, typically 2-5 m tall, provide sparse to low cover and include *Juniperus scopulorum*, *Pinus edulis*, and *Pseudotsuga menziesii*. The associated shrub layer is moderate in terms of species composition, typically provides sparse to low cover, and includes *Artemisia bigelovii*, *Artemisia tridentata*, and *Chrysothamnus viscidiflorus*. The herbaceous layer is low to diverse in terms of species composition but typically sparse in terms of cover, usually less than 5% total cover. The common graminoid is *Poa fendleriana*. Forbs can be absent from the stand or can include sparse *Antennaria parvifolia* and *Artemisia ludoviciana*.

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*, *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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus scopulorum</i> , <i>Pinus edulis</i> , <i>Pinus ponderosa</i>
Short shrub/sapling	<i>Purshia tridentata</i>
Herb (field)	<i>Poa fendleriana</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pinus ponderosa</i> var. <i>scopulorum</i>
Shrub/sapling (tall & short)	<i>Purshia tridentata</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G5 (1-Feb-1996).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: One stand consists of large old trees on a protected bench. There are signs of grazing by cattle and elk, fire, and logging in one stand. Stands have open canopies.

Capitol Reef National Park Data: The description is based on 1986 and 2003 field data (3 plots: CARE.0586, CARE.0589, CARE.9074).

Local Description Authors: J. Von Loh, mod. D. Clark

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, 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	<i>PINUS PONDEROSA</i> WOODLAND ALLIANCE (A.530) Ponderosa Pine Woodland Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This major woodland association 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 ft.). 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. *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 tree-like 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. 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

Capitol Reef National Park

This association is rare. It was sampled in North Coleman Canyon and above South Coleman Canyon on Dry Bench.

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

Capitol Reef National Park

This woodland association occurs on mesa tops and canyon sides. Sites are on gentle to steep slopes between 1952 and 2232 m elevation. Litter, rocks or gravel cover most of the unvegetated surface, with little exposed soil or dead wood. Soils are rapidly drained sandy loams derived from Wingate or Kayenta sandstones.

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 ft.). 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. High litter cover (70-90%) about 5 cm deep is common in many stands. Rock outcrops (about 10%) and some bare soil are usually present. 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 down slope to *Pinus ponderosa* / *Quercus hypoleucoides* Woodland (CEGL000872).

VEGETATION DESCRIPTION

Capitol Reef National Park

This rare woodland occurs in North Coleman Canyon and on Dry Bench near the park boundary. Total vegetation cover ranges from 48 to 90%. Stands are characterized by a canopy, typically 10-15 m tall, of *Pinus ponderosa* with 25 to 35% cover. *Pinus edulis*, *Juniperus osteosperma*, and *Pseudotsuga menziesii* may be scattered through the canopy or form a very open subcanopy. *Quercus gambelii* dominates a mixed mountain shrub understory with between 5 and 15% cover. Associated shrubs include *Amelanchier utahensis*, *Artemisia tridentata* ssp. *vaseyana*, *Cercocarpus montanus*, *Shepherdia rotundifolia*, and *Opuntia fragilis*. The herbaceous layer is diverse sparse. The common graminoid is *Poa fendleriana*. Forbs present with more than 1% cover include *Lathyrus brachycalyx*.

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 tree-like, 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. 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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pinus ponderosa</i>
Tall shrub/sapling	<i>Quercus gambelii</i>
Herb (field)	<i>Poa fendleriana</i>

Globally

<u>Stratum</u>	<u>Species</u>
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Tree canopy *Pinus ponderosa*
Tall shrub/sapling *Quercus gambelii*

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (1-Feb-1996).

CLASSIFICATION COMMENTS

Capitol Reef National Park
Data are not available.

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

Capitol Reef National Park Inventory Notes: Stands occur as patches and are not typical here. Plots is on a steep, rocky slope. The area is largely dominated by pinyon-juniper woodland. The habitat has gently rolling microtopography. The sampled site is grazed by elk.

Capitol Reef National Park Data: The description is based on 2004 field data and accuracy assessment data collected in 2005 (2 plots: CARE.0702, CARE_AA.0727).

Local Description Authors: J. Von Loh, mod. D. Clark and J. Coles

Global Description Authors: K.A. Schulz, mod. J. Coles

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, DeVelvece 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, 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, NVNHP 2003, 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	<i>PINUS PONDEROSA</i> WOODLAND ALLIANCE (A.530) Ponderosa Pine Woodland Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This open woodland association has only been described from Capitol Reef National Park; this summary is based on plot data collected from one site in 2004. It occurs on the bottom and sides of an intermittent stream drainage. The site has a gentle (4°) slope, occurs at 2308 m elevation, and is oriented to a southeastern aspect. The unvegetated surface has high cover of litter and low to moderate cover of large and small rocks. There is 30% exposure of bare soil. Downed wood has little cover. The substrate is Navajo sandstone that has eroded and re-deposited as alluvium, and the soil is a rapidly drained sandy loam. Total vegetation cover ranges to 65% and is characterized by an open canopy, typically 15-20 m tall, of *Pinus ponderosa* trees that range in cover from 35 to 45%. A subcanopy layer of 2 to 5-m tall *Pinus edulis* and *Juniperus osteosperma* trees provides sparse cover. The shrub layer is low in terms of species composition and provides sparse to low cover, with the dwarf-shrub *Artemisia frigida* providing as much as 5% cover. The herbaceous layer is moderately diverse in terms of species composition but is sparse, less than 5% total cover. The common graminoid is *Poa fendleriana*. The forb commonly present is *Stephanomeria minor*.

DISTRIBUTION

Capitol Reef National Park

This association is rare within the park and was sampled in upper Paradise Flats.

Globally

This association is known only from Capitol Reef National Park. It is likely to occur in isolated canyons throughout the Colorado Plateau.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed within an intermittent stream or drainage. The sampled site is gentle (4° slope), occurs at 2308 m elevation, and is oriented to a southeastern aspect. The unvegetated surface has high cover of litter and low to moderate cover of large and small rocks. There is moderate exposure of bare soil. Downed wood is uncommon. Parent materials are Navajo sandstone that have eroded and deposited as alluvium. Soils are rapidly drained sandy loams.

Globally

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

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is rare within the park and occupies the bottoms and sides of intermittent drainages. The total vegetation cover ranges from 39 to 65% in these moderately to densely vegetated stands. This woodland association is characterized by an open canopy, typically 15-20 m tall, of *Pinus ponderosa* trees that range in cover from 35 to 45%. A subcanopy layer of 2 to 5-m tall *Pinus edulis* and *Juniperus osteosperma* trees provides sparse cover. The shrub layer is low in terms of species composition and provides sparse to low cover, with the dwarf-shrub *Artemisia frigida* providing up to 5% cover. The herbaceous layer is moderately diverse but provides less than 5% total cover. The common graminoid is *Poa fendleriana*. The forb commonly present is *Stephanomeria minor*.

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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pinus ponderosa</i>
Tree subcanopy	<i>Pinus edulis</i>
Herb (field)	<i>Artemisia frigida</i>
Herb (field)	<i>Stephanomeria minor</i>
Herb (field)	<i>Poa fendleriana</i>

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (23-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef 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

Capitol Reef National Park Inventory Notes: Plot is in drainage that intermittently floods. Ponderosa pine trees are quite tall in the drainage with smaller trees encroaching on adjacent flats. There are signs of grazing by elk. Flats nearby are covered by pinyon-juniper and grass or are grasslands. Navajo sandstone domes above the plot support pinyon-juniper / mesic shrubs or littleleaf mountain-mahogany.

Capitol Reef National Park Data: The description is based on 2004 field data (1 plot: CARE.0657).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Pseudotsuga menziesii* / *Cercocarpus ledifolius* Woodland**

Douglas-fir / Curl-leaf Mountain-mahogany Woodland

CODE	CEGL000897
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	<i>PSEUDOTSUGA MENZIESII</i> WOODLAND ALLIANCE (A.552) Douglas-fir Woodland Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This is a widespread association found only occasionally in small patches in central Oregon, Idaho, western Wyoming and Montana, Utah and northwestern Colorado. It is generally found on ridge tops, plateau rims or colluvial upper slopes. Elevations range from 1220 m (4000 ft.) in central Oregon to over 2750 m (9025 ft.) in southern Utah. Sites are often subject to year-round winds and intense insolation, which contribute to reduced snow packs and dry conditions. Parent materials vary widely. In Oregon, it occurs on basalts. Farther east it is found on limestone, shale, sandstone, pumice, quartz monzonite and quartzite. Soil textures vary, but the sites are characterized by extensive areas of exposed soil and rock, as much as 40% at many sites. Trees are generally widely

spaced, with *Pseudotsuga menziesii* generally the only tree present. At the western portions of the range, *Juniperus occidentalis* is often present, with occasional *Pinus ponderosa* trees found. Farther east, these habitats have *Juniperus scopulorum*, *Pinus edulis*, *Pinus longaeva*, and occasional *Pinus flexilis*. The understory is characterized by a tall-shrub layer dominated by *Cercocarpus ledifolius*. Other shrubs include *Symphoricarpos* spp. (*Symphoricarpos albus* in the western part of the range and *Symphoricarpos oreophilus* in the eastern part), *Spiraea betulifolia*, *Mahonia repens*, *Artemisia tridentata*, and *Amelanchier* spp.. Graminoids, including *Pseudoroegneria spicata*, *Carex geyeri*, *Poa fendleriana*, *Poa secunda*, and/or *Festuca idahoensis*, comprise most of the sparse herbaceous layer.

DISTRIBUTION

Capitol Reef National Park

This association is rare within the park and was sampled on the eastern portion of Billings Pass Summit. Within the park, this association only occurs in the northwestern corner.

Globally

This is an uncommon and patchily distributed association, which is very widely distributed, from central Oregon east to Montana, and south to southern Utah and northwestern Colorado.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on the upper slopes of north-facing ridges. These ridges may be covered with black lava boulder scree. Sites are gentle to mildly steep (3 to 12° slopes), occur between 2683 and 2756 m elevation, and occupy northeastern and eastern aspects. The unvegetated surface of one stand has high cover of litter and low cover of large rocks and gravel. Downed wood is uncommon. Parent materials are variable and include sandstones and shale that have eroded to boulder deposits at one site. Soils are well-drained loamy sands.

Globally

This is a widespread association found only occasionally in small patches in central Oregon, Idaho, western Wyoming, northwestern Colorado, Utah and Montana. It is generally found on ridge tops, plateau rims or upper colluvial slopes. Elevations range from 1220 m (4000 ft.) in central Oregon to over 2750 m (9025 ft.) in southern Utah. Sites are often subject to year-round winds and intense insolation, which contribute to reduced snow packs and dry conditions. Parent materials vary widely. In Oregon, it occurs on basalts. Farther east it is found on limestone, shale, sandstone, pumice, quartz monzonite and quartzite. Soil textures vary, but the sites are characterized by extensive areas of exposed soil and rock, up to 40% at many sites.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is rare in the park. The total vegetation cover ranges from 9 to 35%. This woodland association is characterized by an open tree canopy, typically 10-15 m tall, of *Pseudotsuga menziesii* that ranges in cover from 5 to 15%, and the tall shrub *Cercocarpus ledifolius* that ranges in cover from 1 to 5%. The subcanopy layer provides low cover by *Pinus ponderosa* and *Pinus edulis* trees that are 2-5 m tall and sparse cover in one stand by *Juniperus osteosperma*, *Juniperus scopulorum*, *Pinus edulis*, and *Pinus longaeva*. The shrub layer is variable in cover and composition. Associated tall shrubs provide sparse cover, but short and dwarf-shrubs provide low to moderate cover and include *Artemisia tridentata*, *Purshia tridentata*, and *Symphoricarpos oreophilus*. The herbaceous layer is moderately diverse in terms of species composition and provides low cover. The most common and abundant graminoid is *Poa fendleriana*. Forbs commonly present include *Phlox hoodii* and *Packera multilobata*.

Globally

Trees are generally widely spaced, with *Pseudotsuga menziesii* generally the only tree present. At the western portions of the range, *Juniperus occidentalis* is often present, with occasional *Pinus ponderosa* trees found. Farther east and south, these habitats may have *Pinus ponderosa*, *Juniperus osteosperma*, *Juniperus scopulorum*, *Pinus edulis*, *Pinus longaeva*, and *Pinus flexilis*. The understory is characterized by a tall-shrub or subcanopy layer dominated by *Cercocarpus ledifolius*. Other shrubs include *Symphoricarpos* spp. (*Symphoricarpos albus* in the western part of the range and *Symphoricarpos oreophilus* in the east and south), *Spiraea betulifolia*, *Mahonia repens*, *Purshia tridentata*, *Artemisia tridentata*, *Amelanchier utahensis*, and *Amelanchier alnifolia*. Graminoids, including *Pseudoroegneria spicata*, *Carex geyeri*, *Poa fendleriana*, *Poa secunda*, and/or *Festuca idahoensis*, provide most of the sparse herbaceous undergrowth.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pseudotsuga menziesii</i>
Tree subcanopy	<i>Pinus edulis, Pinus ponderosa</i>
Tall shrub/sapling	<i>Cercocarpus ledifolius</i>
Short shrub/sapling	<i>Artemisia tridentata, Purshia tridentata</i>
Herb (field)	<i>Phlox hoodii</i>
Herb (field)	<i>Poa fendleriana</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pseudotsuga menziesii</i>
Tall shrub/sapling	<i>Cercocarpus ledifolius</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G4 (23-Oct-2002). This is a fairly widespread but uncommon association. There are only about 25 known stands, but there are likely three to four times more stands not identified. Stands are not threatened, nor are they particularly sensitive. They are important for wildlife, are rare, and differ in character throughout their range. With additional study, it is likely that this type will be split into two types, an eastern, higher elevation, drier type, and a western, lower elevation, type - with significantly different floristics. While there are quite a few occurrences, most are small, thus the area occupied by the type is probably less than 25,000 acres. This warrants changing the rank from G4 to G3G4, until additional inventories are completed and the extent of the type is made clearer.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This is a moderately defined type. It is clearly different from other associations in the classification, given the canopy dominants and the ecological setting. However, given the very large geographic range and the significantly different floristics represented within the range, it is likely that it represents two different types, an eastern, higher elevation, drier type with *Pseudotsuga menziesii* / *Cercocarpus ledifolius* - *Symphoricarpos oreophilus* and a western, lower elevation type with *Pseudotsuga menziesii* / *Cercocarpus ledifolius* - *Symphoricarpos albus*. The fact that habitat probably exists in northwestern California and Nevada for this type implies that additional distinction is required. For now, since the occurrences appear so small and not all that common, additional splitting does not appear to be necessary.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: There are some fire scars on downed wood in one stand. One stand adjoins an *Artemisia tridentata* - *Cercocarpus ledifolius* community; the plot is possibly ecotonal.

Capitol Reef National Park Data: The description is based on 1986 and 2003 field data (2 plots: CARE.0583, CARE.9149).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Bourgeron and Engelking 1994, DeVelice 1992, Driscoll et al. 1984, Johnson and Clausnitzer 1992, Kagan et al. 2000, MTNHP 2002b, Mauk and Henderson 1984, Steele et al. 1981, Steele et al. 1983, Western

Ecology Working Group n.d., Youngblood and Mauk 1985

***Pseudotsuga menziesii* / *Cercocarpus montanus* Woodland
Douglas-fir / Mountain-mahogany Woodland**

CODE	CEGL000898
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	<i>PSEUDOTSUGA MENZIESII</i> WOODLAND ALLIANCE (A.552) Douglas-fir Woodland Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This Colorado Plateau woodland association occupies dry, sometimes rocky sites on the slopes of ravines, canyons and mountains in central and southern Utah and northwestern Colorado, where it occurs in isolated stands at the lower end of the *Pseudotsuga menziesii* zone. Sites are gentle to steep (7-60% slopes), occur between 1738 and 2575 m (5700-8450 ft.) elevation, and are oriented to all aspects, although warm west and south aspects are rare. Rocks, gravel and litter cover most of the unvegetated surface. Parent materials include sandstones and shale, weathering into rapidly drained sandy loams, silt loams or clay loams. Total vegetation cover ranges from 25 to 90%. The 10 to 20-m tall canopy is open and dominated by *Pseudotsuga menziesii* with 10-35% cover. Other trees are generally present in the canopy and subcanopy, including *Juniperus scopulorum*, *Pinus edulis*, *Juniperus osteosperma*, and occasionally *Abies concolor*. There is an open shrub layer dominated by *Cercocarpus montanus* with between 5 and 15% cover. Associated shrubs include *Amelanchier utahensis*, *Cercocarpus intricatus*, *Ephedra viridis*, *Fraxinus anomala*, *Fendlera rupicola*, *Rhus trilobata*, *Shepherdia rotundifolia*, and *Symphoricarpos oreophilus*. If *Quercus gambelii* is present, it has less than 5% cover. The herbaceous layer is moderately diverse, provides sparse cover, and includes the graminoids *Carex rossii*, *Achnatherum hymenoides*, *Hesperostipa comata*, *Poa fendleriana*, and *Poa secunda*.

DISTRIBUTION

Capitol Reef National Park

This association was sampled in Bulberry Canyon and in the vicinity of Bear Canyon within the park. It likely occurs on north-facing slopes of Upper Deep Creek also.

Globally

This association has been documented from central and southern Utah and northwestern Colorado. It is likely to occur in cool canyons throughout the Colorado Plateau and in the foothills of southwestern Colorado.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on midslopes of ravines and upper slopes of canyons. Sites are gentle to steep (4 to 30° slopes), occur between 2165 and 2407 m elevation, and are oriented to northern and northwestern aspects. The unvegetated surface has high cover of litter and low exposure of small rocks and gravel. Downed wood is common. Parent materials are Carmel and Kayenta formation sandstones and shale. Soils are rapidly drained clay loams.

Globally

This Colorado Plateau woodland association occurs on dry, sometimes rocky sites on the slopes of ravines, canyons and mountains in central and southern Utah and northwestern Colorado. Sites are gentle to steep (7-60% slopes), occur between 1738 and 2575 m (5700-8450 ft.) elevation, and are oriented to a variety of aspects, although warm west and south aspects are rare. Rocks, gravel and litter cover most of the unvegetated surface. Parent materials

include sandstones and shale, weathering into coarse-textured, rapidly drained sandy loams, silt loams or clay loams.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is uncommon within the park. Total vegetation cover ranges from 24 to 90%. This woodland association is characterized by an open canopy, typically 5-10 m tall, of *Pseudotsuga menziesii* trees and an open shrub layer dominated by *Cercocarpus montanus*. A subcanopy includes *Pinus edulis* (5 to 15% cover), *Juniperus osteosperma* (1 to 5% cover), and *Pseudotsuga menziesii* (1 to 5% cover). The remaining tall-, short-, and dwarf-shrub layer is low to moderate in terms of species composition, provides low to moderate cover, and includes *Amelanchier utahensis*, *Cercocarpus intricatus*, and *Symphoricarpos oreophilus*. Some locations on the north slope of Bulberry Canyon have moderate cover of *Shepherdia rotundifolia* added to the mix of shrubs. The herbaceous layer is moderately diverse, provides sparse cover, and includes the graminoids *Carex rossii* and *Poa fendleriana*.

Globally

This woodland association occurs in isolated stands at the lower end of the *Pseudotsuga menziesii* zone in Utah (Youngblood and Mauk 1985) and northwestern Colorado. Total vegetation cover ranges from 25 to 90%. The 10 to 20-m tall canopy is open and dominated by *Pseudotsuga menziesii* with 10-35% cover. Other trees are generally present in the canopy and subcanopy, including *Juniperus scopulorum*, *Pinus edulis*, *Juniperus osteosperma*, and occasionally *Abies concolor*. There is an open shrub layer dominated by *Cercocarpus montanus* with between 5 and 15% cover. Associated shrubs include *Amelanchier utahensis*, *Cercocarpus intricatus*, *Ephedra viridis*, *Fraxinus anomala*, *Fendlera rupicola*, *Rhus trilobata*, *Shepherdia rotundifolia*, *Symphoricarpos oreophilus*, *Yucca harrimaniae*, and *Yucca angustissima*. If *Quercus gambelii* is present, it has less than 5% cover. The herbaceous layer is moderately diverse, provides sparse cover, and includes the graminoids *Carex rossii*, *Achnatherum hymenoides*, *Achnatherum nelsonii*, *Hesperostipa comata*, *Poa fendleriana*, and *Poa secunda*. Common forbs include *Eriogonum umbellatum*, *Lepidium montanum*, and *Packera multilobata*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pseudotsuga menziesii</i>
Tree subcanopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i> , <i>Pseudotsuga menziesii</i>
Tall shrub/sapling	<i>Amelanchier utahensis</i>
Tall shrub/sapling	<i>Cercocarpus montanus</i>
Short shrub/sapling	<i>Shepherdia rotundifolia</i> , <i>Symphoricarpos oreophilus</i>
Short shrub/sapling	<i>Cercocarpus intricatus</i>
Herb (field)	<i>Carex rossii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pseudotsuga menziesii</i>
Tall shrub/sapling	<i>Cercocarpus montanus</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

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

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Because the shrub layer is somewhat mixed, it may sometimes be difficult in the field to distinguish this association

from the broadly defined but somewhat more mesic *Pseudotsuga menziesii* / *Symphoricarpos oreophilus* Forest (CEGL000462).

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: There is mistletoe infestation of some Douglas-fir trees on one site, causing their death. There is light grazing by elk and cattle on one site.

Capitol Reef National Park Data: The description is based on 1986 and 2004 field data (2 plots: CARE.0717, CARE.9163).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Western Ecology Working Group n.d., Youngblood and Mauk 1985

***Pseudotsuga menziesii* Scree Woodland
Douglas-fir Scree Woodland**

CODE	CEGL000911
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	<i>PSEUDOTSUGA MENZIESII</i> WOODLAND ALLIANCE (A.552) Douglas-fir Woodland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Cliff, Canyon and Massive Bedrock (CES306.815)
Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association occurs throughout the interior western U.S. but is restricted to steep slopes covered by loose rock and colluvium on mountain or canyon slopes. It has the appearance of a stand of scattered trees with a sparse understory; the vegetation is limited by the lack of soil development. Slopes generally exceed 60% and are generally unstable, with constantly shifting rocks on the slopes as well as additional rockfall from outcrops upslope. Elevations at the northern end of the range (Montana) are from 915 to 2180 m (3100-7150 ft.), and sites are usually limited to warm, south to west-facing slopes in canyons. In northern Arizona, stands occur on various aspects around 2930 m (9600 ft.) elevation, and in southern Colorado stands have been documented at around 2560 m (8400 ft.). Most of the unvegetated ground surface is covered by rocks and boulders, with small amounts of litter and dead wood. Soils are poorly developed and often too rocky to sample. The rocky slope is the dominant visual element of the community. The sparse to open canopy of this association is generally mixed and rarely exceeds 35% cover. *Pseudotsuga menziesii* is always present and dominant or codominant; other tree species may include *Juniperus osteosperma*, *Juniperus scopulorum*, *Picea engelmannii*, *Pinus edulis*, *Pinus flexilis*, *Pinus strobiformis*, *Pinus ponderosa*, *Populus tremuloides*, *Abies concolor*, and *Abies lasiocarpa*. Shrubs are variable depending on the site, but cover is too sparse and the mix either lacks a diagnostic species in the understory or the shrub layer is too poorly developed to be diagnostic. Shrub species present may include *Arctostaphylos uva-ursi*, *Acer glabrum*, *Amelanchier utahensis*, *Juniperus communis*, *Dasiphora fruticosa* ssp. *floribunda*, *Holodiscus dumosus*, *Prunus virginiana*, *Ribes inerme*, *Ribes montigenum*, *Salix scouleriana*, *Shepherdia canadensis*, *Shepherdia rotundifolia*, and *Symphoricarpos oreophilus*. Herbaceous species are sparse and inconsistent among sites.

DISTRIBUTION

Capitol Reef National Park

This rare association was sampled in the fins area west of Upper Muley Twist Canyon. It also occurs in Sheets Gulch.

Globally

This association has been documented from sites scattered throughout the interior western U.S., including Montana, Utah, New Mexico, Arizona and Colorado.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on shady, north-facing active talus or rockfall slopes. The sampled site is steep (32° slope), occurs at 2030 m elevation, and occupies a northeastern aspect. The unvegetated surface has moderate cover of litter and high cover of large rocks. Exposure of bare soil is moderate. Downed wood is uncommon. Parent materials are Chinle Formation overlain by Wingate boulders and debris fallen from the cliffs above. Soils are rapidly drained loamy sands.

Globally

This association occurs throughout the interior western U.S. but is restricted to steep slopes covered by loose rock and colluvium on mountain or canyon slopes. Slopes generally exceed 60% and are generally unstable, with constantly shifting rocks on the slopes as well as additional rockfall from outcrops upslope. Elevations at the northern end of the range (Montana) are from 915 to 2180 m (3100-7150 ft.), and sites are usually limited to warm, south to west-facing slopes in canyons. In northern Arizona, stands occur on various aspects around 2930 m (9600 ft.) elevation, and in southern Colorado stands have been documented at around 2560 m (8400 ft.). Most of the unvegetated ground surface is covered by rocks and boulders, with small amounts of litter and dead wood. Soils are poorly developed and often too rocky to sample.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is rare, occurring on steep colluvial slopes in the park. The total vegetation cover ranges from 36 to 70% in this moderately to densely vegetated stand. This woodland association is characterized by emergent *Pseudotsuga menziesii* 20 to 35 m tall scattered through an open *Pinus edulis* canopy 5-10 m tall. Total tree cover ranges from 30 to 50%. The subcanopy layer is present and provides sparse cover by *Fraxinus anomala* trees. The shrub layer is low in species composition and provides sparse to low cover by the tall shrub *Amelanchier utahensis* and the short shrub *Shepherdia rotundifolia*. The herbaceous layer is low in species composition and sparse, with no individual species attaining 1% cover. Cryptogam cover is also sparse, less than 1%.

Globally

This association has the appearance of a stand of scattered trees with a sparse understory; the vegetation is limited by the lack of soil development. The rocky slope is the dominant visual element of the community. The sparse to open canopy of this association is generally mixed and rarely exceeds 35% cover. *Pseudotsuga menziesii* is always present and dominant or codominant; other tree species may include *Juniperus osteosperma*, *Juniperus scopulorum*, *Picea engelmannii*, *Pinus edulis*, *Pinus flexilis*, *Pinus strobiformis*, *Pinus ponderosa*, *Populus tremuloides*, *Abies concolor*, and *Abies lasiocarpa*. Shrubs are variable depending on the site, but cover is too sparse and the mix either lacks a diagnostic species in the understory or the shrub layer is too poorly developed to be diagnostic. Shrub species present may include *Arctostaphylos uva-ursi*, *Acer glabrum*, *Amelanchier utahensis*, *Juniperus communis*, *Dasiphora fruticosa* ssp. *floribunda*, *Holodiscus dumosus*, *Prunus virginiana*, *Ribes inerme*, *Ribes montigenum*, *Salix scouleriana*, *Shepherdia canadensis*, *Shepherdia rotundifolia*, and *Symphoricarpos oreophilus*. Herbaceous species are sparse and inconsistent among sites.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pinus edulis</i> , <i>Pseudotsuga menziesii</i>
Tall shrub/sapling	<i>Amelanchier utahensis</i>
Short shrub/sapling	<i>Shepherdia rotundifolia</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pseudotsuga menziesii</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park
Bromus tectorum

Globally
Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park
Data are not available.

Globally
This association is distinguished from other scree woodland associations by the clear dominance of *Pseudotsuga menziesii* in the canopy and a shrub layer that is too sparse and scattered to be diagnostic.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Dynamic community where steep slope and talus contributes to instability. There are episodic rock falls and water erosion events. The lower slope supports a pinyon-juniper woodland, while the wash below has Fremont cottonwood / *Phragmites australis* riparian community.

Capitol Reef National Park Data: The description is based on 1987 and 2003 field data (2 plots: CARE.0530, CARE.9655).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Bourgeron and Engelking 1994, DeVelice et al. 1986, Driscoll et al. 1984, Fitzhugh et al. 1987, MTNHP 2002b, Pfister et al. 1977, Western Ecology Working Group n.d.

***Picea pungens* / *Cornus sericea* Woodland**
Blue Spruce / Red-osier Dogwood Woodland

CODE	CEGL000388
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	<i>PICEA PUNGENS</i> TEMPORARILY FLOODED WOODLAND ALLIANCE (A.567) Blue Spruce Temporarily Flooded Woodland Alliance
ECOLOGICAL SYSTEM(S):	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825) Rocky Mountain Subalpine-Montane Riparian Woodland (CES306.833)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally
This riparian woodland association is best developed on cool, narrow floodplains in the montane zone of Colorado, New Mexico and Utah. Scattered, isolated stands also occur in canyons of the Colorado Plateau. Sites flood periodically and range from nearly flat on broader floodplains to moderately steep in the narrowest canyons. In Colorado, the association occurs between 2100 and 2600 m (7000-8500 ft.) elevation and in New Mexico between approximately 2500 and 3230 m (8200-10,600 ft.). Soils tend to be poorly developed coarse alluvium. The evergreen needle-leaved tree canopy has 10 to 80% cover, is dominated by *Picea pungens*, and shades an open to dense shrub

layer dominated by *Cornus sericea*. Other tree species may be present in the canopy, including *Populus angustifolia*, *Populus tremuloides*, *Picea engelmannii*, and *Abies lasiocarpa*. Other components of the shrub layer include *Symphoricarpos oreophilus*, *Betula occidentalis*, *Alnus incana*, *Crataegus rivularis*, *Salix monticola*, *Salix geyeriana*, *Acer glabrum*, *Amelanchier* spp., and *Prunus virginiana*. The herbaceous layer is variable in cover and composition depending on the density of the canopy and shrub layers and the frequency of flooding. Common herbaceous species include *Equisetum hyemale*, *Equisetum arvense*, *Chamerion angustifolium*, *Heracleum maximum*, and *Maianthemum stellatum*. *Picea pungens* / *Cornus sericea* Woodland (CEGL000388) was once a more common type and represents slightly more stable habitats than those of *Picea pungens* / *Alnus incana* Woodland (CEGL000894).

DISTRIBUTION

Capitol Reef National Park

This rare association was sampled in Upper Deep Creek in the northwestern corner of the park.

Globally

This association has been documented from New Mexico, Utah, central and western Colorado. It is likely to occur in northern Arizona.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed in narrow, dark canyon bottoms. The site is gentle (3° slope), occurs at 2622 m elevation, and is oriented to the southeastern aspect. The unvegetated surface is unrecorded. The parent material is Navajo sandstone. Soils are coarse in texture.

Globally

This riparian woodland association is best developed on cool, narrow floodplains in the montane zone of Colorado, New Mexico and Utah. Scattered, isolated stands also occur in canyons of the Colorado Plateau. It is likely to occur in northern Arizona. Sites flood periodically and range from nearly flat on broader floodplains to moderately steep in the narrowest canyons. In Colorado, the association is restricted to the montane zone, between 2100 and 2600 m (7000-8500 ft.) (Carsey et al. 2003a). In New Mexico, this association occurs between approximately 2500 and 3230 m (8200-10,600 ft.) (Dick-Peddie 1993). Soils tend to be poorly developed coarse alluvium.

VEGETATION DESCRIPTION

Capitol Reef National Park

This rare association occurs in a slot canyon in Upper Deep Creek. The vegetation is characterized by an open canopy of *Picea pungens* and *Cornus sericea*. The associated canopy tree layer is low in species diversity and sparse to low in cover. The remaining shrub layer is sparse in terms of cover and is low in species diversity. The herbaceous layer is low in diversity but provides dense cover. *Equisetum hyemale* provides most of the herbaceous cover.

Globally

The evergreen needle-leaved tree canopy has 10 to 80% cover, is dominated by *Picea pungens*, and shades the open to dense shrub layer dominated by *Cornus sericea*. Other tree species may be present in the canopy, including *Populus angustifolia*, *Populus tremuloides*, *Picea engelmannii*, and *Abies lasiocarpa*. *Cornus sericea* is not tolerant of deep shade (Crane 2005); its presence in closed-canopy stands is usually limited to the margins and to openings. In more open stands, the red-osier dogwood understory may be quite dense. Other components of the shrub layer include *Symphoricarpos oreophilus*, *Betula occidentalis*, *Alnus incana*, *Crataegus rivularis*, *Salix monticola*, *Salix geyeriana*, *Acer glabrum*, *Amelanchier* spp., and *Prunus virginiana*. The herbaceous layer is variable in cover and composition depending on the density of the canopy and shrub layers and the frequency of flooding. Common herbaceous species include *Equisetum hyemale*, *Equisetum arvense*, *Chamerion angustifolium*, *Heracleum maximum*, and *Maianthemum stellatum*. *Picea pungens* / *Cornus sericea* Woodland (CEGL000388) was once a more common type and represents slightly more stable habitats than those of *Picea pungens* / *Alnus incana* Woodland (CEGL000894).

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Picea pungens</i>

Tall shrub/sapling *Cornus sericea*
Herb (field) *Equisetum hyemale*

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Picea pungens</i>
Short shrub/sapling	<i>Cornus sericea</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G4 (1-Feb-1996).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Most of the available information for this association comes from Colorado stands.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Data are not available.

Capitol Reef National Park Data: The description is based on 1986 field data (1 plot: CARE.9442).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Alexander et al. 1987, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Carsey et al. 2003a, Crane 1989, DeVelice and Ludwig 1983a, DeVelice et al. 1986, Dick-Peddie 1993, Driscoll et al. 1984, Fitzhugh et al. 1987, Hess and Wasser 1982, Johnston 1984, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1999a, Komarkova et al. 1988a, Larson and Moir 1987, Moir and Ludwig 1979, Richard et al. 1996.

***Pseudotsuga menziesii* / *Betula occidentalis* Woodland
Douglas-fir / Water Birch Woodland**

CODE	CEGL002639
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	<i>PSEUDOTSUGA MENZIESII</i> TEMPORARILY FLOODED WOODLAND ALL. (A.568) Douglas-fir Temporarily Flooded Woodland Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Mesic Montane Mixed
Conifer Forest and Woodland (CES306.825)
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland
(CES306.821)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This woodland association occurs in cool, narrow foothill canyons of the Colorado Front Range between 2015 and 2500 m (6600-8080 ft.) elevation in the upper Arkansas and South Platte river basins and in Rio Grande National Forest. It has also been documented from box canyons in southeastern Utah at 1883 m (6175 ft.) and may occur in Nevada. Vegetation is limited to a narrow band along small, steep perennial streams in fairly shallow (165-343 cm [65-135 inches]), loamy alluvial soils, often with a high cover of surface rock. *Pseudotsuga menziesii* (15-50% cover) trees to 35 m tall and *Betula occidentalis* (20-40% cover) are key indicators even if other tree and shrub species are present. Other tree species may include *Acer negundo*, *Salix amygdaloides*, *Populus angustifolia*, *Populus tremuloides*, *Juniperus scopulorum*, *Pinus ponderosa*, *Abies concolor*, *Abies lasiocarpa*, or *Picea pungens*. The shrub canopy may be thick and diverse and include *Alnus incana*, *Acer glabrum*, *Ericameria nauseosa*, *Quercus gambelii*, *Rhus trilobata*, *Salix bebbiana*, *Salix ligulifolia*, *Salix monticola*, *Salix irrorata*, *Rosa woodsii*, *Jamesia americana*, and *Cornus sericea*. The herbaceous layer is generally sparse due to heavy shade; more abundant species include *Maianthemum stellatum*, *Eurybia glauca*, *Equisetum arvense*, *Equisetum hyemale*, *Carex disperma*, and *Melilotus officinalis*.

DISTRIBUTION

Capitol Reef National Park

This association is rare in the park. It was sampled just outside the park boundary in Sheets Gulch.

Globally

Documented locations occur across the eastern half of the Colorado Rocky Mountains ecoregion in Colorado and in sheltered canyons of the Colorado Plateau in southeastern Utah. It may also occur in Nevada.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed in the upper reaches of a box canyon. The sampled site is gentle (4° slope), occurs at 1883 m elevation, and is oriented to a northeastern aspect. The unvegetated surface has high cover of litter and a moderate cover of large rocks. There is a moderate cover a live vegetation basal area. Downed wood is uncommon. Parent materials are Wingate sandstone that erodes and deposits as alluvium. Soils are moderately well-drained loamy sands. The sampled site had a small stream running through it.

Globally

This woodland association occurs in cool, narrow foothill canyons of the Colorado Front Range between 2015 and 2500 m (6600-8080 ft.) elevation in the upper Arkansas and South Platte river basins and in Rio Grande National Forest. It has also been documented from box canyons in southeast Utah at 1883 m (6175 ft.) and may occur in Nevada. Vegetation is limited to a narrow band along small, steep perennial streams in fairly shallow (165-343 cm [65-135 inches]), loamy alluvial soils, often with a high cover of surface rock.

Sites with this association were sampled only in the Blue Mountains Ecoregion but this association may also occur in the Columbia Basin Ecoregion and northern part of the East Cascades Ecoregion of Oregon (Crowe et al. 2004). Valleys are north- and east-facing, moderately steep, narrow to wide and V-, trough- and flat-shaped with moderately steep to steep side slopes. Most valley aspects are east- and southeast-facing. Rosgen (1996) stream types are C2 and C3. Soils are skeletal in subsoil horizons. Data are available for only two sites and show the average depth to 20-30% coarse fragments is 11 cm and to 23-35% coarse fragments is 38 cm.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is rare in the park and was sampled just outside the park boundary. The total vegetation cover ranges from 102 to 190% in this densely vegetated stand. This woodland association is characterized by an open canopy, typically 20-35 m tall, of *Pseudotsuga menziesii* trees that range in cover from 15 to 25% and the tall shrub *Betula occidentalis* that ranges in cover from 25 to 35%. The subcanopy layer provides moderate cover by *Acer negundo* and *Salix amygdaloides* trees that are 2-10 m tall. The shrub layer is moderately diverse in terms of species composition and provides low to moderate cover. Other tall shrubs provide moderate cover and include *Ericameria nauseosa*, *Quercus gambelii*, *Rhus aromatica*, and *Salix exigua*. The herbaceous layer is low in species diversity and provides sparse to low cover. Forbs commonly present include *Eurybia glauca* and *Equisetum hyemale*.

Globally

Pseudotsuga menziesii (15-50% cover) trees to 35 m tall and *Betula occidentalis* (20-40% cover) are key indicators even if other tree and shrub species are present. Other tree species may include *Acer negundo*, *Salix amygdaloides*, *Populus angustifolia*, *Populus tremuloides*, *Juniperus scopulorum*, *Pinus ponderosa*, *Abies concolor*, *Abies lasiocarpa*, or *Picea pungens*. The shrub canopy may be thick and diverse and include *Alnus incana*, *Acer glabrum*, *Ericameria nauseosa*, *Quercus gambelii*, *Rhus trilobata*, *Salix bebbiana*, *Salix ligulifolia*, *Salix monticola*, *Salix irrorata*, *Rosa woodsii*, *Jamesia americana*, and *Cornus sericea*. The herbaceous layer is generally sparse due to heavy shade; more abundant species include *Maianthemum stellatum*, *Eurybia glauca*, *Equisetum arvense*, *Equisetum hyemale*, *Carex disperma*, and *Melilotus officinalis*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pseudotsuga menziesii</i>
Tree canopy	<i>Acer negundo</i>
Tree subcanopy	<i>Salix amygdaloides</i>
Tall shrub/sapling	<i>Betula occidentalis</i> , <i>Ericameria nauseosa</i> , <i>Quercus gambelii</i> , <i>Rhus aromatica</i> , <i>Salix exigua</i>
Herb (field)	<i>Eurybia glauca</i>
Herb (field)	<i>Equisetum hyemale</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pseudotsuga menziesii</i>
Tree canopy	<i>Populus angustifolia</i>
Tree subcanopy	<i>Salix amygdaloides</i>
Tall shrub/sapling	<i>Betula occidentalis</i> , <i>Cornus sericea</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Tamarix chinensis

Globally

Tamarix chinensis

CONSERVATION STATUS RANK

Global Rank & Reasons: G3? (3-Nov-2005). This woodland association is documented from 7 plots on the eastern slope of the Colorado Rockies with less than 20 occurrences expected. One site has been documented in Utah and it may occur in Nevada. It appears to be limited to perennial streams where cold-air drainage and perennial water provide a cool, moist environment. Severe flooding must be infrequent enough to allow *Pseudotsuga menziesii* to achieve dominance. This plant association is highly threatened by development, road maintenance and improvements, and heavy recreational use. The question mark in the rank indicates that the community is suspected to be more abundant, but additional locations have not been documented.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Classification is based on 8 quantitative plots from Colorado and Utah. Closely related communities occur in the Snake Range of Nevada.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Plot is outside park boundary on a flowing stream. There is cottonwood just downstream from the plot, and Douglas-fir grow sporadically all along the riparian corridor. There is evidence of occasional flash flooding.

Capitol Reef National Park Data: The description is based on 2004 field data (1 plot: CARE.0659).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: CONHP unpubl. data 2003, Carsey et al. 2003a, Crowe et al. 2004, Kittel et al. 1996, Kittel et al. 1997a, Kittel et al. 1999a, Kittel et al. 1999b, Manning and Padgett 1995, NVNHP 2003,

***Cercocarpus ledifolius* / *Artemisia tridentata* ssp. *vaseyana* Woodland
Curl-leaf Mountain-mahogany / Mountain Big Sagebrush Woodland**

CODE	CEGL001022
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	<i>CERCOCARPUS LEDIFOLIUS</i> WOODLAND ALLIANCE (A.586) 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 association is documented in southeastern Oregon and southern Utah and possibly occurs in the Owyhee Uplands of Idaho, in scattered mountain ranges in the northern Great Basin region of Nevada and California, and the Colorado Plateau of western Colorado. Sites are well-drained loams or loamy sands over basalt, sandstone or rhyolite. Elevations range from 1600-1950 m (5250-6400 ft.) in Oregon and around 2750 m (9025 ft.) in Utah and Colorado. Aspects are variable, with slopes ranging from 0-60%. The vegetation is variable in its appearance. The canopy may be open to moderately closed, with a sparse to dense shrub understory. The canopy typically is dominated by *Cercocarpus ledifolius* var. *ledifolius*, which averages 50% cover but may have as much as 80% cover or as little as 20%. Common shrubs include *Artemisia tridentata* ssp. *vaseyana*, *Amelanchier alnifolia*, *Cercocarpus montanus*, *Paxistima myrsinoides*, *Ericameria nauseosa*, *Symphoricarpos oreophilus*, and *Chrysothamnus viscidiflorus*. *Elymus elymoides* and *Achnatherum lemmonii* are the most common grasses, but *Festuca idahoensis*, *Poa fendleriana*, *Pseudoroegneria spicata*, and *Poa secunda* may also be present. Stands may have emergent trees of *Pseudotsuga menziesii* that range in height from 15-20 m tall and provide less than 5% cover.

DISTRIBUTION

Capitol Reef National Park

This rare association was sampled 200 m below and east of Billings Pass in the northwestern corner of the park.

Globally

This association is possibly widely distributed in the northern Great Basin, Colorado Plateau and the Owyhee Uplands, although currently it is documented only in Oregon, Colorado and southern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on the high slopes of ridges. The sampled site is moderately steep (19° slope), occurs at 2744 m elevation, and is oriented to an eastern aspect. The unvegetated surface has high cover of litter and sparse cover of rocks and gravel. Downed wood is common. Parent materials are sandstones and shale of the Carmel Formation. Soils are well-drained loamy sands.

Globally

This association is documented in southeastern Oregon and southern Utah and possibly occurs in the Owyhee Uplands of Idaho, in scattered mountain ranges in the northern Great Basin region of Nevada and California, and the Colorado Plateau of western Colorado. Sites are well-drained loams or loamy sands over basalt, sandstone or rhyolite. Elevations range from 1600-1950 m (5250-6400 ft.) in Oregon and around 2750 m (9025 ft.) in Utah and

Colorado. Aspects are variable with slopes ranging from 0-60%.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is rare in the park, occurring in the northwestern corner. The total vegetation cover ranges from 52 to 80% in this moderately to densely vegetated stand. This woodland association is characterized by a closed canopy, typically 5-10 m tall, of *Cercocarpus ledifolius* trees that range in cover from 45 to 55% and *Artemisia tridentata* short shrubs that range in cover from 5 to 15%. The stand has emergent trees of *Pseudotsuga menziesii* that range in height from 15-20 m tall and provide less than 5% cover. The associated understory shrubs are sparse in terms of diversity and cover, with *Symphoricarpos oreophilus* present in the dwarf-shrub layer. Herbaceous species are mostly forbs that are low in diversity and provide sparse cover.

Globally

This association is variable in its appearance. The canopy may be open to moderately closed, with a sparse to dense shrub understory. The canopy typically is dominated by *Cercocarpus ledifolius* var. *ledifolius*, which averages 50% cover but may have as much as 80% cover or as little as 20%. Common shrubs include *Artemisia tridentata* ssp. *vaseyana* or (less commonly) *Artemisia tridentata* ssp. *wyomingensis*, *Amelanchier alnifolia*, *Cercocarpus montanus*, *Paxistima myrsinites*, *Ericameria nauseosa*, *Symphoricarpos oreophilus*, and *Chrysothamnus viscidiflorus*. *Elymus elymoides* and *Achnatherum lemmonii* are the most common grasses, but *Festuca idahoensis*, *Poa fendleriana*, *Pseudoroegneria spicata*, and *Poa secunda* may also be present. Stands may have emergent trees of *Pseudotsuga menziesii* that range in height from 15-20 m tall and provide less than 5% cover.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pseudotsuga menziesii</i>
Tree canopy	<i>Cercocarpus ledifolius</i>
Short shrub/sapling	<i>Symphoricarpos oreophilus</i>
Short shrub/sapling	<i>Artemisia tridentata</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Cercocarpus ledifolius</i>
Short shrub/sapling	<i>Artemisia tridentata</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Descurainia pinnata, *Marrubium vulgare*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G3 (15-Nov-1999). Although this type may be regionally widespread, its occurrences are small and fragmented. Overgrazing and fire suppression have changed the nature of most stands, and even the "protected" sites are grazed by cattle. Cattle and heavy wildlife (elk) grazing have degraded most sites, leading to very high *Artemisia tridentata* ssp. *vaseyana* cover and lower cover of *Cercocarpus ledifolius* and bunch grasses. While the *Cercocarpus* has spread out from its naturally protected habitats, stands have smaller plants and different associated species.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Dealy (1975) divided this type into several subtypes, which were lumped in the regional classification: *Cercocarpus ledifolius* / *Artemisia tridentata* / *Festuca idahoensis*, *Cercocarpus ledifolius* / *Artemisia tridentata* / *Pseudoroegneria spicata*, and *Cercocarpus ledifolius* / *Artemisia tridentata* / *Poa ampla*.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Fire scars on some downed logs; site is exposed to wind that has toppled conifer snags. There is elk and cattle grazing in the area. Extensive "old-growth" *Cercocarpus ledifolius* with some regeneration; however, the older *Cercocarpus ledifolius* are trees, not shrub-like. The understory is often sparse because little light shines through the dense canopy.

Capitol Reef National Park Data: The description is based on 2003 field data (1 plot: CARE.0582).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: M.P. Murray, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, Dealy 1975, Dealy et al. 1981, Driscoll et al. 1984, Kagan et al. 2000, NVNHP 2003, Western Ecology Working Group n.d.

***Celtis laevigata* var. *reticulata* Slickrock Canyon Woodland [Provisional]
Netleaf Hackberry Slickrock Canyon Woodland**

CODE	CEGL002359
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	Cold-deciduous woodland (II.B.2.N.a.)
ALLIANCE	<i>CELTIS LAEVIGATA</i> VAR. <i>RETICULATA</i> WOODLAND ALLIANCE (A.632) Netleaf Hackberry Woodland Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This slickrock canyon community is currently only known from Capitol Reef National Park where it is rare. Stands occurred in side drainages that drain into larger canyons between 1250 and 2409 m elevation, and are oriented to all aspects. Soils are rapidly drained sands and sandy loams derived from Navajo sandstone. The vegetation is characterized by open to moderately dense canopy of *Celtis laevigata* var. *reticulata* trees that are typically 2 to 5-m tall. Other trees such as *Fraxinus anomala*, *Juniperus osteosperma*, *Pinus edulis*, *Acer negundo*, and *Populus tremuloides* are occasionally present. Open to moderately dense shrub layers may be present and include tall shrubs, *Amelanchier utahensis*, *Fraxinus anomala*, *Mahonia fremontii*, and *Quercus gambelii*, and short shrubs *Ephedra viridis*, *Ericameria nauseosa*, *Opuntia polyacantha*, and *Rhus trilobata*. The herbaceous layer is diverse in terms of species composition and provides low to moderate cover of grasses and forbs.

DISTRIBUTION

Capitol Reef National Park

This rare association was sampled in main and tributary drainages of Halls Creek, Brimhall Canyon, and in Upper Deep Creek. The Upper Deep Creek stand is probably misidentified, since netleaf hackberry does not occur at higher elevations. Netleaf hackberry is known from the canyons of Halls Creek, Cottonwood Tanks, and Grand Wash.

Globally

Data are not available.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

The netleaf hackberry slickrock canyon community was observed in slickrock and associated drainage channels within the park. Sites are gentle to steep (1 to 30° slopes), occur between 1250 and 2409 m elevation, and are oriented to all aspects. The unvegetated surface has low to high exposure of bedrock, sand, and bare soil. The cover by litter is sparse to low, and live vegetation basal area can be low to moderate in cover. Parent materials are Navajo sandstone. Soils are rapidly drained sands and sandy loams.

Globally

Data are not available.

VEGETATION DESCRIPTION

Capitol Reef National Park

This slickrock canyon community is rare within the park, occupying bedrock exposures and drainage channels in slickrock habitat. The total vegetation cover ranges from 3 to 110%. This woodland community is characterized by typically 2 to 5-m tall *Celtis laevigata* var. *reticulata* trees that range in cover from 0 to 5%. The canopy tree layer is moderately diverse, provides sparse to moderate cover, and includes *Fraxinus anomala*, *Juniperus osteosperma*, *Pinus edulis*, *Acer negundo*, and *Populus tremuloides*, among several other tree species occasionally present. The shrub layer has moderate to high species diversity and provides low to moderate cover. Tall shrubs commonly to occasionally present include *Amelanchier utahensis*, *Fraxinus anomala*, *Mahonia fremontii*, and *Quercus gambelii*. Common short and dwarf-shrubs include *Ephedra viridis*, *Ericameria nauseosa*, *Opuntia polyacantha*, and *Rhus trilobata*. The herbaceous layer is diverse in terms of species composition and provides low to moderate cover. Graminoids commonly present in the community include *Achnatherum hymenoides*, *Bromus tectorum*, *Poa fendleriana*, and *Vulpia octoflora*. Forbs often present include *Artemisia ludoviciana*, *Castilleja linariifolia*, *Heterotheca villosa*, and *Lepidium montanum*. The vine *Clematis ligusticifolia* is often present and typically provides sparse cover.

Globally

Data are not available.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Juniperus scopulorum</i> , <i>Pinus ponderosa</i>
Tree canopy	<i>Celtis laevigata</i> var. <i>reticulata</i> , <i>Fraxinus anomala</i> , <i>Populus tremuloides</i>
Tall shrub/sapling	<i>Acer glabrum</i> , <i>Amelanchier utahensis</i> , <i>Cornus sericea</i> , <i>Frangula betulifolia</i> , <i>Fraxinus anomala</i> , <i>Quercus gambelii</i> , <i>Salix gooddingii</i>
Tall shrub/sapling	<i>Mahonia fremontii</i>
Short shrub/sapling	<i>Juniperus communis</i>
Short shrub/sapling	<i>Ericameria nauseosa</i> , <i>Rhus trilobata</i> , <i>Rosa woodsii</i> , <i>Vancleavea stylosa</i>
Short shrub/sapling	<i>Ephedra viridis</i> , <i>Purshia mexicana</i> , <i>Purshia tridentata</i>
Herb (field)	<i>Clematis ligusticifolia</i>
Herb (field)	<i>Artemisia ludoviciana</i> , <i>Lepidium montanum</i> , <i>Lomatium parryi</i> , <i>Marrubium vulgare</i> , <i>Mirabilis multiflora</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Bromus tectorum</i> , <i>Hesperostipa comata</i>

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Descurainia pinnata*, *Marrubium vulgare*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (29-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE:

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Plot is located in a wash within bedrock exposure, the vegetation is on the bedrock, and the wash is subject to flash flooding. The plot in Upper Deep Creek has riparian vegetation, but no hackberry grows on the site since this species does not occur at that high elevation. Stands in the southern portion of the park may have experienced heavy grazing prior to 1988.

Capitol Reef National Park Data: The description is based on 1986 and 2003 field data (5 plots: CARE.0508, CARE.0562, CARE.9093, CARE.9328, CARE.9357).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: K.A. Schulz

REFERENCES: Western Ecology Working Group n.d.

***Acer negundo* - *Ostrya knowltonii* Woodland [Provisional]
Box-elder - Knowlton's Hop-hornbeam Woodland**

CODE	CEGL002342
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	<i>ACER NEGUNDO</i> TEMPORARILY FLOODED WOODLAND ALLIANCE (A.642) Box-elder Temporarily Flooded Woodland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This riparian woodland association is only known from Capitol Reef National Park. This summary is derived from a plot sampled there in 1988. It was sampled on a sandy bench adjacent to a perennial stream. The site slopes gently (3°) to the northeast at 1220 m elevation. The soil is derived from alluvium. Total vegetation cover is in excess of 100% in this multi-layered stand. The vegetation is characterized by a relatively closed canopy of *Acer negundo* and *Ostrya knowltonii* trees that each range in cover from 51 to 75%. The associated tree canopy provides moderate cover and includes *Celtis laevigata*. The tall-shrub layer is low in terms of species composition, provides moderate to high cover, and includes *Frangula betulifolia* and *Quercus gambelii*. Short and dwarf-shrubs are low in terms of species composition, provide sparse cover, and include *Brickellia longifolia* and *Mahonia fremontii*. The herbaceous layer is low in terms of species diversity and provides sparse to moderate cover. Graminoids include *Elymus canadensis* and *Poa fendleriana*. Forbs include the fern-ally *Equisetum hyemale*.

DISTRIBUTION

Capitol Reef National Park

This rare association was sampled in Halls Narrows along Halls Creek. It is probably restricted to this area, as Knowlton's hophornbeam is known only from Halls Narrows and side canyons of Halls Creek below the Narrows.

Globally

This association is known only from Capitol Reef National Park. It is likely to occur in Canyonlands National Park and Glen Canyon National Recreation Area as well. It is possible that it occurs in association with perennial streams in northern Arizona and New Mexico

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on sandy benches along creeks. The site is gentle (3° slope), occurs at 1220 m elevation, and is oriented to the northeast. The unvegetated surface is unrecorded. Parent materials are variable and include sandstones and shale that have eroded and deposited as alluvium. Soils are typically well-drained on sandy

terraces.

Globally

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

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is rare within the park. The vegetation is characterized by a relatively closed canopy of *Acer negundo* and *Ostrya knowltonii* trees. The associated tree canopy provides moderate cover and includes *Celtis laevigata*. The tall-shrub layer is low in terms of species composition, provides moderate to high cover, and includes *Frangula betulifolia* and *Quercus gambelii*. Short and dwarf-shrubs are low in terms of species composition, provide sparse cover, and include *Brickellia longifolia* and *Mahonia fremontii*. The herbaceous layer is low in terms of species diversity and provides sparse to moderate cover. Graminoids include *Elymus canadensis* and *Poa fendleriana*. Forbs include the fern-ally *Equisetum hyemale*.

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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Acer negundo</i> , <i>Celtis laevigata</i> , <i>Ostrya knowltonii</i>
Tall shrub/sapling	<i>Frangula betulifolia</i> , <i>Quercus gambelii</i>
Herb (field)	<i>Poa fendleriana</i>
Herb (field)	<i>Equisetum hyemale</i>

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Lactuca serriola*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (16-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef 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

Capitol Reef National Park Inventory Notes: Data are not available.

Capitol Reef National Park Data: The description is based on 1988 field data (1 plot: CARE.9440).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Acer negundo* / *Quercus gambelii* Woodland
Box-elder / Gambel Oak Woodland**

CODE	CEGL002797
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	<i>ACER NEGUNDO</i> TEMPORARILY FLOODED WOODLAND ALLIANCE (A.642) Box-elder Temporarily Flooded Woodland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This woodland association is only known from along the Gunnison River in Curecanti National Recreation Area. Stands occur in riparian sites with natural or human disturbance, including constructed roadway fill slopes and rockfall or talus from adjacent cliffs. Sites are steep (75% slopes), occur between 2032 and 2073 m elevation, and are oriented to northeastern and southern aspects. The unvegetated surface has high cover of bedrock, large and small rocks, and low to moderate cover of litter. Soil was not present in the rock fill and rockfall substrate in the sampled stands. The vegetation is characterized by an open to moderately dense tree canopy of *Acer negundo* and *Quercus gambelii*. Occasional emergent *Pseudotsuga menziesii* trees or subcanopy *Juniperus scopulorum* may be present. The understory is typically sparse and variable in species composition. Tall, short, and dwarf-shrubs contribute low cover and include *Cornus sericea*, *Fendlerella utahensis*, *Holodiscus dumosus*, *Mahonia repens*, *Rhus trilobata*, *Ribes cereum*, *Ribes inerme*, and *Prunus virginiana*. The herbaceous layer is sparse and has low in species diversity. Species include *Piptatherum micranthum*, *Arabis* sp., *Brickellia grandiflora*, and *Artemisia michauxiana*.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon in the park and is represented by stands in slot canyons in the Waterpocket Fold.

Globally

This association has only been sampled from one location in Curecanti National Recreation Area in western Colorado.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association occurs on the floors of slot canyons cross-cutting the Waterpocket Fold. Sites slope gently and lie at 1890 m elevation. The unvegetated surface has high cover of sand or bare soil and gravel, with lesser cover by litter and bedrock. Soils are alluvial and derived primarily from surrounding Kayenta sandstone.

Globally

Data are not available.

VEGETATION DESCRIPTION

Capitol Reef National Park

This riparian woodland association is rare in the park, occurring in narrow belts and small patches in slot canyons. Total vegetation cover ranges from 45 to 75%. *Acer negundo* trees 10-20 m tall contribute between 35 and 45% cover; *Quercus gambelii* provides a subcanopy to 10 m high with between 5 and 15% cover. Because of the dense canopy and probably also because of periodic scouring by floods, the understory is poorly developed; *Symphoricarpos oreophilus* is the only species with significant cover. Herbaceous species were not recorded.

Globally

Data are not available.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Acer negundo</i>
Tall shrub/sapling	<i>Quercus gambelii</i>
Herb (field)	<i>Symphoricarpos oreophilus</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Acer negundo</i> , <i>Quercus gambelii</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (21-Jun-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This association has only been sampled from one location in Curecanti National Recreation Area in western Colorado. More survey and classification work are needed to change the provisional status of this association.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Plots are in narrow, sheltered slot canyons walled in by cliffs to 60 m (200 ft.) high.

Capitol Reef National Park Data: The description is based on field data collected in 2005 during accuracy assessment (2 plots: CARE_AA.1493, CARE_AA.1809).

Local Description Authors: J. Coles

Global Description Authors: K.A. Schulz

REFERENCES: Western Ecology Working Group n.d.

***Acer negundo* / *Rhus trilobata* Woodland Box-elder / Skunkbush Woodland**

CODE	CEGL002750
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	<i>ACER NEGUNDO</i> TEMPORARILY FLOODED WOODLAND ALLIANCE (A.642) Box-elder Temporarily Flooded Woodland Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This slickrock canyon community is currently known from a few scattered locations in Capitol Reef National Park in

the Waterpocket Fold and in Dinosaur National Monument. From the few stands found it typically is found in alcoves or on concave, sheltered (north-facing) slopes at the heads of canyons, where sub-surface seepage from the adjacent canyon walls provides moisture. Slopes are often steep and are comprised of colluvium or patches of bedrock. Elevations were documented as 1875 m elevation in Capitol Reef and below 1800 m in Dinosaur. Large boulders and rocks, or some bedrock patches, cover most of the unvegetated surface, but in some stands leaf litter can be abundant. The soils are coarse-textured and derived from underlying Chinle shale, Wingate sandstone colluvium, or from the Round Valley formation. The vegetation is limited by the rock cover and is characterized by an open tree canopy of *Acer negundo* tall with 15-20% cover. The open shrub layer (10-20% cover) is dominated by *Rhus trilobata*, and *Fraxinus anomala* is co-dominant in some stands; *Ephedra viridis*, *Amelanchier utahensis*, and *Mahonia repens* present with minimal cover. Species codominating the herbaceous layer can include *Clematis ligusticifolia*, *Solidago canadensis*, *Lactuca serriola*, and *Equisetum laevigatum*, totaling more than 20% cover. Some graminoid species with low cover include *Pascopyrum smithii*, *Piptatherum micranthum*, and *Poa pratensis*.

DISTRIBUTION

Capitol Reef National Park

This rare association is known from a single plot sampled in the head of a nameless canyon in the Waterpocket Fold.

Globally

This association is known from a few scattered locations in Capitol Reef NP in Utah and Dinosaur NM in Colorado. It may occur more widely.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This association was reported once tucked into an alcove at the head of a tributary canyon. The sampled site is on a steep colluvial slope at 1875 m elevation. Large colluvial boulders cover most of the unvegetated surface, with minor cover by bare soil and litter. The soil is coarse-textured and derived from underlying Chinle shale and Wingate sandstone colluvium.

Globally

This type is poorly known; from the few documented stands it typically is found in alcoves, at the heads of small canyons, or on concave, sheltered (north-facing) slopes. Sub-surface seepage from the adjacent canyon walls provides moisture. Slopes are often steep and are comprised of colluvium or patches of bedrock. Elevations were documented as 1875 m elevation in Capitol Reef and below 1800 m in Dinosaur. Large boulders and rocks, or some bedrock patches, cover most of the unvegetated surface, but in some stands leaf litter can be abundant. The soils are coarse-textured and derived from underlying Chinle shale, Wingate sandstone colluvium, or from the Round Valley formation.

VEGETATION DESCRIPTION

Capitol Reef National Park

The vegetation is as dense in this association as the rock covering most of the ground will allow. Total vegetation cover is approximately 35%. *Acer negundo* forms a canopy layer between 5 and 10 m high with 15% cover. *Rhus trilobata* and *Fraxinus anomala* dominate the somewhat open shrub layer with a total of 14% cover. Other shrubs include *Ephedra viridis*, *Amelanchier utahensis*, and *Mahonia repens* with minimal cover. No herbaceous species were reported from the sample plot.

Globally

This is a woodland association comprised of a mix of deciduous trees and shrubs. The vegetation is limited by the rock cover and is characterized by an open tree canopy of *Acer negundo* between 5 and 10 m tall with 15-20% cover. The open shrub layer (10-20% cover) is dominated by *Rhus trilobata*, and *Fraxinus anomala* is co-dominant in some stands; *Ephedra viridis*, *Salix exigua*, *Amelanchier utahensis*, and *Mahonia repens* are often present with minimal cover. Species codominating the herbaceous layer can include *Clematis ligusticifolia*, *Solidago canadensis*, *Lactuca serriola*, and *Equisetum laevigatum*, totaling more than 20% cover. Some graminoid species with low cover include *Pascopyrum smithii*, *Piptatherum micranthum*, and *Poa pratensis*. If rock cover is high, then herbaceous species may not be present at all.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Acer negundo</i>
Tall shrub/sapling	<i>Fraxinus anomala, Rhus trilobata</i>

Globally

Tree canopy	<i>Acer negundo</i>
Tall shrub/sapling	<i>Fraxinus anomala, Rhus trilobata</i>
Short shrub	<i>Amelanchier utahensis</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (11-Apr-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 3- Weak

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: The polygon is at the head of a narrow, steep-walled canyon just below a 60 to 80-m high Wingate cliff. The plot is on a steep, colluvial slope. Colluvial boulders are car to truck-sized. The vegetation is growing mostly on the sides of the canyon, both north- and south-facing.

Capitol Reef National Park Data: The description is based on field data collected in 2005 during accuracy assessment (1 plot: CARE_AA.1802).

Local Description Authors: J. Coles

Global Description Authors: M.S. Reid

REFERENCES: Western Ecology Working Group n.d.

***Fraxinus anomala* Woodland**
Singleleaf Ash Woodland

CODE	CEGL002752
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	<i>FRAXINUS ANOMALA</i> TEMPORARILY FLOODED WOODLAND ALLIANCE (A.2511) Singleleaf Ash Temporarily Flooded Woodland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)
Rocky Mountain Subalpine-Montane Riparian Shrubland (CES306.832)
Inter-Mountain Basins Wash (CES304.781)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This locally occurring association is found in deep canyons and mountains on the Colorado Plateau in Utah and western Colorado between 1430 and 2043 m (4700-6700 ft.) elevation. This vegetation is restricted to mesic sites, such as near seeps, springs and ephemeral stream channels, or on lower colluvial slopes where additional soil moisture is available. In rare cases, it occurs on upland sites where fractured bedrock concentrates runoff to create small areas of mesic conditions. Substrates are nearly always derived from colluvium but are often redistributed into alluvial deposits. Soils have large amounts of gravel and cobble. Parent material is typically sandstone. The vegetation is characterized by a moderately dense (30-50%) cold-deciduous tall-shrub (2-5 m) canopy dominated by *Fraxinus anomala* with *Amelanchier alnifolia* and *Quercus gambelii* frequent associates. There may be a sparse short-shrub stratum composed of species such as *Ephedra viridis*, *Ericameria nauseosa*, *Holodiscus dumosus*, *Rhus trilobata*, *Symphoricarpos rotundifolius*, and the vine *Vitis arizonica*. Herbaceous species are variable and contribute minimal cover.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon and was sampled in side drainages of Halls Creek, west of Fruita, in CoHab Canyon, Spring Canyon, Brimhall Canyon and at Cottonwood Tanks.

Globally

This woodland association occurs in canyons and mountains on the Colorado Plateau in southwestern Utah and western Colorado, and may occur in similar habitats in Arizona and New Mexico.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This tall-shrub association was observed on talus slopes and along drainages. Sites are gentle (1 to 4° slopes), occur between 1555 and 2043 m elevation, and are oriented to all aspects. The unvegetated surface is unrecorded. One stand has high cover of cryptogams. Parent materials are variable and include sandstones and shale that have eroded to form colluvial slopes and have been transported to form alluvial deposits. Soils are rapidly drained and fine-textured.

Globally

This woodland association is found in deep canyons and mountains on the Colorado Plateau in southwestern Utah and western Colorado. Elevation ranges from 1430 to 2043 m (4700-6700 ft.). Climate is semi-arid; however, this vegetation is restricted to mesic sites, such as near seeps, springs and ephemeral stream channels, on fractured bedrock or on lower colluvial slopes where additional soil moisture is available. Sites are flat to gently sloping and may have any aspect. Substrates are nearly always derived from colluvium but often have been transported or redistributed by water to form alluvial deposits. Soils have large amounts of gravel and cobble and are well-drained to rapidly drained. Parent material is typically sandstone but can be shale, colluvium or other materials.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is uncommon in the park. The vegetation is characterized by open stands of *Fraxinus anomala* shrubs. The remaining tall-shrub layer is low in species diversity, provides sparse to moderate cover, and includes *Amelanchier utahensis*, *Mahonia fremontii*, *Fallugia paradoxa*, *Purshia stansburiana*, *Shepherdia rotundifolia*, *Rhus trilobata*, and *Quercus gambelii*. A canopy tree layer is rarely present and can include sparse cover of *Juniperus osteosperma*, *Pinus edulis*, and *Pseudotsuga menziesii*. The short- and dwarf-shrub layer is moderately diverse in terms of species composition, provides sparse to low cover, and includes *Ephedra viridis*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, and *Gutierrezia sarothrae*. The herbaceous layer is moderately diverse in terms of species composition and provides sparse to low cover. Common graminoids include *Achnatherum hymenoides*, *Bromus tectorum*, *Elymus elymoides*, and *Poa fendleriana*. Forbs occasionally present include *Artemisia ludoviciana*, *Heterotheca villosa*, *Hymenopappus filifolius*, and *Streptanthella longirostris*. The vine *Clematis ligusticifolia* is rarely present.

Globally

This association is characterized by a moderately dense (30-50%) cold-deciduous tall-shrub canopy that is typically 2-5 m tall and dominated by *Fraxinus anomala*. Associated tall shrubs include *Amelanchier alnifolia* and *Quercus gambelii*, (which is codominant in at least one stand). Taller trees are sometimes present and include *Juniperus*

osteosperma, *Pinus edulis*, or *Pseudotsuga menziesii*. Short shrubs contribute low cover and include *Ephedra viridis*, *Ericameria nauseosa*, *Holodiscus dumosus*, *Rhus trilobata*, *Symphoricarpos rotundifolius*, and the vine *Vitis arizonica*. Herbaceous species are variable and contribute minimal cover. Common species include *Achnatherum hymenoides*, *Artemisia ludoviciana*, Asteraceae spp., *Bromus tectorum*, *Elymus elymoides*, *Eriogonum* spp., and *Poa fendleriana*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i> , <i>Pseudotsuga menziesii</i>
Tall shrub/sapling	<i>Amelanchier utahensis</i> , <i>Fraxinus anomala</i> , <i>Quercus gambelii</i>
Tall shrub/sapling	<i>Mahonia fremontii</i>
Short shrub/sapling	<i>Brickellia longifolia</i> , <i>Chrysothamnus viscidiflorus</i> , <i>Ericameria nauseosa</i> , <i>Rhus trilobata</i> , <i>Shepherdia rotundifolia</i> , <i>Symphoricarpos oreophilus</i>
Short shrub/sapling	<i>Cercocarpus intricatus</i>
Herb (field)	<i>Artemisia ludoviciana</i> , <i>Asclepias labriformis</i>
Herb (field)	<i>Achnatherum aridum</i> , <i>Achnatherum hymenoides</i> , <i>Pleuraphis jamesii</i> , <i>Poa fendleriana</i>
Herb (field)	<i>Selaginella mutica</i> var. <i>limitanea</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tall shrub/sapling	<i>Amelanchier alnifolia</i> , <i>Fraxinus anomala</i> , <i>Quercus gambelii</i>
Short shrub/sapling	<i>Ericameria nauseosa</i> , <i>Rhus trilobata</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Conyza canadensis*, *Descurainia pinnata*, *Erodium cicutarium*, *Salsola tragus*, *Tamarix chinensis*, *Tragopogon dubius*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GUQ (26-Jun-2001).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This association is known from only a few scattered locations: the Roan Plateau and Colorado National Monument in western Colorado, Zion National Park, and Capitol Reef National Park. More survey and classification work are needed to fully describe this association range-wide. *Fraxinus anomala* is present in many montane shrubland and woodland communities on the Colorado Plateau but is only a dominant species in this association.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: There is light grazing in some stands. One stand is on talus; another is in a drainage bottom.

Capitol Reef National Park Data: The description is based on 1986 and 1988 field data (11 plots: CARE.9002, CARE.9006, CARE.9088, CARE.9133, CARE.9188, CARE.9226, CARE.9227, CARE.9301, CARE.9307, CARE.9317, CARE.9335).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: G. Kittel, mod. J. Drake and J. Coles

REFERENCES: CONHP Ecology Team 2001, Cogan et al. 2004, Kittel et al. 1999a, Welsh et al. 1987,

***Populus angustifolia* / *Rhus trilobata* Woodland**
Narrowleaf Cottonwood / Skunkbush Woodland

CODE	CEGL000652
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	<i>POPULUS ANGUSTIFOLIA</i> TEMPORARILY FLOODED WOODLAND ALL. (A.641) 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 deciduous riparian woodland occurs on dry upper stream terraces of perennial streams and on lower terraces or banks of intermittent stream courses in the mountains, canyons and plateaus of Utah, Colorado, Wyoming and Idaho. This community is one of the drier *Populus angustifolia* plant associations and rarely floods. Elevations range from 1360 to 2400 m (4265-7875 ft.), with lower stands occurring in Idaho and higher stands at the southern end of the range. Slopes are gentle, and the lack of flooding is indicated by the fact that downed wood and litter cover most of the unvegetated ground surface. Substrates are well-drained, rocky alluvium. The association has an open upper tree canopy dominated by *Populus angustifolia* or *Populus X acuminata*. Other tree species in the canopy and subcanopy may include *Acer negundo*, *Populus deltoides*, *Pinus ponderosa*, *Pinus edulis*, and *Juniperus* spp. Tall shrubs, such as *Betula occidentalis*, *Prunus virginiana*, *Amelanchier utahensis*, *Salix monticola*, *Crataegus rivularis*, and *Quercus gambelii*, form an open layer. A moderately dense to dense short-shrub layer dominated by *Rhus trilobata* is diagnostic of this type. *Cornus sericea*, *Rosa woodsii*, *Symphoricarpos oreophilus*, *Artemisia tridentata*, *Chrysothamnus viscidiflorus*, *Ericameria parryi*, *Ribes montigenum*, *Forestiera pubescens*, *Berberis fendleri*, *Crataegus rivularis*, and *Symphoricarpos* spp. may also be present. The herbaceous layer is generally sparse but may be dense in openings where introduced grasses such as *Poa pratensis*, *Phragmites australis*, *Dactylis glomerata*, *Bromus inermis*, or *Bromus tectorum* may dominate. Introduced forbs may include *Cynoglossum officinale*, *Carduus nutans*, *Cirsium arvense*, *Melilotus officinalis*, or *Taraxacum officinale*. Common native forbs include *Maianthemum stellatum* and *Glycyrrhiza lepidota*, and the vine *Clematis ligusticifolia* is abundant in some stands. The mix of riparian and upland species indicates that this association occurs on riparian terraces that are in the process of becoming isolated from the water table. Over time as the stand continues to dry out, the more mesic species, such as *Betula occidentalis*, *Salix monticola*, and *Cornus sericea*, will be replaced by additional upland species.

DISTRIBUTION

Capitol Reef National Park

This association was sampled along Polk Creek adjacent to the park boundary.

Globally

This riparian woodland occurs locally in small stands in the mountains and canyons of Utah, Wyoming, Colorado and Idaho. It is likely to occur along any perennial tributary stream where low gradients allow for the development of cottonwood gallery forests.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on the banks and within Polk Creek, an intermittent stream. Sites are gentle (7 to 8° slopes), occur between 2280 and 2400 m elevation, and are oriented to eastern and southeastern aspects. The unvegetated surface has low to moderate cover of litter, large rock, and exposure of bare soil. Downed wood is common. Parent materials are variable and include sandstones and shale that have eroded to alluvium and boulder deposits. Soils are rapidly drained and are organic, consisting of peat.

Globally

This deciduous riparian woodland occurs on toe slopes and upper stream terraces of perennial streams and on lower terraces or banks of intermittent stream courses in the mountains, canyons and plateaus of Utah, Colorado, Wyoming and Idaho. This community is one of the drier *Populus angustifolia* plant associations and rarely floods. Elevations range from 1360 to 2400 m (4265-7875 ft.), with lower stands occurring in Idaho and higher stands at the southern end of the range in western Colorado and eastern Utah. Slopes are gentle, not exceeding 10%. The major components covering the unvegetated ground surface include litter, large rocks and downed wood. Substrates are well-drained, rocky alluvium poorly developed into sandy loam and clay loam soils.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland was recorded along Polk Creek just outside the park boundary. It has not been found within the park to date. The total vegetation cover is 47 to 215% in these moderately to densely vegetated stands. This woodland association is characterized by a relatively open emergent tree canopy, typically 5-10 m tall, of *Populus angustifolia* trees that range in cover from 15 to 25%. The canopy tree layer is also open, typically 2-5 m tall, and includes *Populus angustifolia*, *Pinus ponderosa*, *Pinus edulis*, and *Juniperus osteosperma* trees that range in cover from 5 to 25%, 0 to 5%, 5 to 25%, and 1 to 25%, respectively. The subcanopy layer provides low to moderate cover and includes *Populus angustifolia*, *Pinus edulis*, and *Juniperus osteosperma* trees. The shrub layer is characterized by the tall shrub *Rhus trilobata* that ranges in cover from 5 to 25%. Additional low to moderate cover is provided by the short shrubs *Cornus sericea*, *Rosa woodsii*, and *Symphoricarpos oreophilus*. The herbaceous layer is moderately diverse, provides sparse cover, and supports several exotic plant species. A common forb is the exotic *Melilotus officinalis*.

Globally

The association has an open upper tree canopy dominated by *Populus angustifolia* or *Populus X acuminata*. Other tree species in the canopy and subcanopy may include *Acer negundo*, *Populus deltoides*, *Pinus ponderosa*, *Pinus edulis*, *Juniperus scopulorum*, and *Juniperus osteosperma*. Tall shrubs, such as *Betula occidentalis*, *Prunus virginiana*, *Amelanchier utahensis*, *Salix monticola*, *Crataegus rivularis*, and *Quercus gambelii*, form an open layer. A moderately dense to dense short-shrub layer dominated by *Rhus trilobata* is diagnostic of this type. *Cornus sericea*, *Rosa woodsii*, *Symphoricarpos oreophilus*, *Artemisia tridentata*, *Chrysothamnus viscidiflorus*, *Ericameria parryi*, *Ribes montigenum*, *Forestiera pubescens*, *Berberis fendleri*, *Crataegus rivularis*, and *Symphoricarpos* spp. may also be present. The herbaceous layer is generally sparse but may be dense in openings where introduced grasses such as *Poa pratensis*, *Phragmites australis*, *Dactylis glomerata*, *Bromus inermis*, or *Bromus tectorum* may dominate. Introduced forbs may include *Cynoglossum officinale*, *Carduus nutans*, *Cirsium arvense*, *Melilotus officinalis*, or *Taraxacum officinale*. Common native forbs include *Maianthemum stellatum* and *Glycyrrhiza lepidota*. The vine *Clematis ligusticifolia* is abundant in some stands.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i> , <i>Pinus ponderosa</i>
Tree canopy	<i>Populus angustifolia</i>
Tree subcanopy	<i>Pinus edulis</i>
Tree subcanopy	<i>Populus angustifolia</i>
Tall shrub/sapling	<i>Rhus trilobata</i>
Short shrub/sapling	<i>Rosa woodsii</i>
Herb (field)	<i>Clematis ligusticifolia</i>
Herb (field)	<i>Melilotus officinalis</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Populus angustifolia</i>
Tall shrub/sapling	<i>Rhus trilobata</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Descurainia pinnata, *Melilotus officinalis*, *Poa pratensis*

Globally

Bromus inermis, Carduus nutans, Cirsium arvense, Melilotus officinalis, Poa pratensis

CONSERVATION STATUS RANK

Global Rank & Reasons: G3 (27-Dec-1999). This riparian woodland is uncommon and occurs locally throughout much of its range. There are more than 20 occurrences estimated for this type range-wide. Although this association appears stable, the condition of high-quality occurrences is extremely threatened. Development, heavy recreational use, expansion and maintenance of roads and railroads, improper grazing, and modification of the 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

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Association has become established along Polk Creek, which floods periodically. The associated upland is pinyon-juniper.

Capitol Reef National Park Data: The description is based on 2004 field data (2 plots: CARE.0634, CARE.0635).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: K.A. Schulz, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Carsey et al. 2003a, Driscoll et al. 1984, IDCDC 2005, Jones 1992b, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1996, Kittel et al. 1999a, Kittel et al. 1999b, Manning and Padgett 1995, Padgett et al. 1988b, Padgett et al. 1989, Richard et al. 1996, Walford 1996, Western Ecology Working Group n.d.

***Populus fremontii* - *Salix gooddingii* Woodland**
Fremont Cottonwood - Goodding's Willow Woodland

CODE	CEGL000944
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	<i>POPULUS FREMONTII</i> TEMPORARILY FLOODED WOODLAND ALL. (A.644) Fremont Cottonwood Temporarily Flooded Woodland Alliance

ECOLOGICAL SYSTEM(S): North American Warm Desert Lower Montane Riparian Woodland and Shrubland (CES302.748)
North American Warm Desert Riparian Woodland and Shrubland (CES302.753)
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This community occurs as small isolated stands or as linear bands that parallel stream channels in the Trans-Pecos region of western Texas, in southwestern New Mexico, southeastern Arizona, and south into northern Mexico. It has

also been reported from isolated tributary drainages in southern Utah. The vegetation is dependent upon a subsurface water supply and varies considerably with the height of the water table. Major flood events and consequent flood scour, overbank deposition of water and sediments, and stream meandering are important factors that shape this community. Soils are typically stratified sands, loams, and gravels. This deciduous woodland typically towers above the surrounding vegetation. *Populus fremontii* and *Salix gooddingii* may be nearly equal in abundance, or either may dominate. Individuals of *Populus fremontii* are scattered or occur in groves and may reach 30 m in height and 2 m in diameter. Other species that may occur in the canopy/subcanopy include *Populus deltoides* ssp. *wislizeni*, *Salix lasiolepis*, *Salix amygdaloides*, *Fraxinus berlandieriana*, *Celtis laevigata* var. *reticulata*, *Juglans microcarpa*, *Prosopis pubescens*, *Prosopis glandulosa*, and *Prosopis velutina*. The understories of most examples have been considerably altered by grazing and other factors, thus the composition and cover of the native understory is difficult to ascertain but frequently consists of shrubs and small trees (1-5 m tall). The herbaceous stratum varies in composition and coverage but is characterized by mixed annuals and short-lived perennials.

DISTRIBUTION

Capitol Reef National Park

This association is rare in the park and was sampled at Lower and Upper Cottonwood Tanks.

Globally

This community is found in the Trans-Pecos region of western Texas, in southwestern New Mexico, southeastern Arizona, and south into northern Mexico. This community type is known to occur along the southern middle Rio Grande, along smaller montane tributary basins that drain the eastern side of the Black Range, along the Gila and San Francisco rivers and in the Pecos basin in southern New Mexico along three tributaries (Rio Ruidoso, Rio Hondo and Black River). It has also been reported from isolated tributary drainages in southern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed in tanks or pockets within drainages in canyon bottoms. Sites are gentle (2° slope), occur at 1463 m elevation, and are oriented to a northeastern aspect. The unvegetated surface is unrecorded. Parent materials are variable and include sandstones and shale that have eroded and deposited as alluvium. Soils are typically somewhat poorly drained on these temporarily flooded sites fine sands.

Globally

This deciduous woodland is best developed along alluvial floodplains of large, low-gradient, perennial streams that flow through wide, unconstrained valleys. It has also been recorded surrounding perennially wet potholes within intermittent canyon drainages, as well as in the floodplains of intermittent streams. The vegetation is dependent upon a subsurface water supply and varies considerably with the height of the water table. Major flood events and consequent flood scour, overbank deposition of water and sediments, and stream meandering are important factors that shape this community. Soils are typically stratified sands, loams, and gravels classified as Torrifluvents or Ustifluvents, with Haplustolls on more stable sites. These coarse-textured, alluvial sediments have a low water-holding capacity and low nutrient availability.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is rare in the southern portion of the park. The vegetation is characterized by a relatively closed canopy of *Populus fremontii* and *Salix gooddingii* trees. The shrub layer is low in cover and composition. The most abundant tall shrub is the exotic *Tamarix chinensis*. Short and dwarf-shrubs provide sparse to low cover and include *Euthamia occidentalis*. The herbaceous layer is diverse and provides sparse to moderate cover. The most abundant graminoids include *Dichanthelium oligosanthes* and *Juncus balticus*. Forbs are sparse, with no one species being diagnostic; however, *Artemisia ludoviciana* and *Xanthium strumarium* provide low cover.

Globally

This community occurs as small isolated stands or as narrow bands that parallel the stream channel or border a pothole. This deciduous woodland typically towers above the surrounding vegetation, with *Populus fremontii* and *Salix gooddingii* as the dominant species. These species may be nearly equal in abundance, or either may dominate. Individuals of *Populus fremontii* are scattered or occur in groves and may reach 30 m in height and 2 m in diameter. Other species that may occur in the canopy/subcanopy include *Populus deltoides* ssp. *wislizeni*, *Salix lasiolepis*, *Salix amygdaloides*, *Fraxinus berlandieriana*, *Celtis laevigata* var. *reticulata*, *Fraxinus velutina*, *Juglans microcarpa*,

Prosopis pubescens, *Prosopis glandulosa*, and *Prosopis velutina*. The understory of most examples has been considerably altered by grazing and other factors, thus the composition and cover of the native understory is difficult to ascertain. The understory can be dense to open and frequently consists of shrubs and small trees 1-5 m tall, including *Prosopis* spp., *Baccharis salicifolia*, *Salix exigua*, *Sambucus mexicana*, *Rhamnus* spp., *Morus microphylla*, and *Amorpha fruticosa*. The woody exotics *Elaeagnus angustifolia* and various species of *Tamarix* now dominate the understory of most examples. The herbaceous stratum varies in composition and coverage but is characterized by mixed annuals and short-lived perennials. While most examples now have a herbaceous flora dominated by exotic species, in particular *Cynodon dactylon*, native species reported from this community include *Amaranthus palmeri*, *Amsinckia* spp., *Anemopsis californica*, *Boerhavia coccinea*, *Bowlesia incana*, *Carex* spp., *Chloracantha spinosa*, *Conyza canadensis* var. *canadensis*, *Cucurbita* spp., *Datura wrightii*, *Distichlis spicata*, *Euthamia occidentalis*, *Gutierrezia sarothrae*, *Juncus balticus*, *Lemna* spp., *Oenothera* spp., *Sorghum halepense*, *Sporobolus wrightii*, and *Trifolium longipes* ssp. *shastense*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Populus fremontii</i> , <i>Salix gooddingii</i>
Tall shrub/sapling	<i>Tamarix chinensis</i>
Short shrub/sapling	<i>Euthamia occidentalis</i>
Herb (field)	<i>Artemisia ludoviciana</i> , <i>Xanthium strumarium</i>
Herb (field)	<i>Dichanthelium oligosanthes</i> , <i>Juncus balticus</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Populus fremontii</i> , <i>Salix gooddingii</i>
Tree subcanopy	<i>Fraxinus velutina</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Salsola kali*, *Tamarix chinensis*, *Tragopogon dubius*, *Xanthium strumarium*

Globally

Bromus rubens, *Cynodon dactylon*, *Elaeagnus angustifolia*, *Hordeum murinum* ssp. *leporinum*, *Pennisetum setaceum*, *Sisymbrium irio*, *Tamarix chinensis*, *Xanthium strumarium*

CONSERVATION STATUS RANK

Global Rank & Reasons: G2 (23-Feb-1994). Few intact examples of this association remain in the southwestern United States. The association continues to be in decline, primarily as a function of major hydrological alterations (dams and diversions), grazing, off-road vehicles and agricultural conversion. The remaining functional stands are restricted to wild rivers such as the Gila and San Francisco rivers, and possibly along the Mimbres River in New Mexico, or the San Pedro River in Arizona. A few remnant stands are also known from the middle Rio Grande and a few locations in western Texas. This is a very significant association with respect to biodiversity and was once one of the major riparian communities of the Southwest. Stands that have not been invaded by exotic trees, shrubs and herbs are also very rare. Even protected examples are threatened by continued declines in upland watershed conditions and hydrological modification.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

In Trans-Pecos Texas this woodland is dependent on a subsurface water supply and varies considerably with the water table levels. Major flood events and consequent flood scour, overbank deposition of water and sediments, and stream meandering are important factors that shape this community. These woodlands once occupied the floodplains and riverbanks of most perennial waterways within its range, but have mostly been replaced by disturbance types dominated by exotic species.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: One stand has an unvegetated surface consisting of half sand and half Navajo sandstone bedrock.

Capitol Reef National Park Data: The description is based on 1987 field data (2 plots: CARE.9369, CARE.9370).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: E. Milford and E. Muldavin, mod. J. Coles

REFERENCES: Allard 1990, Boles and Dick-Peddie 1983, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Campbell and Dick-Peddie 1964, Diamond 1993, Diamond et al. 1992, Driscoll et al. 1984, Metcalfe 1902, NMNHP unpubl. data, Stromberg 1993a, Szaro 1989, TNC 1992b, Western Ecology Working Group n.d.

***Populus fremontii* / *Ericameria nauseosa* Woodland Fremont Cottonwood / Rubber Rabbitbrush Woodland**

CODE	CEGL002465
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	<i>POPULUS FREMONTII</i> TEMPORARILY FLOODED WOODLAND ALL. (A.644) Fremont Cottonwood Temporarily Flooded Woodland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)
North American Warm Desert Riparian Woodland and Shrubland (CES302.753)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This common woodland association occurs on the high terraces of perennial streams and on the banks of intermittent washes throughout the Colorado Plateau on sites that are rarely subject to flooding. Sites are level to gently sloping and are located between 1165 and 2165 m (3825-7100 ft.) elevation. Soils are poorly developed, well-drained sands and loamy sands derived from alluvium. Total vegetation cover ranges from 34 to 170%. The 10 to 15-m tall canopy is dominated by mature *Populus fremontii* trees that range in cover from 5 to 50%. Other trees, both riparian and upland, may be present with low cover in the canopy and subcanopy, including *Populus angustifolia*, *Salix gooddingii*, and *Juniperus osteosperma*. Young *Populus* and *Salix* are rare, because these stands are often at least 2 m above the water table. The shrub layer is low to moderate in terms of species composition and cover. *Ericameria nauseosa* dominates or codominates the stratum, often with *Artemisia tridentata* ssp. *tridentata*. Other shrubs may be scattered through the stand, including *Rhus trilobata*, *Sarcobatus vermiculatus*, *Opuntia* spp., *Forestiera pubescens*, *Atriplex canescens*, and *Fraxinus anomala*. The exotic *Tamarix chinensis* may also be present. The herbaceous layer is diverse in terms of species composition, although many species are exotic and most reflect upland conditions. Common graminoids include *Achnatherum hymenoides*, *Agrostis stolonifera*, *Bromus tectorum*, *Bromus japonicus*, *Elymus canadensis*, *Sporobolus* spp., and *Juncus balticus*. Forbs commonly present include *Ambrosia acanthicarpa*, *Artemisia campestris*, *Castilleja linariifolia*, *Equisetum hyemale*, *Lepidium montanum*, *Sphaeralcea* spp., and *Heterotheca villosa*.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon within the park and was sampled at Meeks Spring, lower Halls Creek, upper Pleasant Creek, Muley Twist drainage, Spring Canyon, Fremont River, Oak Creek Divide Canyon, and Brimhall Canyon.

Globally

This association has been described from southeastern Utah. It is likely to be widespread throughout the Colorado Plateau.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on terraces of drainages located in canyons and basin floor drainages. Sites are flat to gentle (0 to 2° slopes), occur between 1250 and 2165 m elevation, and are oriented to all aspects. The unvegetated surface is unrecorded. Parent materials are variable and include sandstones and shale that have eroded and deposited as alluvium. Soils are typically somewhat poorly drained on these temporarily flooded sites fine sands.

Globally

This common woodland association occurs on the high terraces of perennial streams and on the banks of intermittent washes throughout the Colorado Plateau. These habitats are rarely subject to flooding. Sites are level to gently sloping and are located between 1165 and 2165 m (3825-7100 ft.) elevation. Aspect is not important in determining the distribution of this association. Bare soil and litter cover most of the unvegetated surface. Soils are poorly developed, well-drained sands and loamy sands derived from alluvium.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is uncommon within the park. The vegetation is characterized by a relatively closed canopy of *Populus fremontii* trees. The canopy tree *Populus angustifolia* is often present and contributes low to moderate cover. The shrub layer is low to moderate in terms of species composition and cover. The tall-shrub layer includes *Amelanchier utahensis* and the exotic *Tamarix chinensis*. The short shrub *Ericameria nauseosa* ranges in cover from 5 to 25 %. Additional short and dwarf-shrubs include *Artemisia tridentata*, *Gutierrezia sarothrae*, and the succulent *Opuntia phaeacantha*. The herbaceous layer is diverse in terms of species composition, includes a number of exotic species, and provides sparse to moderate cover. Common graminoids include *Achnatherum hymenoides*, *Bromus tectorum*, *Juncus balticus*, and *Sporobolus flexuosus*. Forbs commonly present include *Ambrosia acanthicarpa*, *Hymenopappus filifolius*, and *Psoralidium lanceolatum*.

Globally

This woodland association is common throughout the Colorado Plateau, where it occupies dry terraces along intermittent and perennial stream courses. Total vegetation cover ranges from 27 to 170%. The 10 to 15-m tall canopy is dominated by mature *Populus fremontii* trees that range in cover from 5 to 50%. Other trees, both riparian and upland, may be present with low cover in the canopy and subcanopy, including *Populus angustifolia*, *Salix gooddingii*, and *Juniperus osteosperma*. Young *Populus* and *Salix* are rare, because these stands are often at least 2 m above the water table. The shrub layer is low to moderate in terms of species composition and cover. *Ericameria nauseosa* dominates or codominates the stratum, often with *Artemisia tridentata* ssp. *tridentata*. Other shrubs may be scattered through the stand, including *Rhus trilobata*, *Sarcobatus vermiculatus*, *Opuntia* spp., *Forestiera pubescens*, *Atriplex canescens*, *Fraxinus anomala*, and in the southern extent *Parryella filifolia* and *Isocoma drummondii*. The exotic *Tamarix chinensis* may also be present. The herbaceous layer is diverse, although many species are exotic, and most reflect upland conditions. Common graminoids include *Achnatherum hymenoides*, *Agrostis stolonifera*, *Bromus tectorum*, *Bromus japonicus*, *Elymus canadensis*, *Sporobolus airoides*, and *Juncus balticus*. Forbs commonly present include *Ambrosia acanthicarpa*, *Artemisia campestris*, *Castilleja linariifolia*, *Equisetum hyemale*, *Lepidium montanum*, *Sphaeralcea* spp., and *Heterotheca villosa*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

Stratum

Tree canopy

Tree canopy

Tall shrub/sapling

Tall shrub/sapling

Short shrub/sapling

Short shrub/sapling

Herb (field)

Herb (field)

Herb (field)

Species

Juniperus osteosperma, *Pinus edulis*

Populus angustifolia, *Populus fremontii*

Amelanchier utahensis

Mahonia fremontii

Ericameria nauseosa

Artemisia tridentata

Opuntia phaeacantha

Amsonia tomentosa var. *stenophylla*, *Asclepias speciosa*, *Dalea candida*,

Hymenopappus filifolius, *Iva acerosa*, *Psoralidium lanceolatum*, *Stephanomeria minor*,

Townsendia incana

Achnatherum hymenoides, *Agrostis gigantea*, *Aristida purpurea*, *Bromus tectorum*,

Herb (field) *Elymus elymoides*, *Juncus balticus*, *Monroa squarrosa*, *Schoenoplectus americanus*,
Sporobolus airoides, *Sporobolus flexuosus*
Equisetum hyemale

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Populus fremontii</i>
Short shrub/sapling	<i>Atriplex canescens</i> , <i>Ericameria nauseosa</i>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>tridentata</i>
Herb (field)	<i>Artemisia campestris</i>
Herb (field)	<i>Achnatherum hymenoides</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park
Agropyron cristatum, *Bromus tectorum*, *Conyza canadensis*, *Descurainia pinnata*, *Hordeum jubatum*, *Lactuca serriola*, *Melilotus officinalis*, *Plantago major*, *Portulaca oleracea*, *Salsola tragus*, *Tamarix chinensis*, *Tragopogon dubius*, *Trifolium repens*

Globally

Bromus tectorum, *Tamarix chinensis*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (24-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park
Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Meeks Spring has been developed with the water flowing from a pipe. Some stands are on sandy benches. There is light to heavy grazing at a few sites.

Capitol Reef National Park Data: The description is based on 1986 and 1988 field data (12 plots: CARE.9123, CARE.9139, CARE.9176, CARE.9182, CARE.9198, CARE.9215, CARE.9316, CARE.9338, CARE.9349, CARE.9356, CARE.9360, CARE.9437).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Populus fremontii* / Mesic Forbs Woodland**
Fremont Cottonwood / Mesic Forbs Woodland

CODE	CEGL002470
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	<i>POPULUS FREMONTII</i> TEMPORARILY FLOODED WOODLAND ALL. (A.644) Fremont Cottonwood Temporarily Flooded Woodland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Lower Montane-Foothill
Riparian Woodland and Shrubland (CES306.821)

North American Warm Desert Lower Montane Riparian Woodland and Shrubland
(CES302.748)
Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland
(CES304.045)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This woodland association is documented along low-gradient perennial and intermittent streams, in mesic valley bottoms and below springs in southeastern Utah. Although these stands may not occur on sites that flood regularly, the water table is generally within a few feet of the surface through most of the growing season. Sites slope gently (less than 5%) and are located between 1530 and 1890 m (5020-6200 ft.) elevation. Soils are typically somewhat poorly drained fine sands in these temporarily flooded sites and are derived from alluvium and colluvium. Total vegetation cover ranges from 50% to nearly 100% in these moist woodlands. The vegetation is characterized by an open to moderately closed canopy of *Populus fremontii* with between 26 and 50% cover. There is no developed shrub layer, although scattered shrubs such as *Rosa woodsii* and *Forestiera pubescens* and the exotic shrub *Tamarix chinensis* may be present. The herbaceous layer is diverse and provides up to 50% cover. The forb understory varies greatly from site to site and from year to year, depending on the timing of flooding and the height of the water table. Documented species with significant cover include *Iva acerosa*, *Maianthemum stellatum*, *Equisetum arvense*, and *Equisetum laevigatum*. Graminoids are low in cover and include *Juncus balticus*, *Phragmites australis*, and *Schoenoplectus americanus*.

DISTRIBUTION

Capitol Reef National Park

This association is rare in the park and was sampled in upper Sheets Gulch and near the mouth of Divide Canyon.

Globally

This association has been described from a few locations in southeastern Utah. It is likely more widespread, although probably not common, throughout the Colorado Plateau.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed along creeks and on midslopes, possibly on seeps. Sites are gentle (2° slope), occur between 1585 and 1890 m elevation, and are oriented to southern and southeastern aspects. The unvegetated surface is unrecorded. Parent materials are variable and include sandstones and shale that have eroded and deposited as alluvium. Soils are typically somewhat poorly drained on these temporarily flooded saturated sites.

Globally

This woodland association is documented along low-gradient perennial and intermittent streams, in mesic valley bottoms and below springs in southeastern Utah. Sites slope gently (less than 5%) and are located between 1530 and 1890 m (5020-6200 ft.) elevation. Soils are typically somewhat poorly drained fine sands in these temporarily flooded sites and are derived from alluvium and colluvium.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is rare in the park. The vegetation is characterized by a relatively closed canopy of *Populus fremontii* trees. One stand has equal cover by the canopy tree *Pinus ponderosa* and also contains the subcanopy tree *Juniperus osteosperma*. The shrub layer is low in terms of species composition and provides low cover. The exotic tall shrub *Tamarix chinensis* is present in one stand. The herbaceous layer is diverse and provides sparse to moderate cover. The most abundant forbs include *Iva acerosa* and the fern-ally *Equisetum arvense*. Graminoids are low in terms of species composition and cover and include *Juncus balticus*.

Globally

Total vegetation cover ranges from 50% to nearly 100% in these moist woodlands. The vegetation is characterized by an open to moderately closed canopy of *Populus fremontii* with between 26 and 50% cover. There is no developed shrub layer, although scattered shrubs such as *Rosa woodsii* and *Forestiera pubescens* may be present. The exotic tall shrub *Tamarix chinensis* may be present. The herbaceous layer is diverse and provides as much as

50% cover. The forb understory varies greatly from site to site and from year to year, depending on the timing of flooding and the water table. Documented species with significant cover include *Iva acerosa*, *Maianthemum stellatum*, *Equisetum arvense*, and *Equisetum laevigatum*. Graminoids are low in cover and include *Juncus balticus*, *Phragmites australis*, and *Schoenoplectus americanus*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pinus ponderosa</i>
Tree canopy	<i>Populus fremontii</i>
Tall shrub/sapling	<i>Tamarix chinensis</i>
Herb (field)	<i>Iva acerosa</i>
Herb (field)	<i>Juncus balticus</i>
Herb (field)	<i>Equisetum arvense</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Populus fremontii</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Melilotus officinalis, *Tamarix chinensis*, *Xanthium strumarium*

Globally

Tamarix chinensis

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (24-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This association is intended to describe *Populus fremontii* woodlands occupying the active floodplain (water table is still high) that lack a developed shrub layer and in which most of the understory cover is composed of non-graminoid herbaceous species, where there is no consistent dominant or diagnostic element.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: There is heavy grazing in one stand.

Capitol Reef National Park Data: The description is based on 1986 field data (1 plot: CARE.9214).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Populus fremontii* / Mesic Graminoids Woodland Fremont Cottonwood / Mesic Graminoids Woodland**

CODE	CEGL002473
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	<i>POPULUS FREMONTII</i> TEMPORARILY FLOODED WOODLAND ALL.(A.644) Fremont Cottonwood Temporarily Flooded Woodland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)
North American Warm Desert Lower Montane Riparian Woodland and Shrubland (CES302.748)
Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland (CES304.045)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This woodland association occurs on the banks of intermittent and perennial streams, in seepy areas on valley bottoms and in active floodplains in southeastern Utah. Flooding occurs irregularly, but the water table remains within a few feet of the surface throughout the growing season. Stands are located on gently sloping (less than 5%) sites between 1438 and 1768 m (4715-5800 ft.) elevation. Soils are typically somewhat poorly drained fine sands derived from alluvium. Total vegetation cover generally exceeds 50%. The vegetation is characterized by an open canopy of *Populus fremontii* trees that range in cover from 25 to 40%, although cover in some stands may be as high as 80%. There is no developed shrub layer, although scattered individuals of shrubs such as *Salix exigua*, *Salix lutea*, *Ericameria nauseosa*, and *Artemisia tridentata* ssp. *tridentata* may be present, and the exotic shrub *Tamarix chinensis* is often present. The herbaceous layer is constant only in that it is dominated by graminoids; otherwise it varies greatly in composition and cover from site to site and from year to year, depending on the flooding regime and the height of the water table. No species is characteristic of this type, but significant species recorded from sampled sites include *Equisetum* spp., *Juncus balticus*, *Juncus ensifolius*, *Muhlenbergia asperifolia*, and *Polypogon viridis*. Forbs are present but are inconsistent and provide low cover.

DISTRIBUTION

Capitol Reef National Park

This association is rare in the park and was sampled along Pleasant Creek.

Globally

This association has been described from a few locations in southeastern Utah. It is likely more widespread, although not common, throughout the Colorado Plateau.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed on basin floor drainages. The site is gentle (2° slope), occurs at 1768 m elevation, and is oriented to an eastern aspect. The unvegetated surface is unrecorded. Parent materials are variable and include sandstones and shale that have eroded and deposited as alluvium. Soils are typically somewhat poorly drained on these temporarily flooded sites.

Globally

This woodland association occurs on the banks of intermittent and perennial streams, in seepy areas on valley bottoms and in active floodplains in southeastern Utah. Flooding occurs irregularly, but the water table remains within a few feet of the surface throughout the growing season. Stands are located on gently sloping (less than 5%) sites between 1438 and 1768 m (4715-5800 ft.) elevation. Soils are typically somewhat poorly drained fine sands derived from alluvium.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association is rare in the park. The vegetation is characterized by a relatively closed canopy of *Populus fremontii* trees. The shrub layer is low in cover and composition. The exotic tall shrub *Tamarix chinensis* is present. The herbaceous layer is diverse and provides sparse to moderate cover. The most abundant graminoids that characterize this stand's understory include *Muhlenbergia asperifolia* and *Polypogon viridis*. Forbs are sparse, with no one species providing low cover.

Globally

This woodland association is documented only from southeastern Utah but is likely to occur in small patches throughout the Colorado Plateau. Total vegetation cover generally exceeds 50%. This woodland association is

characterized by an open canopy of *Populus fremontii* trees that range in cover from 25 to 40%, although cover in some stands may be as high as 80%. There is no developed shrub layer, although scattered individuals of shrubs such as *Salix exigua*, *Salix lutea*, *Ericameria nauseosa*, and *Artemisia tridentata* ssp. *tridentata* may be present, and the exotic shrub *Tamarix chinensis* is often present. The herbaceous layer is constant only in that it is dominated by graminoids; otherwise it varies greatly in composition and cover from site to site and from year to year, depending on the flooding regime and the height of the water table. No species is characteristic of this type, but significant species recorded from sampled sites include *Equisetum* spp., *Juncus balticus*, *Juncus ensifolius*, *Muhlenbergia asperifolia*, and *Polypogon viridis*. Forbs are present but are inconsistent and provide low cover.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Populus fremontii</i>
Herb (field)	<i>Muhlenbergia asperifolia</i> , <i>Polypogon viridis</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Populus fremontii</i>
Herb (field)	<i>Juncus balticus</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Dactylis glomerata*, *Melilotus officinalis*, *Tamarix chinensis*, *Trifolium repens*

Globally

Bromus tectorum, *Dactylis glomerata*, *Melilotus officinalis*, *Tamarix chinensis*, *Trifolium repens*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (24-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This association describes *Populus fremontii* woodlands occupying the active floodplain (water table is still high) that lack a developed shrub layer and in which most of the understory is composed of sedges, rushes or grasses.

CLASSIFICATION CONFIDENCE:

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Cattle are trailed through Pleasant Creek annually so these areas receive moderate grazing for a short period of time each year.

Capitol Reef National Park Data: The description is based on 1986 and 1987 field data (3 plots: CARE.9118, CARE.9333, CARE.9653).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Artemisia filifolia* Colorado Plateau Shrubland Sand Sagebrush Colorado Plateau Shrubland**

CODE	CEGL002697
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 FILIFOLIA* SHRUBLAND ALLIANCE (A.816)
Sand Sagebrush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Blackbrush-Mormon-tea Shrubland (CES304.763)
Inter-Mountain Basins Active and Stabilized Dune (CES304.775)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This sand sagebrush shrubland association is widespread in the Colorado Plateau of Utah, Arizona and probably New Mexico. It occurs on sandy, often somewhat disturbed sites on valley floors, stream terraces, stabilized dunes and sand sheets, benches, floodplains and alluvial fans. Most sites are level to gently sloping, with a few on moderate slopes (up to 21%), and may be oriented to any aspect, although there is a slight tendency toward warmer southerly aspects. Elevations range from 1122 to 1769 m (3680-5803 ft.). Sand or bare soil covers most of the unvegetated ground surface, although biological soil crusts may have as much as 40% cover. Soils are sandy and derived from local sandstones, alluvium, or eolian deposits. Total vegetation cover ranges broadly, from sparsely vegetated disturbed sites with less than 5% total cover to stable, well-developed communities with more than 50% cover. Regardless of cover, the vegetation is characterized by an open shrub canopy dominated by *Artemisia filifolia* that is usually mixed with other shrubs, especially *Atriplex canescens*, *Ericameria nauseosa*, and *Opuntia* spp. Less commonly, the shrub layer will include *Vanleavea stylosa*, *Eriogonum leptocladon*, or *Sarcobatus vermiculatus*. *Coleogyne ramosissima*, *Ephedra viridis*, and *Ephedra torreyana* are generally absent or have only trace cover. The herbaceous layer is moderate in terms of species composition and provides sparse to moderate cover. Graminoids that are consistently present include *Achnatherum hymenoides* and *Bromus tectorum*; some sites may also have *Hesperostipa comata*, *Pleuraphis jamesii*, *Sporobolus cryptandrus*, and *Vulpia octoflora*. Forbs vary among sites but are typical of sandy habitats, including *Abronia fragrans*, *Lepidium montanum*, *Oenothera pallida*, *Salsola tragus*, and *Sphaeralcea parvifolia*. Cryptogam cover ranges from 0% to 40%.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon and was sampled within the park south of the Post, and along Hall's Creek near Cottonwood Tanks. It also occurs in the South Desert.

Globally

This sand sagebrush shrubland association is widespread on sandy sites in the Colorado Plateau of Utah, Colorado, Arizona and New Mexico.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This shrubland association was observed on stabilized dunes, sandy pockets on Navajo sandstone, drainage terraces, valley floor alluvium, and eolian deposits on slopes. Sites are gentle to moderately steep (2 to 12° slopes), occur between 1280 and 1769 m elevation, and are oriented to western and southwestern aspects. The unvegetated surface has low to high exposure of sand and bare soil, and low to moderate cover of litter and live stem basal area. Cryptogams may be absent or can provide up to 40% cover. Parent materials are Dakota and Entrada sandstones that have eroded and been distributed to alluvial, terrace gravel, and eolian deposits. Soils are rapidly drained to well-drained loamy sands and sandy loams.

Globally

This sand sagebrush shrubland is widespread on sandy sites in the Colorado Plateau of Utah, Colorado, Arizona and New Mexico. This common association occurs on sandy sites on valley floors, valley sides, stream terraces, stabilized dunes and sand sheets, benches, floodplains, terraces and alluvial fans. Most sites are level to gently sloping, with a few on moderate slopes (up to 21%), and may be oriented to any aspect, although there is a slight tendency to occur on warmer southerly aspects. Elevations range from 1122 to 1769 m (3680-5803 ft.). Sand or bare soil covers most of the unvegetated ground surface, although biological soil crusts may have up to 40% cover. Soils are sandy to sometimes gravelly and derived from local sandstones, alluvium, or eolian deposits.

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland association is uncommon but occurs primarily in the southern portion of the park. The total vegetation cover ranges from 4 to 60%. This shrubland association is characterized by an open to moderately closed canopy of *Artemisia filifolia* short shrubs that range in cover from 1 to 45%. The canopy tree *Juniperus osteosperma* provides sparse cover in one stand. The associated short- and dwarf-shrub layers are moderate in terms of species composition and provide low to moderate cover. Occasionally associated shrubs include *Atriplex canescens*, *Opuntia polyacantha*, and *Sarcobatus vermiculatus*. The herbaceous layer is moderate in species composition and provides sparse cover. Graminoids commonly present include *Achnatherum hymenoides* and *Vulpia octoflora*. Common forbs include *Plantago patagonica*. Cryptogams provide up to 40% cover.

Globally

Total vegetation cover ranges broadly, from sparsely vegetated disturbed and alluvial terrace sites with less than 5% total cover to more stable, well-developed communities with greater than 50% cover. Regardless of cover, the vegetation is characterized by an open shrub canopy of *Artemisia filifolia*, usually mixed with other shrubs, especially *Atriplex canescens*, *Ericameria nauseosa*, and *Opuntia* spp. Less commonly, the shrub layer will include *Vancelevia stylosa*, *Eriogonum leptocladon*, or *Sarcobatus vermiculatus*. *Coleogyne ramosissima*, *Ephedra viridis*, and *Ephedra torreyana* are generally absent or have relatively low cover (usually <1%). The herbaceous layer is moderate in terms of species composition and provides sparse to moderate cover. Graminoids that are consistently present include *Achnatherum hymenoides* and *Bromus tectorum*; some sites may also have *Hesperostipa comata*, *Pleuraphis jamesii*, *Sporobolus cryptandrus*, and *Vulpia octoflora*. Forbs vary among sites but are typical of sandy habitats, including *Abronia fragrans*, *Lepidium montanum*, *Oenothera pallida*, *Salsola tragus*, and *Sphaeralcea parvifolia*. Cryptogams may be absent or may provide as much as 40% cover.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Tall shrub/sapling	<i>Purshia mexicana</i>
Short shrub/sapling	<i>Artemisia filifolia</i> , <i>Brickellia microphylla</i> , <i>Ericameria nauseosa</i> , <i>Sarcobatus vermiculatus</i>
Short shrub/sapling	<i>Atriplex canescens</i>
Herb (field)	<i>Gutierrezia sarothrae</i> , <i>Opuntia polyacantha</i> , <i>Yucca harrimaniae</i>
Herb (field)	<i>Amsonia tomentosa</i> var. <i>stenophylla</i> , <i>Dalea flavescens</i> , <i>Melilotus officinalis</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Aristida purpurea</i> , <i>Bromus tectorum</i> , <i>Sporobolus contractus</i> , <i>Vulpia octoflora</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Artemisia filifolia</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus rubens, *Bromus tectorum*, *Descurainia pinnata*, *Melilotus officinalis*, *Salsola tragus*

Globally

Bromus rubens, *Bromus tectorum*, *Halogeton glomeratus*, *Malcolmia africana*, *Salsola tragus*

CONSERVATION STATUS RANK

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

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This association is distinguished from other *Artemisia filifolia* shrubland associations by its restriction to the Colorado Plateau, the somewhat mixed shrub canopy that usually includes *Atriplex canescens*, a poorly-developed herbaceous layer and often a number of species that indicate disturbance or somewhat alkaline conditions. This

association also occurs in a broader range of habitats than other *Artemisia filifolia* types. However, *Artemisia filifolia* - *Ephedra* (*torreyana*, *viridis*) Shrubland (CEGL002786) is poorly defined, and many stands of *Artemisia filifolia* Colorado Plateau Shrubland (CEGL002697) contain one or the other species of *Ephedra*; it is possible that these two associations should be combined.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Data are not available.

Capitol Reef National Park Data: The description is based on 1986 and 2003 field data (5 plots: CARE.0519, CARE.0522, CARE.0570, CARE.9145, CARE.9200).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: 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	<i>ARTEMISIA NOVA</i> SHRUBLAND ALLIANCE (A.1105) Black Sagebrush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This 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 among 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*, *Machaeranthera canescens*, *Penstemon strictus*, and *Packera multilobata*.

DISTRIBUTION

Capitol Reef National Park

This association was sampled on Billing's Pass within and adjacent to the northwestern portion of the park. During this project, it was only found in this location.

Globally

This association has only been documented from Capitol Reef National Park in southeastern Utah. It may occur nearby in the highlands of Boulder and Thousand Lakes mountains.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This shrubland association was observed on saddles and in depressions on plateaus. Sampled sites are gentle to moderately steep (3 to 16° 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. One stand has moderate to high cover of large rocks 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.

Globally

This association has only been described from Capitol Reef National Park. Until there is additional data, no global information is available.

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland association is found only in the vicinity of Billings Pass within and adjacent to the park. The total vegetation cover ranges from 24 to 80% in these sparsely to densely vegetated stands. This association is characterized by the short shrubs *Artemisia nova* and *Purshia tridentata* that range in cover from 5 to 45% and 1 to 15%, respectively, and the short bunchgrass *Poa fendleriana* that ranges in cover from <1 to 15%. The associated short- and dwarf-shrub layer is moderate in terms of species diversity, provides low to moderate cover, and includes *Artemisia frigida*, *Chrysothamnus viscidiflorus*, *Symphoricarpos oreophilus*, and *Tetradymia canescens*. The herbaceous layer provides sparse to low cover and is diverse in terms of species composition. 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*, *Machaeranthera canescens*, *Penstemon strictus*, and *Packera multilobata*.

Globally

This association has only been described from Capitol Reef National Park. Until there is additional data, no global information is available.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Chrysothamnus viscidiflorus</i> , <i>Symphoricarpos oreophilus</i> , <i>Tetradymia canescens</i>
Short shrub/sapling	<i>Artemisia nova</i> , <i>Purshia tridentata</i>
Herb (field)	<i>Carex rossii</i> , <i>Elymus elymoides</i> , <i>Elymus lanceolatus</i> , <i>Poa fendleriana</i>

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (17-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This association has only been described from Capitol Reef National Park. Until there is additional data, no global information is available.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Sites receive moderate grazing by cattle. The community occurs in openings between ponderosa pine stands in the northwestern corner of the park. One site is being invaded by ponderosa pine and Douglas-fir trees. Distribution is related to elevation and aspect. It occupies thin soils between volcanic boulders and gravel.

Capitol Reef National Park Data: The description is based on 1987 and 2004 field data (3 plots: CARE.0718, CARE.0721, CARE.9703).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***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	<i>ARTEMISIA NOVA</i> SHRUBLAND ALLIANCE (A.1105) 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 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 ft.). 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

Capitol Reef National Park

This association is uncommon in the park. It was sampled on Billings Pass, Deep Creek Ridge, and in the vicinity of Flattop within and adjacent to the park.

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

Capitol Reef National Park

This short-shrub association was observed on the upper slopes of plateaus, midslopes of ridges, and on ridge tops. Sites are gentle (2 to 7° slopes), occur between 2530 and 2898 m elevation, and are oriented to northern and eastern aspects. The unvegetated surface has low cover of litter, moderate cover of small rocks and gravel, and high exposure of bare soil. Parent materials are volcanic and have eroded to form boulder deposits. Soils are rapidly drained sandy

clays and clay loams.

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 ft.). 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

Capitol Reef National Park

This shrubland association is uncommon within the park. The vegetation is characterized by an open canopy of *Artemisia nova* short shrubs that range in cover from 5 to 25%, and the short bunchgrass *Poa fendleriana* that ranges in cover from 1 to 5%. The shrub layer is moderately diverse in terms of species composition and provides low to moderate cover. Other short shrubs commonly present include *Artemisia tridentata* ssp. *vaseyana* and *Tetradymia canescens*. The herbaceous layer is high in terms of species diversity but provides sparse to low cover. Common graminoids include *Bouteloua gracilis*, *Elymus elymoides*, and *Koeleria macrantha*. Forbs commonly present include *Antennaria parvifolia*, *Eriogonum umbellatum*, *Hymenoxys richardsonii*, *Lupinus sericeus*, *Oxytropis borealis* var. *viscida*, and *Petradoria pumila*.

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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Chrysothamnus viscidiflorus</i> , <i>Tetradymia canescens</i>
Short shrub/sapling	<i>Artemisia nova</i> , <i>Artemisia tridentata</i> ssp. <i>vaseyana</i>
Herb (field)	<i>Astragalus miser</i> , <i>Hymenoxys richardsonii</i> , <i>Lupinus sericeus</i> , <i>Oxytropis borealis</i> var. <i>viscida</i> , <i>Petradoria pumila</i>
Herb (field)	<i>Bouteloua gracilis</i> , <i>Elymus elymoides</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Artemisia nova</i>
Herb (field)	<i>Poa fendleriana</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

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

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

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

Capitol Reef National Park Inventory Notes: Site is a rocky hilltop meadow surrounded by woodlands. Lower meadows have more big sagebrush than black sagebrush. Two sites are lightly grazed by cattle and elk. Meadow habitat has a thin layer of rocky soil covering volcanic boulders in one stand.

Capitol Reef National Park Data: The description is based on 1986 and 2004 field data (3 plots: CARE.0710, CARE.0711, CARE.9073).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

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

***Artemisia tridentata* ssp. *tridentata* / *Pleuraphis jamesii* Shrubland
Basin Big Sagebrush / James' Galleta Shrubland**

CODE	CEGL001015
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	<i>ARTEMISIA TRIDENTATA</i> (SSP. <i>TRIDENTATA</i> , <i>XERICENSIS</i>) SHRUBLAND ALL. (A.830) (Basin Big Sagebrush, Foothill Big Sagebrush) Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)
Inter-Mountain Basins Big Sagebrush Steppe (CES304.778)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association has been described from the Colorado Plateau in southeastern Utah and may occur in parts of Colorado, New Mexico and Arizona. Most stands occur on valley floors, alluvial flats and on the terraces of intermittent drainages. A few stands have been reported from mesas. Sites are located between 1866 and 2200 m (6122-7220 ft.) elevation on level to gentle slopes (<5%). As much as 80% of the unvegetated surface is covered by bare ground. Soils are generally deep, calcareous and alkaline sandy loams or clay loams derived from alluvium. This association occupies dry sites on valley floors in the Colorado Plateau. Total vegetation cover is variable; some disturbed stands may appear to be sparsely vegetated with total vegetation cover less than 10%. Stands are characterized by an open shrub canopy (5-35% cover) dominated by *Artemisia tridentata* ssp. *tridentata*. Associated shrubs may include *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, *Atriplex* spp., and *Krascheninnikovia lanata*. Total woody canopy ranges from 5-35% cover. The sparse herbaceous layer (5-15% cover) is dominated by graminoids such as *Pleuraphis jamesii*, *Achnatherum hymenoides*, *Aristida purpurea*, *Bouteloua gracilis*, *Elymus elymoides*, and *Sporobolus cryptandrus*. Forbs are sparse and variable; species recorded from plots include *Castilleja linariifolia* and *Psoralidium lanceolatum*.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon and was sampled along Hartnet Draw and in the vicinity of the Onion Beds. In the Onion Beds, this association was disked and reseeded with non-native grasses and forbs in the mid-1950s.

Globally

This association is found on the Colorado Plateau in southeastern Utah and likely occurs in adjacent Colorado, New Mexico and Arizona.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on valley floors and along intermittent drainages. Sampled sites are gentle (2° slopes), occur between 1866 and 1890 m elevation, and are oriented to all aspects. The unvegetated surface has low cover of litter and high exposure of bare soil. Live vegetation basal area cover is moderate, and downed wood can provide 4% cover. Parent materials are variable and include sandstones and shale eroded to form alluvial deposits. Soils are moderately well-drained sands to clay loams.

Globally

This association has been described from the Colorado Plateau in southeastern Utah and may occur in parts of Colorado, New Mexico and Arizona. Most stands occur on valley floors, alluvial flats and on the terraces of intermittent drainages. A few stands have been reported from mesas. Sites are located between 1866 and 2200 m (6122-7220 ft.) elevation on level to gentle slopes (<5%). Up to 80% of the unvegetated surface is covered by bare ground. Soils are generally deep, calcareous and alkaline sandy loams or clay loams derived from alluvium.

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland association is uncommon within the park. The total vegetation cover ranges from 19 to 65%. This shrub association is characterized by an open to closed canopy of *Artemisia tridentata* ssp. *tridentata* short shrubs that range in cover from 5 to 15% and the short bunchgrass *Pleuraphis jamesii* that ranges in cover from 5 to 15%. The canopy trees *Juniperus osteosperma* and *Pinus edulis* occasionally provide low cover. The associated short- and dwarf-shrub layers are moderately diverse in terms of species composition, provide low to moderate cover, and include *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, and *Opuntia polyacantha*. The herbaceous layer has high species diversity and provides low to moderate cover. Common graminoids include *Achnatherum hymenoides*, *Aristida purpurea*, *Bouteloua gracilis*, and *Elymus elymoides*. Forbs that are occasionally present include *Castilleja linariifolia* and *Psoralidium lanceolatum*.

Globally

This association occupies dry sites on valley floors in the Colorado Plateau. Total vegetation cover is variable; some disturbed stands may appear to be sparsely vegetated with total vegetation cover less than 10%. Stands are characterized by an open shrub canopy (5-35% cover) dominated by *Artemisia tridentata* ssp. *tridentata*. Associated shrubs may include *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, *Atriplex* spp., and *Krascheninnikovia lanata*. Total woody canopy ranges from 5-35% cover. The sparse herbaceous layer (5-15% cover) is dominated by graminoids such as *Pleuraphis jamesii*, *Achnatherum hymenoides*, *Aristida purpurea*, *Bouteloua gracilis*, *Elymus elymoides*, and *Sporobolus cryptandrus*. Forbs are sparse and variable; species recorded from plots include *Castilleja linariifolia* and *Psoralidium lanceolatum*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Chrysothamnus viscidiflorus</i> , <i>Ericameria nauseosa</i>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>tridentata</i> , <i>Ephedra viridis</i>
Herb (field)	<i>Gutierrezia sarothrae</i> , <i>Opuntia polyacantha</i>
Herb (field)	<i>Castilleja linariifolia</i> , <i>Psoralidium lanceolatum</i>
Herb (field)	<i>Aristida purpurea</i> , <i>Bouteloua gracilis</i> , <i>Elymus elymoides</i> , <i>Pleuraphis jamesii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>tridentata</i>
Herb (field)	<i>Pleuraphis jamesii</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Descurainia pinnata

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G2G4 (9-Nov-2005). This association is known from southeastern Utah on the Colorado Plateau but likely occurs in adjacent Colorado, New Mexico and Arizona. Stands are relatively small and grow in deep, non-saline soils on bottomland, alluvial flats, and possibly mesa tops. The lowland sites are easily accessible, and most have been grazed for decades and, in some cases, centuries by livestock. Overgrazing reduces the graminoid layer and damages the *Artemisia tridentata* ssp. *tridentata* shrubs. A number of stands are located in Capitol Reef National Park, although they have been subject to grazing. This association may have a relatively large range, but good-condition stands will be small and difficult to find. Until more information is available from field surveys, the rank should stay G2G4.

CLASSIFICATION COMMENTS

Capitol Reef National Park
Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: There is light grazing on one stand. Two stands are subject to periodic flooding. There are dead big sagebrush shrubs on one plot that could be drought-related. There is some invasion of Utah juniper into one stand.

Capitol Reef National Park Data: The description is based on 1986 and 2003 field data (3 plots: CARE.0424, CARE.9315, CARE.9353).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: K.A. Schulz, mod. J. Coles

REFERENCES: Baker 1984a, Barrows et al. 1977, Bourgeron and Engelking 1994, Branson et al. 1976, Donart et al. 1978b, Driscoll et al. 1984, Francis 1986, Francis and Aldon 1983, Northcutt 1978

***Artemisia tridentata* ssp. *tridentata* / *Sporobolus airoides* Shrubland
Basin Big Sagebrush / Alkali Sacaton Shrubland**

CODE	CEGL002200
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	<i>ARTEMISIA TRIDENTATA</i> (SSP. <i>TRIDENTATA</i> , <i>XERICENSIS</i>) SHRUBLAND ALL. (A.830) (Basin Big Sagebrush, Foothill Big Sagebrush) Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association occurs on riparian terraces and drainage bottoms in western Colorado that rarely, if ever, flood. Elevations range from 1521 to 1873 m (5000-6145 ft.), and sites are level to gently sloping. Soils tend to be fine-textured silty clays derived from alluvium. The vegetation is characterized by a canopy of *Artemisia tridentata* ssp. *tridentata* 1-3 m tall with 30-45% cover, and a moderately dense understory dominated by *Sporobolus airoides* with 30% cover. Other shrubs associated with this community may include *Ericameria nauseosa*, *Rhus trilobata*, and *Sarcobatus vermiculatus*. The herbaceous layer may include *Achnatherum hymenoides*, *Distichlis spicata*, *Pascopyrum smithii*, *Phragmites australis*, and *Glycyrrhiza lepidota*.

DISTRIBUTION

Capitol Reef National Park

This rare association is represented by a single plot sampled on a plain in Middle Desert Wash.

Globally

This association is known from western Colorado. It is to be expected throughout the Colorado Plateau.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

The single sample of this association occurs at 1597 m elevation on a gently sloping alluvial plain. Litter and exposed soil cover most of the unvegetated surface, with limited cover by biological soil crusts. The soil is fine-textured and derived from alluvium and valley fill.

Globally

This association occurs on high riparian terraces and drainage bottoms in western Colorado that rarely, if ever, flood. Elevations range from 1521 to 1873 m (5000-6145 ft.), and sites are level to gently sloping. The substrate is alluvium, and soils tend to be fine-textured silty clays.

VEGETATION DESCRIPTION

Capitol Reef National Park

This bottomland shrubland association is rare in the park. Total vegetation cover is around 65%. The shrub layer is dominated by *Artemisia tridentata* ssp. *tridentata* with 20% cover. Associated shrubs include *Atriplex canescens* and *Opuntia polyacantha*. *Sporobolus airoides* dominates the herbaceous understory with 15% cover.

Globally

This shrubland association is characterized by a canopy of *Artemisia tridentata* ssp. *tridentata* 1-3 m tall and between 30 and 45% cover. Other shrubs associated with this community may include *Ericameria nauseosa*, *Rhus trilobata*, and *Sarcobatus vermiculatus*. The herbaceous layer is well-developed and dominated by the bunchgrass *Sporobolus airoides* with approximately 30% cover. Other herbaceous species present vary but may include *Achnatherum hymenoides*, *Distichlis spicata*, *Pascopyrum smithii*, *Phragmites australis*, and *Glycyrrhiza lepidota*. Some stands have at least rudimentary biological soil crusts.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>tridentata</i> , <i>Atriplex canescens</i>
Herb (field)	<i>Sporobolus airoides</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>tridentata</i>
Herb (field)	<i>Sporobolus airoides</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (6-Jan-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: The plot is on a plain in Middle Desert Wash.

Capitol Reef National Park Data: The description is based on field data collected in 2005 during accuracy assessment (1 plot: CARE_AA.1321).

Local Description Authors: J. Coles

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Artemisia tridentata* - (*Ericameria nauseosa*) / *Bromus tectorum* Semi-natural Shrubland Basin Big Sagebrush - (Rubber Rabbitbrush) / Cheatgrass Semi-natural Shrubland**

CODE	CEGL002699
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	<i>ARTEMISIA TRIDENTATA</i> SHRUBLAND ALLIANCE (A.829) Basin Big Sagebrush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)
Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association is common throughout the Colorado Plateau and likely occurs on disturbed sites throughout the range of basin big sagebrush in the western U.S. Stands occur in small to moderate-sized patches on alluvial terraces, floodplains, and point bars, mostly below 2000 m (6560 ft.) elevation. *Artemisia tridentata* ssp. *tridentata* shrubs are always present, often with a lesser component of *Ericameria nauseosa*, *Atriplex canescens*, or *Chrysothamnus viscidiflorus*. *Bromus tectorum* dominates the occasionally sparse herbaceous layer, frequently accompanied by other weedy exotic or annual grasses and forbs. Individuals or small patches of native grasses and forbs may occur, including *Leymus cinereus*, *Achnatherum hymenoides*, and *Sporobolus cryptandrus*.

DISTRIBUTION

Capitol Reef National Park

This association is represented by two plots sampled on stream terraces along Sandy Wash and the Fremont River between the State Highway and canyon wall. It is a common disturbance type that is probably more widespread in the park.

Globally

This association is widespread in southern Utah and western Colorado and likely occurs on disturbed sites throughout the range of basin big sagebrush in the western U.S.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This association was sampled between 1594 and 1659 m elevation on a gently sloping alluvial terrace within the valley bottom. Litter or exposed soil cover most of the unvegetated surface ranging from moderate to high cover of litter 20-90% cover of litter and trace to 60% cover of bare ground. The soils are deep and derived from alluvium.

Globally

This association occurs on alluvial terraces, flats and fans or valley floors throughout the Colorado Plateau. Most stands occur on level to gently sloping sites below 2000 m (6560 ft.) elevation, but elevations range from 1130-2045 m. Soils are variable and include sandy loams, silt loams, and clay loams, depending on the size of the stream and the geology of the watershed. The unvegetated surface often has high cover of litter and bare soil with low cover of rocks. Cryptobiotic soil crusts are often extensive (up to 15% in some stands).

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland association is characterized by an open to moderately dense shrub layer (10-60% cover) dominated by *Artemisia tridentata* ssp. *tridentata* (8-60% cover) with herbaceous layer dominated by *Bromus tectorum* 10-45% cover. *Ericameria nauseosa* codominated the open stand with 4% cover. Associated species include low cover of *Opuntia polyacantha* and *Achnatherum hymenoides*.

Globally

This association is widespread on floodplains and terraces within the Colorado Plateau that have been subject to grazing. *Artemisia tridentata* ssp. *tridentata* is always present with cover ranging between 10 and 70% and to 2 m in height. *Ericameria nauseosa* is not always present but is likely to be present in the vicinity. Other shrubs that occur in this community consistently include *Atriplex canescens*, *Chrysothamnus viscidiflorus*, and *Sarcobatus vermiculatus*. Less common shrubs are *Ephedra viridis*, *Gutierrezia* spp., *Opuntia* spp., or *Tetradymia canescens*. In some stands there may be scattered trees of *Pinus edulis*, *Juniperus osteosperma*, *Juniperus scopulorum*, and *Populus angustifolia*. The herbaceous layer reflects a long history of disturbance and is dominated by exotic annual *Bromus* species, especially *Bromus tectorum*. Other common exotic herbaceous species include *Bromus rigidus*, *Erodium cicutarium*, *Lappula occidentalis*, *Lactuca serriola*, and *Sisymbrium altissimum*. Because it is dominated by annual species, the total herbaceous cover varies depending on seasonal precipitation. Remnant native herbaceous vegetation may include scattered individuals or patches of *Achnatherum hymenoides*, *Descurainia pinnata*, *Elymus elymoides*, *Heterotheca villosa*, *Oenothera caespitosa*, *Senecio spartioides*, and others. Exotic perennial species such as *Acroptilon repens*, *Bromus inermis*, *Cardaria draba*, and *Carduus nutans* ssp. *macrolepis* may also be present because of the disturbed nature of this community.

MOST ABUNDANT SPECIES

Capitol Reef National Park

Globally

<u>Stratum</u>	<u>Species</u>
Tall shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>tridentata</i> , <i>Ericameria nauseosa</i>
Herb (field)	<i>Bromus tectorum</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tall shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>tridentata</i>
Herb (field)	<i>Bromus tectorum</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Carduus nutans ssp. *macrolepis*, *Lactuca serriola*, *Salsola tragus*, *Sisymbrium altissimum*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (ruderal) (14-Aug-2001).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This semi-natural association is likely much more widespread across the western U.S. but is not often sampled.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Data are not available.

Capitol Reef National Park Data: The description is based on 2003 field data and data collected in 2005 during accuracy assessment (3 plots: CARE.8704, CARE_AA.1482, CARE_AA.1569).

Local Description Authors: K.A. Schulz

Global Description Authors: J. Coles, mod. K.A. Schulz

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

***Artemisia tridentata* / *Achnatherum hymenoides* Shrubland
Basin Big Sagebrush / Indian Ricegrass Shrubland**

CODE	CEGL001006
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	<i>ARTEMISIA TRIDENTATA</i> SHRUBLAND ALLIANCE (A.829) Basin Big Sagebrush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This broadly defined sagebrush association is reported from the Great Basin to the western slope of the southern Rocky Mountains, but it likely occurs throughout the Intermountain western U.S. Stands occur in broad valleys in the Great Basin, on midslopes below rimrock on mesa tops, on hill slopes, and along drainages and in washes in valley bottoms in the Colorado Plateau and southern Rocky Mountains. Sites are nearly level to moderately steep ranging from 1525-1677 m elevation in the Great Basin and Colorado Plateau to 2317-2546 m elevation in the southern Rocky Mountains. Substrates tend to be coarse-textured and likely have low salinity and high sand content, gravel or rocks. The vegetation is characterized by an open to moderately dense (10-50% cover) shrub layer dominated by sagebrush, usually *Artemisia tridentata* ssp. *vaseyana*, *Artemisia tridentata* ssp. *tridentata*, or with subspecies unspecified. A typically open herbaceous layer is characterized by the large bunchgrass *Achnatherum hymenoides*. Other shrubs present may include low cover of *Artemisia frigida*, *Chrysothamnus viscidiflorus*, *Grayia spinosa*, *Gutierrezia sarothrae*, *Opuntia* spp., *Quercus gambelii*, and *Rhus trilobata*. Scattered trees may also be present. The herbaceous layer provides sparse to moderate cover. Other graminoids present on more diverse sites include *Bouteloua gracilis*, *Elymus elymoides*, *Hesperostipa comata*, *Pleuraphis jamesii*, and *Poa secunda*. Forb cover is variable and generally low.

DISTRIBUTION

Capitol Reef National Park

This association was sampled just north of Cedar Mesa campground along the Notom-Bullfrog Road. It occurs along upper Halls Creek drainage.

Globally

This broadly defined sagebrush association is found in the Colorado Plateau, Great Basin, and western slope of the Colorado Rocky Mountains; it likely occurs throughout much of the Intermountain western U.S.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This shrub association was observed in low-flow channels in washes located in valley bottoms. The sampled site is gentle (1° slope) and occurs at 1677 m elevation. The unvegetated surface is unrecorded. Parent materials are variable and include sandstones, shale, and alluvial deposits. Soils are unrecorded but probably have low salinity and high sand content.

Globally

This broadly defined sagebrush association occurs on a variety of landforms throughout its range, including sandy soils in broad valleys in the Great Basin, on midslopes below rimrock on mesa tops, on hill slopes, and along drainages and in washes in valley bottoms in the Colorado Plateau and western slope of the Rocky Mountains. Sites

are nearly level to moderately steep ranging from 1525-1677 m elevation in the Great Basin and Colorado Plateau to 2317-2546 m elevation in the southern Rocky Mountains. Substrates tend to be coarse-textured and likely have low salinity and high sand content, gravel or rocks. Parent materials are variable and include sandstones, shale, and alluvial deposits. The unvegetated surface has moderate to high cover of bare ground with moderate to low cover of rocks and gravel and low cover of litter.

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland association is uncommon, occurring in wash drainages. The vegetation is characterized by the short shrub *Artemisia tridentata* and the large bunchgrass *Achnatherum hymenoides*. The remaining shrub layer has low diversity, provides sparse to low cover, and includes the dwarf-shrub *Gutierrezia sarothrae*. The herbaceous layer is diverse and provides low to moderate cover. Graminoids present include the annual exotic grass *Bromus tectorum*. Associated forbs are diverse but provide sparse to low cover.

Globally

This broadly defined sagebrush association is characterized by an open to moderately dense (10-50% cover) shrub layer of sagebrush, usually *Artemisia tridentata* ssp. *vaseyana*, *Artemisia tridentata* ssp. *tridentata*, or with subspecies unspecified. A typically open herbaceous layer is characterized by the large bunchgrass *Achnatherum hymenoides*. Other shrubs present may include *Artemisia frigida*, *Chrysothamnus viscidiflorus*, *Grayia spinosa*, *Gutierrezia sarothrae*, *Opuntia* spp., and *Rhus trilobata*. If *Quercus gambelii* is present, then it has low cover (<5%). Scattered *Juniperus scopulorum* or *Pseudotsuga menziesii* trees may also be present in higher elevation stands. The herbaceous layer provides sparse to moderate cover. Other herbs present on more diverse sites include graminoids *Bouteloua gracilis*, *Elymus elymoides*, *Hesperostipa comata*, *Pleuraphis jamesii*, *Poa secunda*, and forbs *Chenopodium* spp., *Eriogonum umbellatum*, *Lepidium montanum*, *Mentzelia albicaulis*, *Phlox hoodii*, and *Sphaeralcea coccinea*. Other species present include the annual exotic grasses *Bromus tectorum* and *Halogeton glomeratus*, and exotic forbs *Descurainia sophia* and *Salsola tragus*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Artemisia tridentata</i>
Herb (field)	<i>Gutierrezia sarothrae</i>
Herb (field)	<i>Achnatherum hymenoides</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Artemisia tridentata</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This broadly defined association may include *Artemisia tridentata* ssp. *wyomingensis* / *Achnatherum hymenoides* Shrubland (CEGL001046) when the subspecies is not known. Usually *Artemisia tridentata* ssp. *vaseyana* (higher elevation) or *Artemisia tridentata* ssp. *tridentata* (valley bottoms) dominate stands in this association. As more data become available, it may be reasonable to create new sagebrush/ricegrass associations based on sagebrush subspecies.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: The sampled stand was heavily grazed.

Capitol Reef National Park Data: The description is based on 1986 field data (1 plot: CARE.9045).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: K.A. Schulz

REFERENCES: Blackburn et al. 1968c, Bourgeron and Engelking 1994, Driscoll et al. 1984, Harper and Jaynes 1986, NVNHP 2003, Rickard and Beatley 1965, Western Ecology Working Group n.d.

***Artemisia tridentata* ssp. *vaseyana* / *Poa fendleriana* Shrubland
Wyoming Big Sagebrush / Muttongrass Shrubland**

CODE	CEGL002812
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	<i>ARTEMISIA TRIDENTATA</i> SSP. <i>VASEYANA</i> SHRUBLAND ALLIANCE (A.831) Mountain Big Sagebrush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This sagebrush shrubland association covers medium to large patches on the slopes of mesas, valleys, plateaus, hills and ridges in western Colorado and eastern Utah. It often occurs in a mosaic with other sagebrush communities that cover very large areas. Elevations range from 2100 to 2875 m (6900-9430 ft.). Slopes vary from gentle to steep and may be oriented to any aspect. Litter cover is generally high, and soils are deep and mostly relatively fine-textured clay loams or clays, with a few stands on sandy sites. Total vegetation cover ranges from approximately 35% to nearly 100%. The shrub layer is dominated by *Artemisia tridentata* ssp. *vaseyana* shrubs to 1 m tall with between 20 and 50% cover. The bunchgrass *Poa fendleriana* is dominant in the herbaceous layer with 1 to 25% cover. Other shrub species present, in addition to the sagebrush, include *Purshia tridentata*, *Chrysothamnus viscidiflorus*, and *Symphoricarpos oreophilus*. The herbaceous layer may be sparse to dense and well-developed, diverse or depauperate, depending on location and grazing history. The grass component in particular is generally mixed, and common associated or codominant graminoids include *Koeleria macrantha*, *Poa secunda*, *Elymus lanceolatus*, *Bouteloua gracilis*, *Carex duriuscula*, *Elymus elymoides*, *Pseudoroegneria spicata*, and *Hesperostipa comata*. Forbs commonly present may include *Antennaria parvifolia*, *Castilleja linariifolia*, *Eriogonum umbellatum*, *Lupinus sericeus*, *Artemisia frigida*, and *Penstemon caespitosus*. Grazing has likely contributed to the increase in cover by mountain big sagebrush in these stands at the expense of native grasses. Fire would eliminate the mountain big sagebrush canopy in favor of a mixed graminoid and forb community. In the absence of fire over long periods, some stands show evidence of invasion by *Pinus edulis*, *Juniperus osteosperma*, or *Pseudotsuga menziesii*.

DISTRIBUTION

Capitol Reef National Park

This association is rare in the park and was sampled on Billings Pass and Deep Creek Ridge adjacent to the park. Within the park, mountain big sagebrush occurs only in the extreme northwestern corner.

Globally

This association has been documented in western Colorado and eastern Utah. It is likely to be more common than is currently known.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on all slope positions of valley, plateau and mountain landforms. Sites are

gentle to moderately steep (5 to 13° slopes), occur between 2765 and 2874 m elevation, and are oriented to northeastern and southeastern aspects. The unvegetated surface has low to high cover of litter and exposure of bare soil. Live vegetation basal area cover is low to moderate. Parent materials are volcanic and have eroded to form boulder deposits. Soils are rapidly drained sandy clays and clay loams.

Globally

This sagebrush shrubland association covers medium to large patches on the slopes of mesas, valleys, plateaus, hills and ridges in western Colorado and eastern Utah. Elevations range from 2100 to 2875 m (6900-9430 ft.). Slopes vary from gentle to steep and may be oriented to any aspect. Litter cover is generally high, and soils are deep and mostly relatively fine-textured clay loams or clays, with a few stands on sandy sites.

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland association is rare in the park. The total vegetation cover ranges from 35 to 130% in these moderately to densely vegetated stands. This shrub association is characterized by an open to closed canopy of *Artemisia tridentata* ssp. *vaseyana* short shrubs that range in cover from 25 to 65% and the bunchgrass *Poa fendleriana* that ranges in cover from 1 to 15%. The associated short-shrub layer is moderately diverse in terms of species composition, provides sparse to moderate cover, and includes *Purshia tridentata* and *Symphoricarpos oreophilus*. The herbaceous layer has moderate to high species diversity and provides sparse to low cover. Commonly associated graminoids include *Bouteloua gracilis*, *Carex duriuscula*, *Elymus elymoides*, and *Koeleria macrantha*. Forbs commonly present include *Antennaria parvifolia*, *Astragalus miser*, *Castilleja linariifolia*, *Eriogonum umbellatum*, *Lupinus sericeus*, and *Argentina anserina*.

Globally

This big sagebrush association occurs in a mosaic with other sagebrush communities that in aggregate may cover entire landscapes. Total vegetation cover ranges from 35% to nearly 100%. The shrub layer is dominated by *Artemisia tridentata* ssp. *vaseyana* shrubs to 1 m tall with between 20 and 50% cover. The bunchgrass *Poa fendleriana* is dominant in the herbaceous layer with 1 to 25% cover. Other shrub species present, in addition to the sagebrush, include *Purshia tridentata*, *Chrysothamnus viscidiflorus*, and *Symphoricarpos oreophilus*. The herbaceous layer may be sparse to dense and well-developed, diverse or depauperate, depending on location and grazing history. The grass component in particular is generally mixed, and common associated or codominant graminoids include *Koeleria macrantha*, *Poa secunda*, *Elymus lanceolatus*, *Bouteloua gracilis*, *Carex duriuscula*, *Elymus elymoides*, *Pseudoroegneria spicata*, and *Hesperostipa comata*. Forbs commonly present may include *Antennaria parvifolia*, *Castilleja linariifolia*, *Eriogonum umbellatum*, *Lupinus sericeus*, *Argentina anserina*, *Artemisia frigida*, and *Penstemon caespitosus*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Elymus elymoides</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>vaseyana</i>
Herb (field)	<i>Poa fendleriana</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (28-Jun-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Although *Poa fendleriana* is the dominant grass in the understory of this sagebrush association, it is often accompanied by other grasses, many with significant cover and indicator value. In a sagebrush landscape, the dominant grass in any given spot may depend on many variables, including grazing history and drought cycles, as well as subtle differences in soil, aspect, slope and slope position. In practice it may be difficult to distinguish this association in the field from many of the similar associations listed above.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Two stands are grazed by cattle at a moderate level, and all stands are grazed by elk. Stands are interspersed among quaking aspen woodland stands in the northwestern corner of the park.

Capitol Reef National Park Data: The description is based on 2004 field data (3 plots: CARE.0712, CARE.0715, CARE.0725).

Local Description Authors: Jim Von Loh, mod. by D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Artemisia tridentata* ssp. *wyomingensis* / (*Agropyron cristatum*, *Psathyrostachys juncea*)
Seeded Grasses Semi-natural Shrubland
Wyoming Big Sagebrush / (Crested Wheatgrass, Russian Wildrye) Seeded Grasses
Semi-natural Shrubland**

CODE	CEGL002185
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) Wyoming Big Sagebrush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This shrubland association has been observed in western Colorado and eastern Utah, though it is very likely to be more widespread in the western U.S. It occurs on generally level topography that has been or is currently disturbed by land-management activities such as chaining or heavy grazing. Stands have been observed at mid-elevations, though more data are likely to expand this range. The unvegetated surfaces is generally dominated by litter and bare soil. Dead shrubs can be abundant due to past land-treatment activities. Soils are poorly drained to moderately well-drained sandy loams or loamy sands. Most observed sites have been on eolian deposits derived from sandstone. There is a short (1-2 m) open shrub canopy dominated by *Artemisia tridentata* ssp. *wyomingensis* with other shrubs contributing low cover. Common associates are *Artemisia dracunculoides*, *Artemisia frigida*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, and *Opuntia* spp. Scattered short to medium-tall *Pinus edulis* and *Juniperus osteosperma* trees may be present. The herbaceous stratum has sparse to low cover and is characterized by seeded exotic species, especially *Agropyron cristatum* or *Psathyrostachys juncea*. *Bromus tectorum* is another common exotic species. Native species, which may have been seeded or migrated from nearby seed sources, include *Achnatherum hymenoides*, *Aristida purpurea*, *Bouteloua gracilis*, *Elymus elymoides*, *Hesperostipa comata*, *Poa fendleriana*, *Sporobolus cryptandrus*, and *Vulpia octoflora*. Nonvascular component is usually poor due to the disturbance of these sites.

DISTRIBUTION

Capitol Reef National Park

This association was sampled near the Onion Beds. It is more extensive on BLM lands outside the park.

Globally

This association has been observed in western Colorado and eastern Utah, though it is very likely to occur elsewhere in the western U.S. *Psathyrostachys juncea* is particularly prevalent in northwestern Colorado, as a local seed-producer specialized in this species for revegetation of degraded rangelands.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This manipulated shrubland association occurs only on alluvial flats in the vicinity of the Onion Beds. Elevations range from 2000 to 2043 m, and stands are on gentle slopes. Soils are fine sandy loams derived from alluvium.

Globally

This association is found on generally level topography such as mesa tops, benches, and plateau. Sites can be flat to gently sloping on any aspect. Observed sites in western Colorado have been at mid-elevations (2024-2128 m), though a wider range is certain as more data are available. The unvegetated surfaces is generally dominated by litter and bare soil. Dead shrubs can be abundant due to past land-treatment activities. Soils are poorly drained to moderately well-drained sandy loams or loamy sands. Most observed sites have been on eolian deposits derived from sandstone.

VEGETATION DESCRIPTION

Capitol Reef National Park

This modified shrubland association has a sagebrush canopy with between 15 and 45% closure. *Gutierrezia sarothrae* or *Opuntia polyacantha* may be present with very low cover. The herbaceous layer is variable, but the seeded pasture grass *Psathyrostachys juncea* is always present and often is dominant. Other herbaceous species present may include *Achnatherum hymenoides* and *Bouteloua gracilis*. Biological soil crusts are sparse to absent.

Globally

This shrubland has sparse to moderate total vegetation cover with an open short-shrub canopy. The dominant species in the shrub stratum is *Artemisia tridentata* ssp. *wyomingensis*, which may have between 4 and 50% cover. *Artemisia dracuncululus*, *Artemisia frigida*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, and *Opuntia* spp. are common associates with low cover. Short to medium-tall trees, typically *Juniperus osteosperma* or *Pinus edulis*, may be scattered throughout stands of this association. The herbaceous stratum is dominated by exotic species that have been seeded at some time in the past, most commonly *Agropyron cristatum* or *Psathyrostachys juncea* with 1-25% cover. *Bromus tectorum* is another common exotic species. Native species, which may have been seeded or migrated from nearby seed sources, include *Achnatherum hymenoides*, *Aristida purpurea*, *Bouteloua gracilis*, *Elymus elymoides*, *Hesperostipa comata*, *Poa fendleriana*, *Sporobolus cryptandrus*, and *Vulpia octoflora*. Nonvascular component is usually poor due to the disturbance of these sites.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i>
Herb (field)	<i>Psathyrostachys juncea</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i>
Herb (field)	<i>Agropyron cristatum</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (ruderal) (6-Jan-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE:

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: This association occurs on land that was disturbed by chaining, roller-chopping, possibly herbicide application, and interseeding of exotic species to support livestock grazing.

Capitol Reef National Park Data: The description is based on 2003 and 2005 (AA) field data (6 plots: CARE.0473, CARE.0474, CARE_AA.0077, CARE_AA.0780, CARE_AA.1394, CARE_AA.1460).

Local Description Authors: J. Coles

Global Description Authors: J. Drake

REFERENCES: Western Ecology Working Group n.d.

***Artemisia tridentata* ssp. *wyomingensis* / *Bouteloua gracilis* Shrubland
Wyoming Big Sagebrush / Blue Grama Shrubland**

CODE	CEGL001041
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) Wyoming Big 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 common sagebrush association occurs on ridges, plateaus and benches, and valleys in Wyoming, western Colorado and southeastern Utah. Elevations range from 1840 to 2430 m (6030-7975 ft.). Sites are on gentle to steep slopes and may be oriented to any aspect. Substrates include sandstone, granite and metamorphic rocks, and soils range from clay to sandy loam. The cover of bare ground is high in areas that are grazed by domestic livestock. Total vegetation cover may be sparse to moderately dense, depending on site conditions and grazing history. *Artemisia tridentata* ssp. *wyomingensis* dominates the shrub layer, which may also include lesser amounts of *Artemisia cana*, *Chrysothamnus viscidiflorus*, *Sarcobatus vermiculatus*, *Rhus trilobata*, *Opuntia polyacantha*, and *Atriplex canescens*. The understory usually is dominated by *Bouteloua gracilis* with a combination of *Pascopyrum smithii*, *Pseudoroegneria spicata*, *Hesperostipa comata*, *Koeleria macrantha*, *Poa secunda*, *Pleuraphis jamesii*, *Achnatherum hymenoides*, *Sporobolus cryptandrus*, and *Elymus elymoides*. The introduced grasses *Bromus tectorum* and *Bromus japonicus* are often present. A mix of herbs, including *Artemisia frigida*, *Gutierrezia sarothrae*, *Vulpia octoflora*, *Phlox hoodii*, and *Sphaeralcea coccinea*, contribute little cover. The combination of relatively high cover by sagebrush and dominance of the understory by a grazing increaser such as *Bouteloua gracilis* indicate that this association may represent degraded forms of other Wyoming sagebrush / native grass associations.

DISTRIBUTION

Capitol Reef National Park

This association is rare in the park. It was sampled on Jones Bench, south of Baker Ranch. During this project this

was the only location in which it was found.

Globally

This Wyoming big sagebrush type is found in the Great Basin region of the western United States and possibly into the Great Plains. Documented sites include the Bighorn, Powder River and Wind River basins in Wyoming, Curecanti National Recreation Area in western Colorado, and Capitol Reef and Canyonlands national parks in southeastern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on plateau tops and steps-in-slope. Sample sites are gentle (2° slopes), occur between 2198 and 2232 m elevation, and are oriented to northeastern aspects. The unvegetated surface has low cover of litter and exposure of bare soil. Small rocks and gravel provide low to high cover, and live vegetation basal area cover is high. Parent materials are variable and include sandstones and shale eroded to form pediment deposits. Soils are well-drained clay loams to sandy loams.

Globally

This common sagebrush shrubland occurs on the slopes of ridges and valleys and on plateaus, plains and benches in Wyoming, western Colorado and southeastern Utah. Elevations range from 1840 to 2430 m (6030-7975 ft.). Sites are on gentle to steep slopes and may be oriented to any aspect. Substrates are variable and include clay to sandy loam soils derived from granite and metamorphic rocks, sandstone, shale, alluvium or eolian deposits. The cover of bare ground is high in areas that are grazed by domestic livestock.

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland association is rare within the park. The total vegetation cover ranges from 71 to 110% in these densely vegetated stands. This shrub association is characterized by an open to closed canopy of *Artemisia tridentata* ssp. *wyomingensis* short shrubs that range in cover from 15 to 65% and the shortgrass *Bouteloua gracilis* that ranges in cover from 35 to 65%. The associated shrub layer is absent from one stand and is low in diversity and provides sparse cover in the other. The herbaceous layer is also low in diversity and, with the exception of *Bouteloua gracilis*, provides sparse cover. Common grasses that provide sparse to low cover include *Elymus elymoides* and *Pleuraphis jamesii*.

Globally

Total vegetation cover may be sparse to moderately dense, depending on site conditions and grazing history. *Artemisia tridentata* ssp. *wyomingensis* dominates the shrub layer, which may also include lesser amounts of *Artemisia cana*, *Chrysothamnus viscidiflorus*, *Sarcobatus vermiculatus*, *Rhus trilobata*, *Opuntia polyacantha*, and *Atriplex canescens*. The understory usually is dominated by *Bouteloua gracilis* together with a combination of *Pascopyrum smithii*, *Pseudoroegneria spicata*, *Hesperostipa comata*, *Carex filifolia*, *Koeleria macrantha*, *Poa secunda*, *Pleuraphis jamesii*, *Achnatherum hymenoides*, *Sporobolus cryptandrus*, and *Elymus elymoides*. The introduced grasses *Bromus tectorum* and *Bromus japonicus* are often present but generally contribute less cover. A mix of herbs, including *Artemisia frigida*, *Gutierrezia sarothrae*, *Vulpia octoflora*, *Phlox hoodii*, and *Sphaeralcea coccinea*, often are present but generally contribute little cover.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i>
Herb (field)	<i>Bouteloua gracilis</i> , <i>Pleuraphis jamesii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i>
Herb (field)	<i>Bouteloua gracilis</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Bromus japonicus, Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This association may represent a situation in which *Bouteloua gracilis* is dominant in the understory because other grasses have been removed by grazing. Jones (1992b) states that some stands of this type may represent degraded forms of *Artemisia tridentata* ssp. *wyomingensis* / *Pascopyrum smithii* or *Artemisia tridentata* ssp. *wyomingensis* / *Pseudoroegneria spicata* shrublands.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Small pebbles contribute to open areas in sagebrush and *Bouteloua gracilis* stands. There is evidence of cattle grazing over long periods of time. Pinyon-juniper woodland surrounds plots, both sparse to dense stands. There is a burn in a Utah juniper stand near one plot.

Capitol Reef National Park Data: The description is based on 2002, 2003, and 2005 (AA) field data (4 plots: CARE.0532, CARE.0580, CARE_AA.0353, CARE_AA.0781).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Bighorn Coal Mine n.d., Bourgeron and Engelking 1994, Driscoll et al. 1984, Fisser 1964, Fisser 1970, Francis 1986, Jones 1992b, Keammerer 1987, Knight et al. 1987, MTNHP 2002b, NDNHI n.d., Nichols 1964a, Nichols 1964b, Smith unpubl. data b, Stoecker-Keammerer Consultants n.d., Van Pelt 1978, Warren et al. 1992,

***Artemisia tridentata* ssp. *wyomingensis* / Disturbed Understory Semi-natural Shrubland
Wyoming Big Sagebrush / Disturbed Understory Semi-natural Shrubland**

CODE	CEGL002083
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) Wyoming Big Sagebrush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association has been found in western Colorado and eastern Utah but is likely widespread in other parts of the interior western U.S. It can occur on a variety of landscape positions on sites that are flat to moderately steep. This association has been sampled at elevations between 1455 and 2372 m (4770-7777 ft.) but is probably found elsewhere. The unvegetated surface is mostly composed of litter, bare soil, and rocks. Soils are typically eolian, alluvial, or colluvial loamy sands to sandy loams. This shrubland association has moderately open to dense vegetation cover with an open to closed short-shrub layer. The dominant shrub is *Artemisia tridentata* ssp. *wyomingensis* with low to moderate cover. Scattered (2-5 m tall) *Pinus edulis*, *Juniperus osteosperma*. *Juniperus*

scopulorum trees may be present with sparse cover. Other tall, short, and dwarf-shrubs that may be found are *Ericameria nauseosa*, *Ephedra viridis*, *Gutierrezia sarothrae*, *Sarcobatus vermiculatus*, and succulents. The herbaceous stratum has low to high cover and diversity, but weedy, exotic and invasive species tend to dominate. Common graminoids include *Achnatherum hymenoides*, *Aristida purpurea*, *Bromus tectorum*, *Vulpia octoflora*, *Elymus elymoides*, *Hesperostipa comata*, *Poa fendleriana*, and *Pleuraphis jamesii*. Forbs provide sparse to high cover and include *Astragalus nuttallianus*, *Descurainia pinnata*, *Chenopodium album*, *Erodium cicutarium*, *Lappula occidentalis*, *Lepidium* sp., and *Phacelia crenulata*.

DISTRIBUTION

Capitol Reef National Park

This association is widely distributed throughout the lower elevations of the mapping area. Sampled sites include Pleasant Creek, White Canyon Flats, and the Onion Beds.

Globally

This association has been observed in western Colorado and eastern Utah. It is very likely to occur in other parts of the western U.S.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This degraded sagebrush shrubland occurs primarily on level to gently sloping alluvial flats and terraces. Elevations range from 1829 to 2061 m. Soils are generally fine sandy loams derived from alluvium.

Globally

This association has been found on a variety of landscape features, including mesa tops, midslopes and low slopes of canyons, hills, and valleys, and on terraces. Sites can be flat to moderately steep (0-15°) and have any aspect. Sampled sites have had elevations between 1455 and 2372 m (4770-7777 ft.). The unvegetated surface can be composed of variable amounts of litter, bare soil, and large or small rocks. Soils are typically eolian, alluvial, or colluvial loamy sands to sandy loams.

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland association is well-distributed throughout the mapping area. It supports an understory of weedy and exotic annual plants in addition to native increaser species such as prickly-pear cactus. Total vegetation cover is moderate, generally between 40 and 50%. The shrub canopy is the dominant element, consisting primarily of *Artemisia tridentata* ssp. *wyomingensis*, sometimes with a minor element of *Ericameria nauseosa*, *Gutierrezia sarothrae*, or *Opuntia polyacantha*. The herbaceous layer is generally sparse but may have high cover in years with significant spring precipitation. Exotic and weedy species dominate the field layer, including *Descurainia pinnata*, *Bromus tectorum*, *Schoenocrambe linifolia*, and *Lappula occidentalis*. Tufts of remnant native bunch grasses may be present, including *Achnatherum hymenoides* and *Elymus elymoides*. There is little nonvascular cover.

Globally

This shrubland association has moderately open to dense vegetation cover (28-89%) with an open to closed short-shrub layer. The dominant shrub, *Artemisia tridentata* ssp. *wyomingensis*, typically has 5-45% cover, though some stands may have more or less. Scattered (2-5 m tall) *Pinus edulis*, *Juniperus osteosperma*. *Juniperus scopulorum* trees may provide 5-10% cover. In addition to *Artemisia tridentata* ssp. *wyomingensis*, other tall, short, and dwarf-shrubs that may be found are *Ericameria nauseosa*, *Ephedra viridis*, *Gutierrezia sarothrae*, *Sarcobatus vermiculatus*, and succulents. The herbaceous stratum has low to high cover and diversity and tends to be dominated by weedy and exotic species. Common graminoids include *Achnatherum hymenoides*, *Aristida purpurea*, *Bromus tectorum*, *Vulpia octoflora*, *Elymus elymoides*, *Hesperostipa comata*, *Poa fendleriana*, and *Pleuraphis jamesii*. Forbs provide sparse to high cover and include *Astragalus nuttallianus*, *Chenopodium album*, *Descurainia pinnata*, *Erodium cicutarium*, *Lappula occidentalis*, *Lepidium* sp., and *Phacelia crenulata*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

Stratum

Short shrub/sapling

Species

Artemisia tridentata ssp. *wyomingensis*

Globally

Stratum

Short shrub/sapling

Species

Artemisia tridentata ssp. *wyomingensis*

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (invasive) (14-Dec-2004).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This association is closely related to *Artemisia tridentata* - (*Ericameria nauseosa*) / *Bromus tectorum* Semi-natural Shrubland (CEGL002699), and there may be overlap between the two. Clear criteria need to be developed to distinguish these associations from one another.

CLASSIFICATION CONFIDENCE:

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Understory in these stands is often sparse.

Capitol Reef National Park Data: The description is based on 2003 field data (4 plots: CARE.0425, CARE.0466, CARE.0467, CARE.0471).

Local Description Authors: J. Coles

Global Description Authors: J. Drake, mod. J. Coles and K.A. Schulz

REFERENCES: Western Ecology Working Group n.d.

***Chrysothamnus viscidiflorus* Talus Shrubland**

Green Rabbitbrush Talus Shrubland

CODE	CEGL002347
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	<i>CHRYSOTHAMNUS VISCIDIFLORUS</i> SHRUBLAND ALLIANCE (A.2651) Green Rabbitbrush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Cliff and Canyon (CES304.779)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This shrubland association occurs on moderately steep to steep colluvial or talus slopes in the eastern part of the Colorado Plateau. Continually shifting slopes and occasional rockfall tend to maintain this association in early to mid-seral succession, and fire may also be an important factor. Elevations range from 1489 to 2300 m (4885-7545 ft.). The substrate is generally softer sedimentary rocks such as limestone and shale overlain by sandstone colluvium. *Chrysothamnus viscidiflorus* dominates this community. Other shrubs are generally present, including *Artemisia bigelovii*, *Artemisia tridentata* ssp. *wyomingensis*, *Atriplex canescens*, *Atriplex confertifolia*, *Ericameria nauseosa*, *Eriogonum corymbosum*, *Ephedra viridis*, *Gutierrezia sarothrae*, *Shepherdia rotundifolia*, *Xylorhiza glabriuscula*, and *Zuckia brandegeei*. The herbaceous layer tends to reflect the rocky substrate also and is often sparse. Typical

species may include *Stenotus acaulis*, *Leptodactylon pungens*, *Leymus salinus*, *Pleuraphis jamesii*, and *Poa secunda*, although in some stands *Bromus tectorum* is the dominant.

DISTRIBUTION

Capitol Reef National Park

This association is rare in the park. It was sampled in Capitol Gorge.

Globally

This association is documented from sites in southeastern Utah and western Colorado. It is likely to be locally distributed throughout the Colorado Plateau.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This shrubland association was observed on the lower slopes of steep talus slopes. The sampled site is moderately steep (10° slope), occurs at 1704 m elevation, and is oriented to an eastern aspect. The unvegetated surface has low cover of litter, low exposure of bare soil, and high cover of large rocks. Parent materials are Wingate Formation sandstone that has eroded to form talus and rockfall slopes. Soils are rapidly drained loamy sands.

Globally

This shrubland association occurs on moderately steep to steep colluvial or talus slopes in the eastern part of the Colorado Plateau. Elevations range from 1489 to 2300 m (4885-7545 ft.), and stands may occur on slopes oriented to any aspect. Most of the unvegetated ground surface is covered by large loose rocks. The substrate is generally softer sedimentary rocks such as limestone and shale overlain by sandstone colluvium.

VEGETATION DESCRIPTION

Capitol Reef National Park

This talus shrubland association is rare on talus slopes in the park. The total vegetation cover ranges from 6 to 50% in these sparsely to moderately vegetated stands. This shrubland association is characterized by a sparse to open canopy of *Chrysothamnus viscidiflorus* dwarf-shrubs that range in cover from 15 to 25%. The remaining shrub layer includes sparse to low cover of *Artemisia bigelovii*. Short shrubs commonly present and providing sparse to low cover include *Atriplex canescens*, *Ephedra viridis*, and *Shepherdia rotundifolia*. The herbaceous layer is low in terms of species composition and provides sparse cover. The common grass is the exotic annual *Bromus tectorum*.

Globally

Chrysothamnus viscidiflorus dominates this community, where chronic down slope movement tends to maintain it in an early-seral condition. Other shrubs are generally present, including *Artemisia bigelovii*, *Artemisia tridentata* ssp. *wyomingensis*, *Atriplex canescens*, *Atriplex confertifolia*, *Ericameria nauseosa*, *Eriogonum corymbosum*, *Ephedra viridis*, *Gutierrezia sarothrae*, *Shepherdia rotundifolia*, *Xylorhiza glabriuscula*, and *Zuckia brandegeei*. The herbaceous layer tends to reflect the rocky substrate also and is often sparse. Typical species may include *Stenotus acaulis*, *Leptodactylon pungens*, *Leymus salinus*, *Pleuraphis jamesii*, and *Poa secunda*, although in some stands *Bromus tectorum* is the dominant.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex canescens</i> , <i>Shepherdia rotundifolia</i>
Short shrub/sapling	<i>Ephedra viridis</i>
Herb (field)	<i>Chrysothamnus viscidiflorus</i>
Herb (field)	<i>Bromus tectorum</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Chrysothamnus viscidiflorus</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum

Globally

Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (21-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Chrysothamnus viscidiflorus Talus Shrubland (CEGL002347) may have comparable species composition to some of the associations listed as Similar Associations, but it is distinct because continually shifting slopes and occasional rockfall tend to maintain this association in early to mid-seral succession.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: There are pockets of this association in sandy spots all along the talus slope. The talus slope is erosive so a dynamic community is supported. Rockier talus supports *Atriplex canescens*.

Capitol Reef National Park Data: The description is based on 2004 field data (1 plot: CARE.0629).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Western Ecology Working Group n.d.

***Ericameria nauseosa* / *Bromus tectorum* Semi-natural Shrubland
Rubber Rabbitbrush / Cheatgrass Semi-natural Shrubland**

CODE	CEGL002937
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	<i>ERICAMERIA NAUSEOSA</i> SHRUBLAND ALLIANCE (A.835) Rubber Rabbitbrush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)
Inter-Mountain Basins Wash (CES304.781)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This shrubland association occurs in disturbed situations at moderate altitudes in the Colorado Plateau. It has been documented from sites in northwestern Colorado and southern and eastern Utah. Most stands are the result of fire burning sagebrush or other types of shrublands, but some derive from other forms of disturbance, including grazing. Elevations range from 1220 to 2085 m (4000-6840 ft.), and sites occur on gentle to steep slopes. Soils are variable, but most stands occur on well-drained sandy loams that are often rocky. Total vegetation cover is relatively sparse to moderately dense, depending primarily on the density of cheatgrass in any given year. The shrub canopy is open, consisting of *Ericameria nauseosa* with up to 40% cover. Scattered individuals of other shrub species such as *Artemisia tridentata*, *Rhus trilobata*, *Atriplex canescens*, and *Atriplex confertifolia* may be present. The herbaceous layer contains many species but is overwhelmingly dominated by *Bromus tectorum*. Relict native herbaceous grasses include *Elymus elymoides*, *Achnatherum hymenoides*, *Poa fendleriana*, and *Sporobolus cryptandrus*. Native herbaceous species are also common but contribute only sparse cover and may include *Cleome lutea*, *Eriogonum inflatum*, and *Heterotheca villosa*. Weedy forbs are more abundant in most stands, including *Descurainia pinnata*, *Lappula occidentalis*, and *Salsola tragus*.

DISTRIBUTION

Capitol Reef National Park

This association is fairly common in the southern portion of the park from Cedar Mesa campground to south of The Post. It was sampled just north of The Post.

Globally

This association has currently only been described from northwestern Colorado and southern and eastern Utah but is likely more widespread throughout the western U.S. in disturbed areas. It is also reported from northeastern Arizona.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed in the channel beds of deeply cut eroded drainages and broad floodplains. Sites are gentle (1° slopes), occur between 1585 and 1616 m elevation, and are oriented to various aspects. The unvegetated surface is unrecorded. Parent materials are variable and include sandstones and shale that have eroded and deposited as alluvium. Soils are well-drained fine sands.

Globally

This shrubland association occurs in disturbed situations at moderate altitudes in the Colorado Plateau. It has been documented from sites in northwestern Colorado and southern and eastern Utah. Elevations range from 1220 to 2085 m (4000-6840 ft.), and sites occur on gentle to steep slopes that may be oriented to any aspect. Soils are variable, but most stands occur on sandy loams that are well-drained and often rocky.

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland association is fairly common in the southern portion of the park. The vegetation is characterized by a relatively closed canopy of *Ericameria nauseosa* shrubs and the exotic annual *Bromus tectorum*. The associated shrub layer is low in composition, provides sparse to low cover, and includes *Atriplex canescens* and *Atriplex confertifolia*. In one stand, the exotic tall shrub *Tamarix chinensis* provides low to moderate cover. The remaining herbaceous layer is diverse but provides sparse to low cover. *Elymus elymoides* is the only associated graminoid. The forb layer supports several exotic annuals and commonly includes *Cleome lutea*, *Descurainia pinnata*, *Eriogonum inflatum*, *Lappula occidentalis*, and *Salsola tragus*.

Globally

Total vegetation cover is relatively sparse to moderately dense, depending primarily on the density of cheatgrass in any given year. The shrub canopy is open, consisting of *Ericameria nauseosa* with up to 40% cover. Scattered individuals of other shrub species such as *Artemisia tridentata*, *Rhus trilobata*, *Atriplex canescens*, and *Atriplex confertifolia* may be present. The herbaceous layer contains many species but is overwhelmingly dominated by *Bromus tectorum*. Relict native herbaceous grasses include *Elymus elymoides*, *Achnatherum hymenoides*, *Poa fendleriana*, and *Sporobolus cryptandrus*. Native herbaceous species are also common but contribute only sparse cover and may include *Cleome lutea*, *Eriogonum inflatum*, and *Heterotheca villosa*. Weedy forbs are more abundant in most stands, including *Descurainia pinnata*, *Lappula occidentalis*, and *Salsola tragus*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tall shrub/sapling	<i>Tamarix chinensis</i>
Short shrub/sapling	<i>Atriplex canescens</i> , <i>Ericameria nauseosa</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Ericameria nauseosa</i>
Herb (field)	<i>Bromus tectorum</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Descurainia pinnata*, *Salsola tragus*, *Sonchus asper*, *Tamarix chinensis*, *Tragopogon dubius*

Globally

Descurainia pinnata, *Lepidium latifolium*, *Salsola tragus*, *Sonchus asper*, *Tamarix chinensis*, *Tragopogon dubius*,
Yucca elata var. *utahensis*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (ruderal) (14-Aug-2001).

CLASSIFICATION COMMENTS

Capitol Reef National Park
Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Sites are subject to heavy grazing and erosion due to flows in channels.
Capitol Reef National Park Data: The description is based on 1986 field data (2 plots: CARE.9023, CARE.9026).
Local Description Authors: J. Von Loh, mod. D. Clark
Global Description Authors: J. Coles

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

***Ericameria nauseosa* / *Sporobolus airoides* Shrubland**
Rubber Rabbitbrush / Alkali Sacaton Shrubland

CODE	CEGL002918
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	<i>ERICAMERIA NAUSEOSA</i> SHRUBLAND ALLIANCE (A.835) Rubber Rabbitbrush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Greasewood Flat (CES304.780)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This short-shrub association occurs on stream terraces in southeastern Utah and western Colorado. It is uncommon within its range, occurring in isolated stands on the floodplains of small or intermittent streams and often forming a mosaic with other wash associations, such as *Atriplex canescens* Shrubland (CEGL001281) and *Artemisia tridentata* Shrubland (CEGL000991). Sites slope gently (1-2%) between 1263 and 1829 m (4145-6000 ft.) elevation. Aspect is not important in determining the distribution of stands. The unvegetated surface has high exposure of bare soil and sparse cover by litter. The soils are well-drained sandy loams derived from alluvium. Total vegetation cover ranges from 15 to 65% and is characterized by open to closed stands of *Ericameria nauseosa* shrubs that range in cover from 5 to 60%, with a sparse to moderately dense understory dominated by the tall bunchgrass *Sporobolus airoides* with between 1 and 10% cover. Associated shrubs contribute little in the way of cover and can include *Atriplex canescens*, *Atriplex confertifolia*, *Dicoria canescens*, *Ephedra torreyana*, *Eriogonum leptocladon*, and *Gutierrezia sarothrae*. The herbaceous layer is diverse and provides sparse to low cover. The most common associated graminoid is *Achnatherum hymenoides*. Forbs typically provide only trace cover; those present at greater than 1% cover include *Wyethia scabra* and *Astragalus moencoppensis*.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon to common in the northern portions of the park. It was sampled near the Temple of the Sun and Solomon's Temple and can be found along the Hartnet Draw.

Globally

This association has been documented from southeastern Utah and reported from Colorado. It is likely to occur in small, isolated patches throughout the Colorado Plateau.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on basin floors and stream terraces. Sites are gentle (1° slope), occur between 1646 and 1829 m elevation, and are oriented to southwestern aspects. The unvegetated surface has high exposure of bare soil and sparse cover by litter. Parent materials are variable and include sandstones and shale that have eroded to alluvial deposits. Soils are well-drained sandy loams.

Globally

This short-shrub association occurs on stream terraces in southeastern Utah and western Colorado. Sites slope gently (1-2%) between 1263 and 1829 m (4145-6000 ft.) elevation. Aspect is not important in determining the distribution of stands. The unvegetated surface has high exposure of bare soil and sparse cover by litter. The soils are well-drained sandy loams derived from alluvium.

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland association is uncommon to common in the park. It often forms a mosaic with other wash associations, such as *Atriplex canescens* Shrubland (CEGL001281) and *Artemisia tridentata* Shrubland (CEGL000991). The total vegetation cover ranges from 12 to 50%. This short-shrub association is characterized by open to closed stands of *Ericameria nauseosa* shrubs that range in cover from 5 to 15%, and the tall bunchgrass *Sporobolus airoides* that ranges in cover from 1 to 5%. Other short and dwarf-shrubs are moderately diverse and provide low cover, including *Atriplex canescens*, *Dicoria canescens*, *Ephedra torreyana*, *Eriogonum leptocladon*, and *Gutierrezia sarothrae*. The herbaceous layer is diverse in terms of composition and provides sparse to low cover. Other common graminoids include the bunchgrass *Achnatherum hymenoides*. Forbs typically provide sparse cover, and those present at greater than 1% cover include *Wyethia scabra*.

Globally

This shrubland association is uncommon within its range, occurring in isolated stands on the floodplains of small or intermittent streams. It often forms a mosaic with other wash associations, such as *Atriplex canescens* Shrubland (CEGL001281) and *Artemisia tridentata* Shrubland (CEGL000991). Total vegetation cover ranges from 15 to 65%. The vegetation is characterized by open to closed stands of *Ericameria nauseosa* shrubs that range in cover from 5 to 60%, with a sparse to moderately dense understory dominated by the tall bunchgrass *Sporobolus airoides* with between 1 and 10% cover. Associated shrubs contribute little in the way of cover and can include *Atriplex canescens*, *Atriplex confertifolia*, *Dicoria canescens*, *Ephedra torreyana*, *Eriogonum leptocladon*, and *Gutierrezia sarothrae*. The herbaceous layer is diverse and provides sparse to low cover. The most common associated graminoid is *Achnatherum hymenoides*. Forbs typically provide only trace cover; those present at greater than 1% cover include *Wyethia scabra* and *Astragalus moencoppensis*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex canescens</i> , <i>Dicoria canescens</i> , <i>Ericameria nauseosa</i>
Herb (field)	<i>Gutierrezia sarothrae</i>
Herb (field)	<i>Wyethia scabra</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Sporobolus airoides</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Ericameria nauseosa</i>
Herb (field)	<i>Sporobolus airoides</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Haloptelon glomeratus, *Malcolmia africana*, *Salsola tragus*, *Tamarix chinensis*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G3Q (28-Oct-2002).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: There was heavy grazing in one stand. Site floods during large storm events that deposit sediments.

Capitol Reef National Park Data: The description is based on 1986 and 2003 field data (2 plots: CARE.0433, CARE.9059).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Ericameria nauseosa* Desert Wash Shrubland
Rubber Rabbitbrush Desert Wash Shrubland**

CODE	CEGL002261
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	<i>ERICAMERIA NAUSEOSA</i> SHRUBLAND ALLIANCE (A.835) Rubber Rabbitbrush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Wash (CES304.781)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association is found in or near temporary watercourses on point bars, basin floors, and low stream terraces in western Colorado and eastern Utah. Stands have been found between 1189 and 2104 m (3900-6900 ft.) elevation. Sites are flat to gently sloping (<3°) and of any aspect. The unvegetated surface is mostly bare soil, sand, and/or loose rocks. There is usually little litter, but sometimes woody debris can be deposited by floods. Parent materials are variable, but sandstone, shale, and gneiss are most common on sampled stands. Soils are rapidly drained to well-drained sands or sandy loams. This shrubland association has sparse to moderate total vegetation cover (1-65%). This association is characterized by an open short-shrub layer distributed in linear rows along the intermittent drainages. *Ericameria nauseosa* is the dominant shrub with 1-15% cover. Other shrubs are typically present but contribute little cover. These include *Artemisia tridentata*, *Atriplex canescens*, *Atriplex confertifolia*, *Ephedra viridis*, *Fraxinus anomala*, *Gutierrezia sarothrae*, *Purshia stansburiana*, *Quercus havardii*, and *Sarcobatus vermiculatus*. The herbaceous stratum has sparse to moderate cover. The exotic *Bromus tectorum* is often abundant. Other herbaceous species commonly found are *Achnatherum hymenoides*, *Descurainia pinnata*, *Elymus elymoides*, *Glycyrrhiza lepidota*, *Hesperostipa comata*, *Hordeum jubatum*, and *Pleuraphis jamesii*.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon to common and was sampled in Middle Desert Wash, in the vicinity of Fruita, along Halls Creek drainage, near Solomon's Temple, along the Notom Road, and in the South Desert.

Globally

This association has been found in western Colorado and eastern Utah. It is likely found in other places of the arid western U.S.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This association was observed on basin floors, point bars, and stream terraces. Sites are gentle (1 to 2° slopes), occur between 1189 and 2104 m elevation, and are oriented to all aspects. The unvegetated surface has high exposure of bare soil or sand and sparse cover by litter. Parent materials are variable and include sandstones and shale that have eroded and been transported to form alluvial deposits. Soils are rapidly drained loamy sands and sandy loams

Globally

This association is found in or adjacent to temporary watercourses on point bars, basin floors, and low stream terraces. Stands have been found between 1189 and 2104 m (3900-6900 ft.) elevation. Sites are flat to gently sloping (<3 degrees) and of any aspect. The unvegetated surface is mostly bare soil, sand, and/or loose rocks. There is usually little litter, but sometimes woody debris can be deposited by floods. Parent materials are variable, but sandstone, shale, and gneiss are most common on sampled stands. Soils are rapidly drained to well-drained sands, sandy loams or silt loams derived from alluvium. Biological soil crusts may be present but do not provide much cover.

VEGETATION DESCRIPTION

Capitol Reef National Park

This desert wash shrubland association is uncommon to common within the park. The total vegetation cover ranges from 1 to 20%. This short-shrub association is characterized by open to closed stands of *Ericameria nauseosa* shrubs that range in cover from 1 to 15%. The remaining shrub layer is moderately diverse in terms of species composition and provides sparse to moderate cover. Tall shrubs are occasionally present and include *Fraxinus anomala* and the exotic *Tamarix chinensis*. The short- and dwarf-shrub layer includes *Artemisia bigelovii*, *Atriplex canescens*, *Ephedra viridis*, *Shepherdia rotundifolia*, and *Gutierrezia sarothrae*. The herbaceous layer is moderately diverse in terms of species composition and provides sparse to low cover. Common graminoids include *Achnatherum hymenoides*, *Bromus tectorum*, *Elymus elymoides*, and *Sporobolus contractus*. Forbs occasionally present include *Ambrosia acanthicarpa*, *Eriogonum inflatum*, *Lappula occidentalis*, *Psoralidium lanceolatum*, and *Sphaeralcea parvifolia*.

Globally

This shrubland association has sparse to moderate total vegetation cover (1-65%). This association is characterized by an open to moderately dense short-shrub layer distributed in linear rows along the intermittent drainages. *Ericameria nauseosa* is the dominant shrub with 1-15% cover. In sparse or patchy stands, *Ericameria nauseosa* acts as an indicator species. Other shrubs are typically present, but contribute little cover. These include *Artemisia tridentata*, *Atriplex canescens*, *Atriplex confertifolia*, *Ephedra viridis*, *Fraxinus anomala*, *Gutierrezia sarothrae*, *Purshia stansburiana*, *Quercus havardii*, and *Sarcobatus vermiculatus*. The herbaceous stratum has sparse to moderate cover. The exotic *Bromus tectorum* is often abundant. Other herbaceous species commonly found are *Achnatherum hymenoides*, *Descurainia pinnata*, *Elymus elymoides*, *Glycyrrhiza lepidota*, *Hesperostipa comata*, *Hordeum jubatum*, and *Pleuraphis jamesii*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

Stratum

Tall shrub/sapling

Short shrub/sapling

Short shrub/sapling

Herb (field)

Herb (field)

Herb (field)

Species

Fraxinus anomala

Artemisia bigelovii, *Atriplex canescens*, *Ericameria nauseosa*, *Shepherdia rotundifolia*

Ephedra torreyana

Gutierrezia microcephala, *Gutierrezia sarothrae*

Artemisia campestris, *Artemisia ludoviciana*, *Orobancha ludoviciana*, *Psoralidium lanceolatum*

Achnatherum hymenoides, *Sporobolus contractus*

Globally

Stratum

Short shrub/sapling

Species

Ericameria nauseosa

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Agropyron cristatum, Bromus rubens, Bromus tectorum, Conyza canadensis, Descurainia pinnata, Halogeton glomeratus, Malcolmia africana, Salsola tragus, Tamarix chinensis

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (10-Jan-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

In sparse or patchy stands, *Ericameria nauseosa* acts as an indicator species.

CLASSIFICATION CONFIDENCE:

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: There is moderate grazing in some stands. Some sites located in floodplains on terraces flood during large storm events that also deposit and redistribute sediments.

Capitol Reef National Park Data: The description is based on 1986, 1988, 2003, and 2005 (AA) field data (12 plots: CARE.0437, CARE.0438, CARE.9049, CARE.9055, CARE.9105, CARE.9110, CARE.9113, CARE.9141, CARE.9305, CARE.9363, CARE.9366, CARE_AA.0702).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Drake, mod. J. Coles and K.A. Schulz

REFERENCES: Western Ecology Working Group n.d.

***Ericameria nauseosa* Sand Deposit Sparse Shrubland
Rubber Rabbitbrush Sand Deposit Sparse Shrubland**

CODE	CEGL002980
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	<i>ERICAMERIA NAUSEOSA</i> SHRUBLAND ALLIANCE (A.835) Rubber Rabbitbrush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Active and Stabilized Dune (CES304.775)
Southern Colorado Plateau Sand Shrubland (CES304.793)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association occurs on sand sheets and dune systems in southern and eastern Utah, northeastern Arizona and western Colorado, but is likely more common in similar habitats throughout the interior western U.S. *Ericameria nauseosa* is most likely to dominate a community where there has been chronic or severe disturbance, such as grazing, fire or, in rare instances, flooding. Elevation ranges from 1430-2000 m (4700-6560 ft.). At Zion National Park, a stand was described from a colluvial slope below a sandstone cliff. In other areas it occurs on sand dunes and

on sand sheets in flatter areas such as floodplains, stream terraces and valley floors. Sites are generally gentle to moderately sloping, but range from flat to steep and may occur on any aspect. Soils are sandy and may be derived from local sandstone, eolian sands, or alluvium. This association is characterized by a typically sparse short-shrub layer 5-20% cover (but may range up to 30% cover) dominated by *Ericameria nauseosa* (at least half the cover). Other shrubs or dwarf-shrubs are often present and may include *Artemisia bigelovii*, *Atriplex* spp., *Chrysothamnus viscidiflorus*, *Ephedra torreyana*, *Eriogonum corymbosum*, *Ipomopsis congesta*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, or *Yucca elata* var. *utahensis*. The herbaceous layer is generally sparse and is dominated by perennial graminoids such as *Achnatherum hymenoides*, *Aristida purpurea*, *Hesperostipa comata*, *Muhlenbergia pungens*, and *Sporobolus* spp. Forbs associates may include *Chamaesyce glyptosperma*, *Cirsium* spp., *Heterotheca villosa*, *Penstemon palmeri*, *Phacelia heterophylla*, *Sphaeralcea coccinea*, *Streptanthella longirostris*, and *Sophora stenophylla*.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon and was sampled along Deep Creek in the South Desert, just north of the Fremont River near the junction of Highway 24 and Notom Road, and in Upper Cathedral Valley within the park.

Globally

This association has been described from southern and eastern Utah, northeastern Arizona and western Colorado but is likely more common in similar habitats throughout the interior western U.S.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on valley floors, low slopes of hillsides, alluvial flats, and stream terraces. Sites are gentle (1 to 3° slopes), occur between 1567 and 1982 m elevation, and are oriented to a variety of exposures. The unvegetated surface has low to moderate cover of litter. One stand has high cover of gravel, and another has moderate exposure of bare soil. Parent materials include sandstones and shale that have eroded and deposited as alluvium or hill slope deposits. Soils are moderately well-drained to well-drained loamy sands.

Globally

This association occurs on sand sheets and dune systems in southern and eastern Utah, northeastern Arizona and western Colorado, but is likely more common in similar habitats throughout the interior western U.S. Elevation ranges from 1430-2000 m (4700-6560 ft.). At Zion National Park, a stand was described from a colluvial slope below a sandstone cliff. In other areas it occurs on sand dunes and on sand sheets in flatter areas such as floodplains, stream terraces and valley floors (e.g., Von Loh et al. 2002). Sites are generally gentle to moderately sloping, but range from flat to steep and may occur on any aspect. Soils are sandy and may be derived from local sandstone, eolian sands, or alluvium.

VEGETATION DESCRIPTION

Capitol Reef National Park

This sand deposit association is uncommon within the park. The total vegetation cover ranges from 13 to 45%. This short-shrub association is characterized by a sparse to moderately dense canopy of *Ericameria nauseosa* shrubs that range in cover from 5 to 25%. The associated shrub layer is moderately diverse in terms of composition and provides low to moderate cover. Commonly associated short and dwarf-shrubs include *Artemisia bigelovii*, *Atriplex canescens*, *Atriplex confertifolia*, and *Gutierrezia sarothrae*. The herbaceous layer is typically sparse, usually less than 10% cover and often less. Commonly associated graminoids include *Achnatherum hymenoides*, *Muhlenbergia pungens*, and *Sporobolus airoides*. Forbs commonly include *Gaillardia spathulata*, *Lappula occidentalis*, and *Streptanthella longirostris*.

Globally

This association is characterized by a sparse short-shrub layer 5-20% cover dominated by *Ericameria nauseosa* (at least half the cover). Other shrubs or dwarf-shrubs are often present and may include *Artemisia bigelovii*, *Atriplex confertifolia*, *Atriplex canescens*, *Chrysothamnus viscidiflorus*, *Ephedra torreyana*, *Eriogonum corymbosum*, *Ipomopsis congesta*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, or *Yucca elata* var. *utahensis*. The herbaceous layer is generally sparse and is dominated by perennial graminoids such as *Achnatherum hymenoides*, *Aristida purpurea*, *Hesperostipa comata*, *Muhlenbergia pungens*, *Sporobolus airoides*, and *Sporobolus cryptandrus*. Forbs associates may include *Chamaesyce glyptosperma*, *Cirsium* spp., *Heterotheca villosa*, *Penstemon palmeri*, *Phacelia*

heterophylla, *Sphaeralcea coccinea*, *Streptanthella longirostris*, and *Sophora stenophylla*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

Stratum

Short shrub/sapling
Herb (field)
Herb (field)
Herb (field)

Species

Atriplex canescens, *Atriplex confertifolia*, *Ericameria nauseosa*
Gutierrezia sarothrae
Lithospermum multiflorum, *Oxytropis lambertii*, *Streptanthella longirostris*
Muhlenbergia pungens, *Sporobolus airoides*

Globally

Stratum

Short shrub/sapling
Short shrub/sapling
Herb (field)
Herb (field)
Herb (field)

Species

Ericameria nauseosa
Atriplex canescens
Gutierrezia sarothrae, *Opuntia polyacantha*
Heterotheca villosa
Achnatherum hymenoides, *Aristida purpurea*, *Hesperostipa comata*, *Sporobolus cryptandrus*

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Descurainia pinnata*, *Salsola tragus*

Globally

Bromus tectorum, *Yucca elata* var. *utahensis*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (22-Jan-2002).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This association is distinguished as much by its setting as its floristics, and as such is floristically fairly diverse.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Stands experience moderate to heavy grazing. One site floods during large storm events. One site lies adjacent to an historic homestead.

Capitol Reef National Park Data: The description is based on 1986 and 2003 field data (3 plots: CARE.0403, CARE.9058, CARE.9062).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Cogan et al. 2004, Von Loh et al. 2002, Western Ecology Working Group n.d.

***Tamarix* spp. Temporarily Flooded Semi-natural Shrubland Salt-cedar species Temporarily Flooded Semi-natural Shrubland**

CODE	CEGL003114
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	Temporarily flooded microphyllous shrubland (III.A.4.N.c.)
ALLIANCE	<i>TAMARIX</i> SPP. SEMI-NATURAL TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.842)
	Salt-cedar species Semi-natural Temporarily Flooded Shrubland Alliance

ECOLOGICAL SYSTEM(S): North American Warm Desert Lower Montane Riparian Woodland and Shrubland (CES302.748)
North American Warm Desert Riparian Woodland and Shrubland (CES302.753)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This broadly defined association is composed of shrublands that form moderately dense to dense thickets on banks of larger streams across the western Great Plains, interior and southwestern U.S. and northern Mexico. Stands are dominated by introduced species of *Tamarix*, including *Tamarix ramosissima*, *Tamarix chinensis*, *Tamarix gallica*, and *Tamarix parviflora*. *Tamarix* spp. were introduced from the Mediterranean and have become naturalized in various sites, including salt flats and other saline habitats, springs, and especially along streams and regulated rivers, where it replaces the native vegetation, such as shrublands dominated by species of *Salix* or *Prosopis* or woodlands of *Populus* spp. A remnant herbaceous layer may be present, depending on the age and density of the shrub layer, although in many cases this layer also consists of aggressive exotic species such as *Lepidium latifolium*. *Tamarix* species have become a critical nuisance along most large rivers in the semi-arid West and, because of permanent changes in flood regimes and the difficulty of removing trees, reflect irreversibly changed vegetation on many sites.

DISTRIBUTION

Capitol Reef National Park

The sampled stand is located below the Notch in the South Desert. This association occurs sporadically all along Lower Deep Creek in the South Desert and along Halls Creek. Tamarisk removal efforts are being undertaken by the park along Sulphur and Halls creeks and the Fremont River.

Globally

This semi-natural shrubland is found along drainages in the semi-arid western Great Plains, interior and southwestern U.S. and northern Mexico, from central and eastern Montana, south to Colorado, western Oklahoma and Texas, west to California.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This tall-shrub association was observed in drainages throughout the park. The sampled site is gentle (2° slope), occurs at 1585 m elevation, and is oriented to a southeastern aspect. The unvegetated surface is unrecorded. Parent materials are variable and include sandstones and shale deposited as alluvium. Soils are typically poorly drained, high in alkalinity, and coarse-textured.

Globally

These widespread shrublands are common along larger streams, rivers, and around playas in the western U.S. and Mexico. Elevation ranges from 75 m below sea level to 1860 m. *Tamarix* spp. have become naturalized in various sites including riverbanks, floodplains, basins, sandbars, side channels, springs, salt flats, and other saline habitats. Stands grow especially well along regulated rivers where flood-regenerated native species such as *Populus* are declining, and the absence of regular scouring floods allows *Tamarix* seedlings to become established. Substrates are commonly thin sandy loam soil over alluvial deposits of sand, gravel or cobbles.

VEGETATION DESCRIPTION

Capitol Reef National Park

This tamarisk association is a common invasive type along park drainages and around ponds. The vegetation is characterized by a closed canopy of *Tamarix chinensis* shrubs. Graminoids provide low to moderate cover and include *Muhlenbergia pungens*, *Phragmites australis*, and *Schoenoplectus pungens*. *Iva acerosa*, the single forb present, provides low cover. It forms a mosaic with other riparian and wetland communities along the Fremont River, Sulphur Creek, Pleasant Creek, as well as other mesic drainages throughout the park.

Globally

This semi-natural shrubland occurs along streams, rivers and playas where it forms a moderate to dense tall-shrub layer that is solely or strongly dominated by species of *Tamarix*, including *Tamarix ramosissima*, *Tamarix chinensis*, *Tamarix gallica*, and *Tamarix parviflora*. Other shrubs may include species of *Salix* (especially *Salix exigua*) and *Prosopis*, *Rhus trilobata*, and *Sarcobatus vermiculatus* but with low cover (if shrub species are codominant, then the

stand is classified as a natural shrubland). Scattered *Acer negundo*, *Salix amygdaloides*, *Populus* spp., or *Elaeagnus angustifolia* trees may also be present. Depending on stand age and density of the shrub layer, an herbaceous layer may be present. Associated native species include *Distichlis spicata* and *Sporobolus airoides*, and introduced species include *Agrostis gigantea*, *Agrostis stolonifera*, and *Poa pratensis*. Introduced herbaceous species such as *Polypogon monspeliensis*, *Conyza canadensis*, *Lepidium latifolium*, and others have been reported from shrublands in this association.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tall shrub/sapling	<i>Tamarix chinensis</i>
Herb (field)	<i>Iva acerosa</i>
Herb (field)	<i>Schoenoplectus americanus</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tall shrub/sapling	<i>Tamarix chinensis</i> , <i>Tamarix gallica</i> , <i>Tamarix parviflora</i> , <i>Tamarix ramosissima</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Bromus tectorum, *Lepidium latifolium*, *Poa pratensis*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (invasive) (24-Jul-2001).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This is a broadly defined plant association composed of many diverse *Tamarix* spp.-dominated vegetation communities from a wide variety of environments. Muldavin et al. (2000a) described 8 community types that will be reviewed as possible USNVC associations.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: This association experiences heavy grazing in some locations.

Capitol Reef National Park Data: The description is based on 1987 field data (1 plot: CARE.9310).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: K.A. Schulz, mod. J. Coles

REFERENCES: Baalman 1965, Carsey et al. 2003a, Cogan et al. 2004, Cowardin et al. 1979, Hansen et al. 1995, Hansen et al. 2004b, Hoagland 2000, Holland 1986b, MTNHP 2002b, Muldavin et al. 2000a, NVNHP 2003, Nachlinger and Reese 1996, Ortenberger and Bird 1933, Paysen et al. 1980, Sawyer and Keeler-Wolf 1995, Smith 1989, Stevens and Shannon 1917, Szaro 1989, Ungar 1968, Von Loh et al. 2002, Ware and Penfound 1949

***Artemisia bigelovii* Shrubland Bigelow Sagebrush Shrubland**

CODE	CEGL000276
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 BIGELOVII* SHRUBLAND ALLIANCE (A.1103)
Bigelow Sagebrush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association occurs most commonly on ledgy slopes, canyon rims and ridges in the east-central part of the Colorado Plateau (southeastern Utah and northern Arizona). Slopes are gentle and elevations range from 1552 to 1900 m (5090-6234 ft.). Substrates include alluvial and eolian deposits that have weathered into coarse loamy sands. These soils are often thin and overlie sandstone bedrock. The vegetation is dominated by *Artemisia bigelovii*, but other shrub species are always present, including *Atriplex confertifolia*, *Ephedra torreyana*, *Gutierrezia sarothrae*, *Purshia stansburiana*, and *Yucca harrimaniae*. The total cover of the associated shrubs may exceed that of *Artemisia bigelovii*. The herbaceous understory is sparse, rarely exceeding 5-10% cover, and variable from stand to stand. *Pleuraphis jamesii* is often present in the otherwise graminoid-poor understory; other herbaceous species may include *Arenaria fendleri*, *Calochortus flexuosus*, *Chaenactis stevioides*, *Oenothera pallida*, and *Rumex hymenosepalus*. Cryptobiotic soil crusts may have high cover. Scattered individuals of *Juniperus osteosperma* may be present.

DISTRIBUTION

Capitol Reef National Park

This association was sampled near Solomon's Temple in the park in 1986. Since that time the area near this plot has converted to a mixed grassland with low shrub cover. Another plot of this association was sampled during accuracy assessment in Holts Draw.

Globally

This association has been documented from northern Arizona and adjacent parts of southeastern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This shrubland association was observed on nearly flat settings on uplands as well as on sandy valley floors. Sites slope gently (1° slope) between 1850 and 1900 m elevation. The unvegetated surface consists mostly of exposed sandy soil, pebbles and litter. Parent materials are sandstones and shale that have eroded and been re-deposited as alluvial and eolian material. Soils are rapidly drained loamy sands and sandy loams.

Globally

This short shrubland association occurs most often on ledgy slopes, canyon rims and ridges and less often on valley floors in the east-central part of the Colorado Plateau (southeastern Utah and northern Arizona). Slopes are gentle and elevations range from 1552 to 1900 m (5090-6234 ft.). Substrates include alluvial and eolian deposits derived from sandstones and shales that have weathered into coarse loamy sands. These soils are often thin and overlie sandstone bedrock. A high percentage of the unvegetated surface may be covered by cryptobiotic soil crusts.

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland association is reported both from a high flat-topped ridge and from a sandy valley floor. Total vegetation cover ranges from around 25 to 40%. The open shrub canopy is dominated by *Artemisia bigelovii* with 10 to 20% cover. Associated shrubs include *Eriogonum microthecum*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, and *Yucca harrimaniae*. The herbaceous layer is patchy, but *Pleuraphis jamesii* generally dominates the layer.

Globally

This association occurs primarily in sites where the coarse sandy soils are thin and overlie sandstone bedrock. The total vegetation cover, therefore, is generally somewhat sparse, rarely exceeding 25%. The shrub layer is dominated by *Artemisia bigelovii*, but other shrub species are always present, including *Atriplex confertifolia*, *Ephedra torreyana*, *Gutierrezia sarothrae*, *Purshia stansburiana*, and *Yucca harrimaniae*. The total cover of the associated shrubs may exceed that of *Artemisia bigelovii*. The herbaceous understory is sparse, rarely exceeding 5-10% cover,

and variable from stand to stand. *Pleuraphis jamesii* is often present in the otherwise graminoid-poor understory; other herbaceous species may include *Arenaria fendleri*, *Calochortus flexuosus*, *Chaenactis stevioides*, *Oenothera pallida*, and *Rumex hymenosepalus*. Scattered individuals of *Juniperus osteosperma* may be present, but total tree cover is usually less than 5%, and there is little chance that trees will take over the community because of the lack of suitable sites for establishment of deep-rooted species such as juniper.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Eriogonum microthecum</i> , <i>Gutierrezia sarothrae</i>
Short shrub/sapling	<i>Artemisia bigelovii</i> , <i>Yucca harrimaniae</i>
Herb (field)	<i>Pleuraphis jamesii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex confertifolia</i>
Short shrub/sapling	<i>Artemisia bigelovii</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (7-Jan-2003).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

A closely related association, *Artemisia bigelovii* - *Ephedra* (*viridis*, *torreyana*) Talus Shrubland (CEGL003755), occurs on colluvial slopes, sometimes below the rim habitats that support *Artemisia bigelovii* Shrubland (CEGL000276). It is possible that these associations should be combined.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Area has moderate grazing. This association occurs in conjunction with other mixed desert shrubs where species form a mosaic, often on broad plains cut by dry washes. The 2005 plot is on a large flat area with washes (dry) throughout.

Capitol Reef National Park Data: The description is based on 1988 field data and 2005 accuracy assessment data (2 plots: CARE.9061, CARE_AA.1036).

Local Description Authors: J. Von Loh, mod. D. Clark and J. Coles

Global Description Authors: J. Coles

REFERENCES: Romme et al. 1993, Thomas et al. 2003b, Western Ecology Working Group n.d.

***Ephedra torreyana* / *Achnatherum hymenoides* - *Pleuraphis jamesii* Shrubland Torrey's Joint-fir / Indian Ricegrass - James' Galleta Shrubland**

CODE	CEGL002352
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 *EPHEDRA TORREYANA* SHRUBLAND ALLIANCE (A.2572)
Torrey's Joint-fir Shrubland Alliance
ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)
Colorado Plateau Blackbrush-Mormon-tea Shrubland (CES304.763)
Inter-Mountain Basins Active and Stabilized Dune (CES304.775)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This shrubland association occurs in large patches on broad sandy plains, as well as in smaller patches on knolls, toe slopes and pediments. Sites are flat to gentle (not exceeding 8°), occur between 1220 and 2000 m elevation, and tend to be oriented to warm south or west aspects. The unvegetated surface has up to 90% exposure of sand or bare soil. Parent materials include Entrada, Navajo, Summerville and Carmel formation materials that have eroded to alluvial or eolian sands and clays. Soils are rapidly drained to well-drained loamy sands where derived from secondary materials or sandy clays where derived from underlying shales. Total vegetation cover ranges from 5 to 25% in this variable community, which includes stands that are shrub-herbaceous in structure as well as shrublands and sparse vegetation. Vegetation composition is characterized by an open canopy of *Ephedra torreyana* that ranges between 2 to 25% cover, with an understory codominated by *Achnatherum hymenoides* and *Pleuraphis jamesii* with between 2 and 15% cover. Associated shrubs include *Atriplex canescens*, *Opuntia polyacantha*, and *Gutierrezia sarothrae*. *Coleogyne ramosissima* is absent or has 1% or less cover. The remaining herbaceous layer often includes *Astragalus amphioxys*, *Malacothrix sonchoides*, *Sporobolus airoides*, *Sporobolus flexuosus*, and *Sphaeralcea parvifolia*.

DISTRIBUTION

Capitol Reef National Park

This association is common throughout the park and on adjacent BLM-managed lands. It was sampled within the park in Cathedral Valley, near the Temples, near Campers Spring, and near The Notch.

Globally

This association is known from scattered sites in southeastern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on plains, knolls, interfluves, and pediments. Sites are flat to gentle (0 to 8° slopes), occur between 1524 and 2000 m elevation, and are oriented to all aspects. The unvegetated surface has high exposure of sand and bare soil, and sparse to low cover of litter. Parent materials are Entrada sandstone, Summerville and Carmel exposures that have eroded to alluvial deposits. Soils are rapidly drained to well-drained loamy sands or sandy clays.

Globally

This shrubland association occurs in large patches on broad sandy plains, as well as in smaller patches on knolls, toe slopes and pediments. Sites are flat to gentle (up to 8° slopes), occur between 1220 and 2000 m elevation, and tend to be oriented to warm south or west aspects. Nearly all of the unvegetated surface is sand or bare soil (up to 90%) and sparse to low cover of litter. Parent materials include Entrada, Navajo, Summerville and Carmel formation exposures that have eroded to alluvial or eolian sands. Soils are rapidly drained to well-drained loamy sands where derived from secondary materials or sandy clays where derived from underlying shales.

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland association is common throughout the park and on adjacent BLM-managed lands. The total vegetation cover ranges from 5 to 55%. This shrubland association is characterized by an open canopy of *Ephedra torreyana* short shrubs that range in cover from 1 to 25%, and the bunch grasses *Achnatherum hymenoides* and *Pleuraphis jamesii* that range in cover from <1 to 15%. The associated short- and dwarf-shrub layers are somewhat diverse in terms of species composition, provide sparse to low cover, and include *Atriplex canescens*, *Opuntia polyacantha*, and *Gutierrezia sarothrae*. The remaining herbaceous layer is moderate in species composition, provides sparse cover, and includes the forbs *Astragalus amphioxys*, *Malacothrix sonchoides*, *Salsola tragus*, and

Sphaeralcea parvifolia.

Globally

Total vegetation cover ranges from 5 to 25% in this variable community, which includes stands that are shrub-herbaceous in structure as well as shrublands and sparse vegetation. Vegetation composition is characterized by an open canopy of *Ephedra torreyana* that ranges between 2 to 25% cover, with an understory codominated by *Achnatherum hymenoides* and *Pleuraphis jamesii* with between 2% and 15% cover. Associated shrubs include *Atriplex canescens*, *Opuntia polyacantha*, and *Gutierrezia sarothrae*. *Coleogyne ramosissima* is absent or has 1% or less cover. The remaining herbaceous layer often includes *Astragalus amphioxys*, *Malacothrix sonchoides*, *Sporobolus airoides*, *Sporobolus flexuosus*, and *Sphaeralcea parvifolia*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex canescens</i> , <i>Ericameria nauseosa</i>
Short shrub/sapling	<i>Ephedra torreyana</i>
Herb (field)	<i>Eriogonum corymbosum</i> , <i>Eriogonum leptocladon</i> , <i>Gutierrezia sarothrae</i> , <i>Opuntia polyacantha</i>
Herb (field)	<i>Salsola tragus</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Pleuraphis jamesii</i> , <i>Sporobolus airoides</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex canescens</i>
Short shrub/sapling	<i>Ephedra torreyana</i>
Herb (field)	<i>Gutierrezia sarothrae</i> , <i>Opuntia polyacantha</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Pleuraphis jamesii</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park
Chenopodium album, *Salsola tragus*

Globally

Salsola tragus

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (21-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park
Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: There is light to moderate grazing of some stands by cattle. Stands are flat to gently sloping sandy deposits on wide flats.

Capitol Reef National Park Data: The description is based on 1986, 2003, and 2004 field data (8 plots: CARE.0429, CARE.0435, CARE.0623, CARE.0624, CARE.0625, CARE.0626, CARE.0627, CARE.9129).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Ephedra torreyana* / *Bouteloua gracilis* - *Pleuraphis jamesii* Shrubland**

Torrey's Joint-fir / Blue Grama - James' Galleta Shrubland

CODE	CEGL002351
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	<i>EPHEDRA TORREYANA</i> SHRUBLAND ALLIANCE (A.2572) Torrey's Joint-fir Shrubland Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Blackbrush-Mormon-tea Shrubland (CES304.763)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This shrubland association has only been described from a small area of Capitol Reef National Park, Utah; this summary is derived from plot data collected in the park in 1986 and 2004. The sampled plots are located on top of a mesa capped with basalt boulders. Sampled sites are flat to gently sloping (0-9%), occur between 1677 and 1755 m elevation, and are oriented to any aspect. The unvegetated surface has moderate cover of large rocks, small rocks and gravel. There is low exposure of bare soil and low cover of litter and live vegetation basal area. Soils are rapidly drained sandy clays derived from basalt that has eroded and been re-deposited as terrace boulder gravels. Total vegetation cover ranges from 25 to 75%. The vegetation is characterized by an open canopy of *Ephedra torreyana* shrubs with between 15 and 25% cover and a relatively dense understory dominated by the grasses *Bouteloua gracilis* and *Pleuraphis jamesii* with between 5 and 35% cover. Associated shrubs provide low cover and include *Atriplex confertifolia*, *Echinocereus triglochidiatus*, *Opuntia polyacantha*, and *Yucca harrimaniae*. The remaining herbaceous layer is depauperate and provides sparse cover, including the graminoids *Aristida purpurea* and *Hesperostipa comata* and the forbs *Chaetopappa ericoides* and *Sphaeralcea coccinea*.

DISTRIBUTION

Capitol Reef National Park

This association is rare and was sampled within the park on Johnson Mesa near Fruita.

Globally

This association is known only from Capitol Reef National Park. It may occur in areas adjacent to the park on similar substrates.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This shrubland association was observed on mesa tops. Sampled sites are flat to gentle (0 to 5° slopes), occur between 1677 and 1755 m elevation, and are oriented to all aspects. The unvegetated surface has moderate cover of large rocks, small rocks, and gravel. There is low exposure of bare soil and low cover of litter and live vegetation basal area. Parent materials are volcanic rocks that have deposited as terrace gravels. Soils are rapidly drained sandy clays.

Globally

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

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland association is rare, known only from Johnson Mesa within the park. The total vegetation cover ranges from 24 to 75%. This shrubland association is characterized by an open canopy of *Ephedra torreyana* short shrubs that range in cover from 15 to 25%, and the grasses *Bouteloua gracilis* and *Pleuraphis jamesii* that range in cover from 5 to 25% and 1 to 15%, respectively. The associated short- and dwarf-shrub layers are somewhat diverse in terms of species composition, provide sparse to low cover, and include *Atriplex confertifolia*, *Echinocereus triglochidiatus*, *Opuntia polyacantha*, and *Yucca harrimaniae*. The remaining herbaceous layer is low in species

composition and provides sparse cover. Other graminoids provide sparse cover and commonly include *Aristida purpurea* and *Hesperostipa comata*. Forbs commonly present and providing sparse cover include *Chaetopappa ericoides* and *Sphaeralcea coccinea*.

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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex confertifolia</i>
Short shrub/sapling	<i>Ephedra torreyana</i>
Herb (field)	<i>Echinocereus triglochidiatus</i> , <i>Opuntia polyacantha</i> , <i>Yucca harrimaniae</i>
Herb (field)	<i>Aristida purpurea</i> , <i>Bouteloua gracilis</i> , <i>Hesperostipa comata</i> , <i>Pleuraphis jamesii</i>

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (21-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef 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

Capitol Reef National Park Inventory Notes: Volcanic boulders, black in color, cover the entire mesa top and stabilize soil from erosion on two sites. One site is located on a ridge top.

Capitol Reef National Park Data: The description is based on 1986, 2004, and 2005 (AA) field data (7 plots: CARE.0621, CARE.0622, CARE.9344, CARE_AA.0166, CARE_AA.0637, CARE_AA.0865, CARE_AA.1228).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Ephedra viridis* / (*Achnatherum hymenoides*, *Hesperostipa comata*) Shrubland
Mormon-tea / (Indian Ricegrass, Needle-and-Thread) Shrubland**

CODE	CEGL002354
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 *EPHEDRA VIRIDIS* SHRUBLAND ALLIANCE (A.858)
Mormon-tea Shrubland Alliance

ECOLOGICAL SYSTEM(S): North American Warm Desert Active and Stabilized Dune (CES302.744)
Colorado Plateau Blackbrush-Mormon-tea Shrubland (CES304.763)
Inter-Mountain Basins Active and Stabilized Dune (CES304.775)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This short-shrub association occurs on sand dunes and sand sheets deposited on plateaus, benches and valley floors in southeastern Utah. Stands of this association usually occur as patches of one to several hectares within a matrix of other sandy communities dominated by *Coleogyne ramosissima* and *Artemisia filifolia*. Sites occupy gentle to moderately steep slopes (1-45%) between 1378 and 2018 m elevation and oriented to a variety of aspects, with a slight tendency toward northern and eastern aspects. The unvegetated surface has up to 96% sand or bare soil, with the balance covered by litter or dark cyanobacteria. Soils are rapidly drained loamy sands and sandy loams derived from eolian sands or alluvial deposits. Total vegetation cover ranges from 1 to 55% but generally is around 35%. The vegetation is characterized by an open canopy of clonal *Ephedra viridis* shrubs with between 5 and 20% cover with a well-developed grassy understory dominated by either *Achnatherum hymenoides* or *Hesperostipa comata*. Herbaceous cover totals as much as 35%. Associated shrubs include scattered *Coleogyne ramosissima*, *Atriplex canescens*, *Eriogonum leptocladon*, and the succulent *Opuntia polyacantha*. Other grasses include *Aristida purpurea*, *Muhlenbergia pungens*, *Sporobolus cryptandrus*, and *Bouteloua gracilis*. If *Pleuraphis jamesii* is present, it is with much less cover than either *Hesperostipa comata* or *Achnatherum hymenoides*. Forbs include many species typical of sandy communities, including *Abronia fragrans*, *Chaenactis stevioides*, *Cymopterus newberryi*, *Oenothera pallida*, *Machaeranthera canescens*, *Plantago patagonica*, and *Sphaeralcea parvifolia*. Cryptogams are often present and provide up to 25% cover.

DISTRIBUTION

Capitol Reef National Park

This rare to uncommon association was sampled north of the Halls Creek Overlook and in Halls Creek drainage.

Globally

This association is locally common on sandy sites in the Colorado Plateau in southeastern Utah and probably occurs in adjacent states.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on valley floors on alluvial and eolian deposits. Sampled sites are gentle (0 to 4° slopes), occur between 1378 and 1402 m elevation, and are oriented to eastern aspects. The unvegetated surface has high exposure of bare soil, up to 93%. There is low cover by litter. Parent materials are sandstones and shale that have eroded to eolian and alluvial sand sheet and dune deposits. Soils are rapidly drained sandy loams.

Globally

This short-shrub association occurs on sand dunes and sand sheets deposited on plateaus, benches and valley floors in southeastern Utah. Sites occupy gentle to moderately steep slopes (1-45%) between 1378 and 2018 m elevation and oriented to a variety of aspects, with a slight tendency toward northern and eastern aspects. The unvegetated surface has up to 96% sand or bare soil, with the balance covered by litter or dark cyanobacteria. Cover of biological soil communities is typically sparse (<10%) but ranges from none to 25%. Cover of litter is sparse to low. Soils are rapidly drained loamy sands and sandy loams derived from sandstones and shale that have eroded to eolian sands or alluvial deposits.

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland association is rare to uncommon in Halls Creek drainage within the park. The total vegetation cover ranges from 7 to 75% in these sparsely to densely vegetated stands. This shrubland association is characterized by an open canopy of *Ephedra viridis* short shrubs that range in cover from 1 to 35% and the perennial bunchgrass *Achnatherum hymenoides* that ranges in cover from <1 to 35%. The associated short- and dwarf-shrub layer is low in

species diversity and provides sparse cover, including *Atriplex canescens* and the succulent *Opuntia polyacantha*. The remaining herbaceous layer is somewhat diverse in terms of species composition and provides sparse cover. Commonly associated graminoids include *Aristida purpurea* and the annual exotic grass *Bromus tectorum*. Forbs commonly present include *Ambrosia acanthicarpa*, *Plantago patagonica*, and the exotic annual tumbleweed *Salsola tragus*. Cryptogams are present in these degraded stands and provide 1 to 5% cover.

Globally

Stands of this association usually occur as patches of one to several hectares within a matrix of other sandy communities dominated by *Coleogyne ramosissima* and *Artemisia filifolia*, although occasionally it will be the matrix community. The appearance is that of a grassland containing large, low-growing clonal clumps of *Ephedra viridis*. Total vegetation cover ranges from 5 to 55% but generally is between 15 and 35%. The vegetation is characterized by an open canopy of *Ephedra viridis* shrubs with between 5 and 20% cover with a well-developed grassy understory dominated by either *Achnatherum hymenoides* or *Hesperostipa comata*. The herbaceous layer totals up to 35% cover. Associated shrubs include scattered *Coleogyne ramosissima*, *Atriplex canescens*, *Eriogonum leptocladon*, *Gutierrezia sarothrae*, and the succulents *Opuntia erinacea*, *Opuntia polyacantha*, and *Sclerocactus whipplei*. Other grasses include *Aristida purpurea*, *Bouteloua gracilis*, *Muhlenbergia pungens*, *Sporobolus airoides*, *Sporobolus cryptandrus*, and *Vulpia octoflora*. If *Pleuraphis jamesii* is present, it is with much less cover than either *Hesperostipa comata* or *Achnatherum hymenoides*. Forbs include many species typical of sandy communities, including *Abronia fragrans*, *Ambrosia acanthicarpa*, *Artemisia campestris*, *Chaenactis stevioides*, *Cymopterus newberryi*, *Cryptantha* sp., *Descurainia pinnata*, *Eriogonum deflexum*, *Hymenopappus filifolius*, *Lappula occidentalis*, *Machaeranthera canescens*, *Mentzelia multiflora*, *Oenothera pallida*, *Packera multilobata*, *Plantago patagonica*, and *Sphaeralcea parvifolia*. The exotic annual tumbleweed *Salsola tragus* and the exotic annual grass *Bromus tectorum* are common in some stands. Biological soil crusts are often present and provide up to 25% cover.

MOST ABUNDANT SPECIES

Capitol Reef National Park

Stratum

Short shrub/sapling

Herb (field)

Herb (field)

Species

Ephedra viridis

Corispermum villosum, *Salsola tragus*

Achnatherum hymenoides, *Bromus tectorum*

Globally

Stratum

Shrub/sapling (tall & short)

Herb (field)

Species

Ephedra viridis

Achnatherum hymenoides, *Hesperostipa comata*

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Chenopodium album*, *Salsola tragus*

Globally

Bromus tectorum, *Chenopodium album*, *Salsola tragus*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (21-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Sites were intensively grazed by cattle until 1988. Grazing, coupled with drought resulted in many dead plants and invasion of annual exotic plants. On one stand *Ephedra viridis* is

dying from drought stress.

Capitol Reef National Park Data: The description is based on 2004 field data (5 plots: CARE.0639, CARE.0640, CARE.0704, CARE.0706, CARE.0709).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Anderson 2001b, Western Ecology Working Group n.d.

***Ephedra viridis* / *Bromus tectorum* Semi-natural Shrubland Mormon-tea / Cheatgrass Semi-natural Shrubland**

CODE	CEGL002355
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	<i>EPHEDRA VIRIDIS</i> SHRUBLAND ALLIANCE (A.858) Mormon-tea Shrubland Alliance

ECOLOGICAL SYSTEM(S): Southern Colorado Plateau Sand Shrubland (CES304.793)
Colorado Plateau Blackbrush-Mormon-tea Shrubland (CES304.763)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This shrub association results from disturbance of other shrubland types, either by persistent grazing or by fire. It occurs on hills, plateaus, ridges and canyon walls in western Colorado and southern Utah. Elevations range from 1450 to 1650 m (4760-5415 ft.), and slopes range from gentle to steep. Soils are sandy and may be derived from eolian or alluvial deposits. *Ephedra viridis* dominates the open shrub layer in this association; few other shrubs are present or contribute more than 1% cover. The herbaceous layer is dominated by *Bromus tectorum*, although it is usually accompanied by native grasses, including *Hesperostipa comata*, *Poa fendleriana*, and *Poa secunda*. Other weedy herbaceous species may also be present, such as *Erodium cicutarium*.

DISTRIBUTION

Capitol Reef National Park

This association is common adjacent to the park and was sampled on BLM-managed land one mile east of the park boundary. It is found occasionally in the southern portion of the park along Halls Creek drainage.

Globally

This association has been reported from northwestern Colorado and southern Utah. It is likely to be widespread throughout the Colorado Plateau.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This shrubland association was observed in swales of rolling hills and ridges. The sampled site is gentle (4° slope), occurs at 1555 m elevation, and is oriented to an eastern aspect. The unvegetated surface consists primarily of bare soil, to 70%. The remaining cover consists of litter and live stem basal area. Parent materials are Dakota sandstone that eroded to eolian and alluvial deposits. Soils are well-drained sandy loams.

Globally

This shrub association occurs on hills, plateaus, ridges and canyon walls in western Colorado and southern Utah. Elevations range from 1450 to 1650 m (4760-5415 ft.), and slopes range from gentle to steep. Soils are sandy and may be derived from eolian or alluvial deposits.

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland association is common on Halls Mesa just outside the park and occasional in Halls Creek drainage in the park. The total vegetation cover ranges from 80 to 100% in this densely vegetated stand. This shrubland association is characterized by an open canopy of *Ephedra viridis* dwarf-shrubs that range in cover from 35 to 45% and the exotic annual grass *Bromus tectorum* that ranges in cover from 45 to 55%. The associated dwarf-shrub layer includes the succulent *Opuntia polyacantha*, which provides sparse cover. The remaining herbaceous layer is low in species composition and provides sparse cover. The annual exotic forb *Erodium cicutarium* is present.

Globally

Ephedra viridis dominates the open shrub layer in this association; scattered *Opuntia polyacantha* or *Atriplex confertifolia* may occur in a stand, but few other shrubs are present or contribute more than 1% cover. The herbaceous layer is dominated by *Bromus tectorum*, although it is usually accompanied by native grasses, including *Hesperostipa comata*, *Poa fendleriana*, and *Poa secunda*. Other weedy herbaceous species may also be present, such as *Erodium cicutarium*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Ephedra viridis</i>
Herb (field)	<i>Bromus tectorum</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Ephedra viridis</i>
Herb (field)	<i>Bromus tectorum</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, Erodium cicutarium

Globally

Erodium cicutarium

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (ruderal) (21-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

There is little quantitative information for this semi-natural association.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Plot lies on BLM land one mile from park boundary. This association occurs in pockets between stands of blackbrush, occupying lower swales. Blackbrush occupies upper swales. The grass component varies between James' galleta and cheatgrass. Area is heavily grazed. The heavy grazing results in forbs being weedy species. *Ephedra viridis* is heavily grazed and is no taller than the grasses.

Capitol Reef National Park Data: The description is based on 2004 field data (1 plot: CARE.0652).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Ephedra viridis* / *Pleuraphis jamesii* Shrubland
Mormon-tea / James' Galleta Shrubland**

CODE C EGL002356
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 *EPHEDRA VIRIDIS* SHRUBLAND ALLIANCE (A.858)
Mormon-tea Shrubland Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Blackbrush-Mormon-tea Shrubland (CES304.763)
North American Warm Desert Active and Stabilized Dune (CES302.744)
Inter-Mountain Basins Active and Stabilized Dune (CES304.775)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This shrubland association occurs on partly stabilized dune fields and sand sheets on valley floors, plateau slopes, benches and mesa tops. Stands of this association usually occur as patches of one to several hectares within a matrix of other sandy communities dominated by *Coleogyne ramosissima* or *Artemisia filifolia*, although occasionally it will be the matrix community. The appearance is that of a grassland containing large, low-growing clonal clumps of *Ephedra viridis*. Sites are located on gentle slopes (3-10 %) between 1396 and 1850 m (4577-6070 ft.) elevation. Aspect is not important in determining the distribution of this association. The unvegetated surface has high exposure of bare soil and low to moderate cover of litter; biological soil crusts provide up to 30% cover. The rapidly drained, fine sandy loam, loamy sand, and sandy clay soils are derived from sandstones and shales, eolian deposits and alluvium. Total vegetation cover ranges from 6 to 85%. The vegetation is characterized by an open canopy of *Ephedra viridis* that ranges in cover from 5 to 55% and the short bunchgrass *Pleuraphis jamesii* that ranges in cover from 1 to 15%. If *Achnatherum hymenoides* and *Hesperostipa comata* are present, it is with much less cover than *Pleuraphis jamesii*. Associated shrubs include *Atriplex canescens*, *Gutierrezia sarothrae*, and *Opuntia polyacantha*. The herbaceous layer is diverse in terms of species composition and provides sparse to low cover. Associated graminoids include *Aristida purpurea*, *Bouteloua gracilis*, *Sporobolus airoides*, *Sporobolus cryptandrus*, and the annual exotic grass *Bromus tectorum*. Forbs commonly present include *Cryptantha crassisejala*, *Helianthus petiolaris*, *Lappula occidentalis*, *Plantago patagonica*, and *Sphaeralcea parvifolia*.

DISTRIBUTION

Capitol Reef National Park

This association is common adjacent to the park and was sampled on the Airport Route and at the Halls Creek Overlook. It may occur in Halls Creek drainage within the park but has not been recorded to date.

Globally

This association is known from sandy sites in the Colorado Plateau in southeastern Utah and likely occurs in adjacent states.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This dwarf-shrub association was observed on relatively flat plains or mesa tops. Sampled sites are gentle (0 to 1° slopes), occur between 1522 and 1528 m elevation, and are oriented to northern aspects. The unvegetated surface consists primarily of bare soil and live stem basal area. There is low cover by litter. Parent materials are Dakota sandstone that eroded to eolian and sand sheet deposits. Soils are rapidly drained loamy sands.

Globally

This shrubland association occurs on partly stabilized dune fields and sand sheets on valley floors, plateau slopes, benches and mesa tops. Sites are located on flat to gentle slopes (<10 %) between 1396 and 1850 m (4577-6070 ft.) elevation. Aspect is not important in determining the distribution of this association. The unvegetated surface is variable but generally has high exposure of bare soil and sparse to moderate cover of litter and biological soil communities; rare sites will have high cover of colluvial boulders. Cryptogams may provide up to 30% cover. Soils are derived from sandstones and shales, eolian deposits and alluvium. They are rapidly drained, fine sandy loams, loamy sands, and sandy clays. Parent materials include Dakota sandstone that eroded to eolian and sand sheet

deposits, Morrison Formation and alluvium.

Capitol Reef National Park

This shrubland association is common in the vicinity of Halls Creek Overlook and the Airport Route adjacent to the park. The total vegetation cover ranges from 50 to 85% in these moderately to densely vegetated stands. This shrubland association is characterized by an open canopy of *Ephedra viridis* dwarf-shrubs that range in cover from 45 to 55% and the perennial short bunchgrass *Pleuraphis jamesii* that ranges in cover from 5 to 15%. The associated dwarf-shrub layer includes *Gutierrezia sarothrae* and the succulent *Opuntia polyacantha*, which provide sparse cover. The remaining herbaceous layer is comprised of the annual exotic grass *Bromus tectorum* that can provide 15% cover, and the forbs *Gilia inconspicua* and *Sphaeralcea parvifolia* that provide sparse cover.

Globally

Stands of this association usually occur as patches of one to several hectares within a matrix of other sandy communities dominated by *Coleogyne ramosissima* or *Artemisia filifolia*, although occasionally it will be the matrix community. The appearance is that of a grassland containing large, low-growing clonal clumps of *Ephedra viridis*. The total vegetation cover ranges from 6 to 85% in these sparsely to moderately vegetated stands. This short-shrub association is characterized by an open to moderately dense canopy of *Ephedra viridis* that ranges in cover from 5 to 55% and the short bunchgrass *Pleuraphis jamesii* that ranges in cover from 1 to 15%. If *Achnatherum hymenoides* and *Hesperostipa comata* are present, it is with much less cover than *Pleuraphis jamesii*. Associated shrubs include *Atriplex canescens*, *Gutierrezia sarothrae*, and *Opuntia polyacantha*. The herbaceous layer is diverse in terms of species composition and provides sparse to low cover (<20%). Associated graminoids include *Aristida purpurea*, *Bouteloua gracilis*, *Sporobolus airoides*, *Sporobolus cryptandrus*, and the annual exotic grass *Bromus tectorum* (up to 15% cover). Forb cover is low but may be diverse. Associated forbs include *Cryptantha crassisejala*, *Eriogonum cernuum*, *Gilia inconspicua*, *Helianthus petiolaris*, *Lappula occidentalis*, *Lupinus pusillus*, *Mentzelia albicaulis*, *Packera multilobata*, *Plantago patagonica*, and *Sphaeralcea parvifolia*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Ephedra viridis</i>
Herb (field)	<i>Bromus tectorum</i> , <i>Pleuraphis jamesii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Ephedra viridis</i>
Herb (field)	<i>Pleuraphis jamesii</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum

Globally

Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (22-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

It is not clear what the habitat differences are that determine whether this association or *Ephedra viridis* / (*Achnatherum hymenoides*, *Hesperostipa comata*) Shrubland (CEGL002354) will occupy a site; both prefer relatively level sites with loose sandy soils. Yet they are distinct; on the Island in the Sky in Canyonlands National Park, there is a boundary between the two associations so sharp you can stand astride it.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Sites are grazed by cattle. Flat ground collects water and has no vegetation in lower depressions. Blackbrush dominates sand hummocks and on sandstone outcrops.

Capitol Reef National Park Data: The description is based on 2004 field data (2 plots: CARE.0601, CARE.0603).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Anderson 2001b, Western Ecology Working Group n.d.

***Poliomintha incana* - *Artemisia filifolia* - *Vancleavea stylosa* Shrubland
Hoary Rosemarymint - Sand Sagebrush - Pillar False Gumweed Shrubland**

CODE	CEGL002418
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	<i>POLIOMINTHA INCANA</i> SHRUBLAND ALLIANCE (A.862) Hoary Rosemarymint Shrubland Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Blackbrush-Mormon-tea Shrubland (CES304.763)
Inter-Mountain Basins Active and Stabilized Dune (CES304.775)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This Colorado Plateau shrubland association occurs where there is loose, blowing sand on dunes, benches, sand sheets, stabilized climbing dunes on steep canyon sides and in intermittent channels on valley floors in southeastern Utah. It usually occurs in small patches within a matrix of shrublands on more stable sands and dominated by *Coleogyne ramosissima* or *Artemisia filifolia*. Stands are located on flat to moderate slopes (to 30%) between 1271 and 1663 m (4170-5455 ft.) elevation and tend to be oriented to southern or eastern aspects. The unvegetated surface has low cover of litter and moderate to high exposure of sand and bare soil. Biological soil crusts may absent or provide sparse to up to 25% cover. Soils are poorly developed, rapidly drained sands and sandy loams derived from eolian sands and sandy alluvium. Total vegetation cover ranges from 5 to 55% and is characterized by a mixed open canopy consisting of a combination of *Poliomintha incana*, *Artemisia filifolia*, and *Vancleavea stylosa*. One of these shrubs may be absent, but at a minimum either *Poliomintha incana* or *Vancleavea stylosa* is always present. Associated shrubs commonly include *Atriplex canescens*, *Ephedra viridis*, *Eriogonum leptocladon*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, and *Yucca harrimaniae*. If *Coleogyne ramosissima* is present, it is with very low cover relative to the diagnostic species. The herbaceous layer is moderate to high in terms of species diversity and typically provides sparse to low cover, except in cases where the exotic annual forb *Salsola tragus* may have up to 15% cover. *Achnatherum hymenoides*, *Aristida purpurea*, and *Muhlenbergia pungens* are the most consistent grasses other than the exotic annual *Bromus tectorum*. Forb composition varies greatly among stands, but species tend to be sand specialists such as *Abronia fragrans*, *Ambrosia acanthicarpa*, *Cryptantha crassisejala*, *Chamaesyce parryi*, *Hymenopappus filifolius*, *Iva acerosa*, *Oenothera pallida*, *Stephanomeria exigua*, and *Streptanthella longirostris*. Isolated *Juniperus osteosperma* occur in some stands where the sand is shallow over bedrock.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon and was sampled along both upper and lower Halls Creek drainage. A few pockets of this association also occur in the South Desert.

Globally

This association has been documented from the Colorado Plateau in southeastern Utah, where it is locally common

on sandy sites.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on slopes, steps-in-slope, and in channels on valley floors. Sites are gentle to moderately steep (0 to 15° slopes), occur between 1280 and 1663 m elevation, and are oriented to southern aspects. The unvegetated surface has moderate cover of litter and moderate to high exposure of sand and bare soil. Live vegetation basal area provides low to moderate cover. Cryptogams provide as much as 25% cover. Parent materials are Navajo and Entrada sandstone formations that have eroded and distributed as alluvium and eolian deposits. Soils are well-drained to rapidly drained sands and sandy loams.

Globally

This short-shrub association occurs where there is loose, blowing sand on dunes, benches, sand sheets, stabilized climbing dunes on steep canyon sides and in intermittent channels in southeastern Utah. Stands are generally located on flat to moderate slopes (to 30%) between 1271 and 1663 m (4170-5455 ft.) elevation and tend to be oriented to southern or eastern aspects. The unvegetated surface has low cover of litter and moderate to high exposure of sand and bare soil. Biological soil crusts may be absent or provide up to 25% cover. Soils are poorly developed, rapidly drained sands and sandy loams derived from eolian sands and sandy alluvium. Parent materials include Navajo and Entrada sandstone formations that have eroded and distributed as alluvium and eolian deposits.

VEGETATION DESCRIPTION

Capitol Reef National Park

This association is uncommon within the park. The total vegetation cover ranges from 9 to 50%. The vegetation is characterized by an open to moderately closed canopy of *Poliomintha incana*, *Artemisia filifolia*, and *Vanclaveva stylosa*. *Poliomintha incana* ranges in cover from 1 to 25%; *Artemisia filifolia* ranges in cover from 5 to 25%, and *Vanclaveva stylosa* ranges in cover from 5 to 15%. The canopy tree *Populus fremontii* and tall shrub *Tamarix chinensis* each provide low to moderate cover in one stand. Additional short and dwarf-shrubs commonly present and providing low cover include *Atriplex canescens*, *Dalea flavescens*, *Ephedra viridis*, *Ericameria nauseosa*, and *Opuntia polyacantha*. The herbaceous layer is low to moderate in terms of species diversity and typically provides sparse to low cover. Graminoids commonly present include *Achnatherum hymenoides*, *Bromus tectorum*, and *Vulpia octoflora*. Forb composition varies greatly between stands, and the cover provided is sparse; some of the more common species include *Cryptantha flava*, *Heterotheca villosa*, and *Hymenopappus filifolius*.

Globally

This association often occurs as small patches in a matrix of other sand dune communities typical of the Colorado Plateau and generally dominated by *Coleogyne ramosissima* or *Artemisia filifolia*. Total vegetation cover ranges from 5 to 55%. This short-shrub association is characterized by a mixed, sparse to moderately dense canopy consisting of a combination of *Poliomintha incana*, *Artemisia filifolia*, and *Vanclaveva stylosa*. One of these shrubs may be absent, but at a minimum either *Poliomintha* or *Vanclaveva* is always present. Associated shrubs commonly include *Atriplex canescens*, *Brickellia microphylla*, *Dalea flavescens*, *Ephedra viridis*, *Eriogonum leptocladon*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, and *Yucca harrimaniae*. If *Coleogyne ramosissima* is present, it is with very low cover relative to the diagnostic species. The herbaceous layer is moderate to high in terms of species diversity and typically provides sparse to low cover, except in cases where the exotic annual forb *Salsola tragus* may have as much as 15% cover. *Achnatherum hymenoides*, *Aristida purpurea*, *Muhlenbergia pungens*, *Sporobolus cryptandrus*, and *Vulpia octoflora* are the most consistent grasses other than the exotic annual *Bromus tectorum*. Forb composition varies greatly among stands, but species tend to be sand specialists such as *Abronia fragrans*, *Ambrosia acanthicarpa*, *Astragalus mollissimus*, *Cryptantha crassise-pala*, *Cryptantha flava*, *Chamaesyce parryi*, *Hymenopappus filifolius*, *Ipomopsis gunnisonii*, *Iva acerosa*, *Mentzelia albicaulis*, *Oenothera pallida*, *Plantago patagonica*, *Sphaeralcea parvifolia*, *Stephanomeria exigua*, and *Streptanthella longirostris*. Cryptogams are absent from some stands but can provide up to 30% cover. Isolated *Juniperus osteosperma* occur in some stands where the sand is shallow over bedrock.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Populus fremontii</i>
Tall shrub/sapling	<i>Tamarix chinensis</i>

Short shrub/sapling	<i>Artemisia filifolia, Ericameria nauseosa, Poliomintha incana, Vancleavea stylosa</i>
Short shrub/sapling	<i>Ephedra viridis</i>
Herb (field)	<i>Dalea flavescens</i>
Herb (field)	<i>Achnatherum hymenoides, Bromus tectorum</i>

Globally

Stratum

Short shrub/sapling	<i>Artemisia filifolia, Poliomintha incana, Vancleavea stylosa</i>
Short shrub/sapling	<i>Eriogonum leptocladon</i>
Herb (field)	<i>Achnatherum hymenoides, Muhlenbergia pungens</i>

Species

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park
Bromus tectorum, Salsola tragus, Tamarix chinensis

Globally

Bromus tectorum, Salsola tragus, Tamarix chinensis, Vancleavea stylosa

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (24-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park
Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: There is moderate to heavy grazing in three stands.
Capitol Reef National Park Data: The description is based on 1986 and 2003 field data (4 plots: CARE.0510, CARE.0568, CARE.9010, CARE.9436).
Local Description Authors: J. Von Loh, mod. D. Clark
Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Western Ecology Working Group n.d.

***Atriplex canescens - Ephedra viridis* Talus Shrubland**
Fourwing Saltbush - Mormon-tea Talus Shrubland

CODE	CEGL001287
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	<i>ATRIPLEX CANESCENS</i> SHRUBLAND ALLIANCE (A.869) Fourwing Saltbush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)
Sonora-Mojave Mixed Salt Desert Scrub (CES302.749)
Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This sparse shrubland association occurs on talus slopes throughout the northern Colorado Plateau. It has been

reported from western Colorado and southeastern Utah. Sites are on moderately steep to steep slopes (21-86%), occur between 1500 and 1865 m (4920-6140 ft.) elevation, and tend to occur on southeast aspects. The underlying substrate is usually shale, covered by a layer of sandstone talus. Total vegetation cover is somewhat sparse, ranging between 8 and 35%. The shrub layer is generally diverse, while being codominated by *Atriplex canescens* and *Ephedra viridis*. Other common shrubs include *Ephedra torreyana*, *Artemisia bigelovii*, *Chrysothamnus viscidiflorus*, and *Gutierrezia sarothrae*. Total shrub cover ranges from 3 to 30%. The herbaceous layer is similarly diverse, but cover rarely exceeds 5%. The most consistent species are the exotic grass *Bromus tectorum* and the natives *Achnatherum hymenoides*, *Aristida purpurea*, and *Hesperostipa comata*. Forbs are sparse. Scattered *Juniperus osteosperma* trees occur throughout many stands, but with cover not exceeding 5%.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon in the park. It was sampled on steep talus slopes in Capitol Gorge within the park and is found on the steep talus slopes along South Draw.

Globally

This sparse shrubland occurs on talus slopes throughout the northern Colorado Plateau. It has been reported from western Colorado in Colorado National Monument and southeastern Utah in Canyonlands National Park.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on steep talus slopes. Sampled sites are moderately steep (7 to 18° slopes), occur between 1750 and 1796 m elevation, and are oriented to southeastern aspects. The unvegetated surface has high cover of large rocks and low cover of small rocks and gravel. There is moderate exposure of bare soil and sparse cover of litter. Parent materials are Wingate Formation sandstones deposited as rockfall or talus on Chinle slopes. Soils are rapidly drained loamy sands.

Globally

This sparse shrubland association occurs on warm talus slopes throughout the northern Colorado Plateau. Sites are on moderately steep to steep slopes (21-86%), occur between 1500 and 1865 m (4920-6140 ft.) elevation, and tend to occur on southeast aspects. The underlying substrate is usually shale, covered by a layer of sandstone talus. Ninety percent or more of the ground surface may be covered by rocks and boulders. Soils tend to be sandy.

VEGETATION DESCRIPTION

Capitol Reef National Park

This association is uncommon within the park. The total vegetation cover ranges from 8 to 70% in these sparsely to moderately vegetated stands. This short-shrub association is characterized by an open canopy of *Atriplex canescens* and *Artemisia bigelovii* that ranges in cover from 1 to 25% and 1 to 5%, respectively. The associated shrub layer is moderately diverse in terms of species composition and provides sparse to low cover. Additional short and dwarf-shrubs commonly present include *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Fallugia paradoxa*, *Rhus aromatica*, and *Shepherdia rotundifolia*. The herbaceous layer is moderately diverse in terms of species composition but provides sparse cover. Common graminoids include the exotic annual *Bromus tectorum* and the bunch grasses *Achnatherum hymenoides*, *Aristida purpurea*, *Hesperostipa comata*, and *Pleuraphis jamesii*. Forbs commonly observed include *Cryptantha pterocarya*. In the park, this association is highly variable, ranging from nearly pure stands of *Atriplex canescens* with a low cover of *Artemisia bigelovii*, to sites with the above-listed shrubs dominating the slopes.

Globally

This uncommon shrubland association is typical of warm, southeast-facing talus slopes in eastern Utah and western Colorado. Total vegetation cover is somewhat sparse, ranging between 8 and 35%. The shrub layer is generally diverse, while being codominated by *Atriplex canescens* and *Ephedra viridis*. Other common shrubs include *Ephedra torreyana*, *Artemisia bigelovii*, *Chrysothamnus viscidiflorus*, and *Gutierrezia sarothrae*. Total shrub cover ranges from 3 to 30%. The herbaceous layer is similarly diverse, but cover rarely exceeds 5%. The most consistent species are the exotic grass *Bromus tectorum* and the natives *Achnatherum hymenoides*, *Aristida purpurea*, and *Hesperostipa comata*. Forbs are sparse. Scattered *Juniperus osteosperma* trees occur throughout many stands, but with cover not exceeding 5%.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Chrysothamnus viscidiflorus</i> , <i>Rhus aromatica</i> , <i>Shepherdia rotundifolia</i>
Short shrub/sapling	<i>Artemisia bigelovii</i> , <i>Atriplex canescens</i> , <i>Ephedra viridis</i> , <i>Fallugia paradoxa</i>
Herb (field)	<i>Bromus tectorum</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex canescens</i> , <i>Ephedra viridis</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum

Globally

Data are not available.

CONSERVATION STATUS RANK

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

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

The shrublands occurring on talus slopes in the Colorado Plateau form a continuum. All tend to be very diverse in their cover of shrubs, and most have scattered *Juniperus osteosperma*. Aspect, the underlying slope substrate, and the degree of cover by sandstone talus determine which shrubs are dominant. This association is only sampled from three sites. More data are needed to fully characterize this type.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Stands are below sheer cliffs on talus creating a very dynamic community. Stands are subject to rockfall. Rocky talus supports fourwing saltbush, while areas with soil support xeric shrubs including green rabbitbrush.

Capitol Reef National Park Data: The description is based on 2004 field data (2 plots: CARE.0616, CARE.0617).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Western Ecology Working Group n.d.

***Atriplex canescens* / *Bouteloua gracilis* Shrubland Fourwing Saltbush / Blue Grama Shrubland**

CODE	CEGL001283
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	<i>ATRIPLEX CANESCENS</i> SHRUBLAND ALLIANCE (A.869) 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

In the Great Plains, stands occur on dry barren flats, slopes and bluffs supported by shallow, rocky, alkaline soils. In the Colorado Plateau, this association occurs on valley floors and alluvial flats. Slopes are gentle, and most stands are below 1900 m (6235 ft.) elevation. Soils are deep and alkaline. Throughout its range, stands are dominated by *Atriplex canescens* shrubs between 0.5 and 1 m tall. Associated species include *Rhus aromatica*, *Opuntia polyacantha*, *Toxicodendron rydbergii*, and *Yucca glauca*. The herbaceous layer of short to medium-tall grasses is dominated by *Bouteloua gracilis* and includes *Bouteloua curtipendula* in the Great Plains and *Achnatherum hymenoides* in the Colorado Plateau as important associated species. The rhizomatous *Bouteloua gracilis* is more tolerant of heavy grazing than most bunch grasses; this association may represent a grazing remnant of what was once a more diverse grass understory.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon in the northeastern corner of the park. It was sampled on Rock Springs Bench about 900 m from the park boundary.

Globally

This saltbush type is found in the southern Great Plains of the United States, from Kansas and Colorado south and west to Arizona, Utah and Texas.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on alluvial flats within and adjacent to the park. The sampled site is moderately steep (10° slope), occurs at 1863 m elevation, and is oriented to a northwestern aspect. The unvegetated surface has high exposure of bare soil and low cover of live vegetation basal area and litter. Parent materials are variable and include sandstones and shale that have eroded and deposited as alluvium. Soils are rapidly drained loamy sands.

Globally

In the Great Plains, stands occur in dry barren flats, slopes and bluffs. Soils are shallow, rocky and alkaline (Lauver et al. 1999). In the Colorado Plateau, this association occurs on valley floors and alluvial flats. Slopes are gentle, and most stands are below 1900 m (6235 ft.) elevation. Soils are deep and alkaline.

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland association is uncommon in the park. The total vegetation cover ranges from 12 to 40% in this sparsely to moderately vegetated stand. This short-shrub association is characterized by a sparse canopy of *Atriplex canescens* that ranges in cover from 5 to 15% and the short grass *Bouteloua gracilis* that also ranges in cover from 5 to 15%. The remaining dwarf-shrub layer is low in diversity and is sparse, including *Opuntia polyacantha*. The associated herbaceous layer provides sparse cover and is low in diversity. Associated graminoids provide sparse cover and include *Achnatherum hymenoides*.

Globally

Throughout its range, stands of this association are dominated by *Atriplex canescens* shrubs between 0.5 and 1 m tall. Associated species include *Rhus aromatica*, *Opuntia polyacantha*, *Toxicodendron rydbergii*, and *Yucca glauca*. The herbaceous layer of short to medium-tall grasses is dominated by *Bouteloua gracilis* and includes *Bouteloua curtipendula* in the Great Plains (Lauver et al. 1999) and *Achnatherum hymenoides* in the Colorado Plateau as important associated species.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex canescens</i>
Herb (field)	<i>Opuntia polyacantha</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Bouteloua gracilis</i>

Globally

Stratum

Short shrub/sapling
Herb (field)

Species

Atriplex canescens
Bouteloua gracilis

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G3 (9-Nov-2005). This late-seral shrubland association occurs in the southwestern Great Plains, desert grasslands in Arizona, and alluvial flats in southern Utah. Sites are restricted to alkaline bottomlands. Stands have declined because of exploitation by humans either by farming (plowing) or overgrazing by livestock. An estimated 21-100 occurrences are left. Few are believed to be protected. More survey work is needed to locate examples of this vegetation in good condition.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Because other grasses are usually associated with *Bouteloua gracilis*, it may be difficult in the field to distinguish this association from closely related ones.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Heavy cattle grazing onsite. There is material deposited by erosion from hills to the southeast of this stand. Rabbitbrush and Mormon-tea dominate surrounding areas.

Capitol Reef National Park Data: The description is based on 2003 field data (1 plot: CARE.0442).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: K.A. Schulz, mod. J. Coles

REFERENCES: Aldous and Shantz 1924, BIA 1979, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Diamond 1993, Driscoll et al. 1984, Hyder et al. 1966, Klipple and Costello 1960, Lauver et al. 1999, Maxwell 1975, Soil Conservation Service 1978, Western Ecology Working Group n.d.

***Atriplex canescens* / *Pleuraphis jamesii* Shrubland**

Fourwing Saltbush / James' Galleta Shrubland

CODE	CEGL001288
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	<i>ATRIPLEX CANESCENS</i> SHRUBLAND ALLIANCE (A.869) Fourwing Saltbush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)
Sonora-Mojave Mixed Salt Desert Scrub (CES302.749)
Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This broadly defined shrubland association has been reported from the Colorado Plateau and Uinta Basin and may occur in the Chihuahuan Desert and eastern California. As defined, this association occurs on two distinct types of landforms: alluvial flats and stream terraces with fine-textured, alkaline or saline silty clay loam soils, or on upland flats covered by eolian sand deposits. The vegetation is characterized by a sparse to moderately dense shrub layer (10-40% cover) dominated by *Atriplex canescens* with *Pleuraphis jamesii* dominating the herbaceous layer. Associated shrubs include *Ericameria nauseosa*, *Ephedra torreyana*, *Chrysothamnus viscidiflorus*, *Krascheninnikovia lanata*, *Gutierrezia sarothrae*, *Artemisia bigelovii*, or *Opuntia polyacantha*, depending on topographic position and substrate. Other graminoids include *Achnatherum hymenoides* and *Sporobolus cryptandrus* on sandy sites, and *Bouteloua gracilis* and *Sporobolus airoides* on fine-textured soil. Forbs generally have low cover and may include *Sphaeralcea grossulariifolia* and *Chenopodium* spp. Introduced or weedy species, such as *Bromus tectorum*, *Descurainia pinnata*, and *Salsola kali*, are common on some sites.

DISTRIBUTION

Capitol Reef National Park

This association is fairly common in the park. It was sampled about 2.75 miles south of Bitter Creek Divide off the Notom-Bullfrog Road. In the southern portion of the park, this association has received seasonal grazing for decades allowing a gradual type conversion to a non-native herbaceous community.

Globally

This association has been documented from the Colorado Plateau (Four Corners region) of southeastern Utah and southwestern Colorado. It is to be expected in adjacent northern Arizona and New Mexico, and probably occurs in the Chihuahuan Desert and eastern California. Because the habitat and the diagnostic species are relatively common in this region, the association should be widespread; grazing by sheep and cattle may have eliminated most stands. The sites used in this description have also been grazed heavily and show high cover by disturbance-tolerant herbaceous species.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on valley floors. The sampled site is gentle (3° slope), occurs at 1893 m elevation, and is oriented to an eastern aspect. The unvegetated surface has high live vegetation basal area and low cover by litter. There is low to moderate exposure of bare soil. Parent materials are Dakota sandstone that have eroded and deposited as alluvium. Soils are well-drained sandy loams.

Globally

This shrubland association occurs in the Colorado Plateau and Uinta Basin of eastern Utah and western Colorado and may occur in the Chihuahuan Desert and eastern California. Elevation ranges from 300-1900 m. It occurs on two distinct types of landforms: upland sites such as sand sheets with coarse-textured soils, or lowland sites such as alluvial flats and stream terraces with fine-textured soils. Water tends to pond temporarily in both kinds of sites following heavy rainstorms or spring floods; thus salts tend to accumulate in the soils. Sites are generally level to gently sloping or may be in nearly undetectable shallow depressions. The upland soils are somewhat shallow eolian sands or sandy loams. Lowland sites typically have deep, alkaline, saline silty clay loams derived from alluvium. These substrates are generally less saline and occur higher in the floodplain than *Atriplex canescens* / *Sporobolus airoides*- or *Atriplex confertifolia*-dominated shrublands that prefer saline bottomland sites.

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland association is fairly common in the park. The total vegetation cover ranges from 60 to 90% due to the abundance of *Plantago patagonica* in this heavily disturbed stand. This short-shrub association is characterized by a sparse canopy of *Atriplex canescens* that ranges in cover from 1 to 5% and the short bunchgrass *Pleuraphis jamesii* that also ranges in cover from 1 to 5%. The remaining short- and dwarf-shrub layers are sparse and low in diversity. The herbaceous layer provides high cover but is low in diversity. Associated graminoids are low in diversity and provide sparse cover, including *Achnatherum hymenoides*, *Bromus tectorum*, and *Vulpia octoflora*. Forbs are low in diversity and high in cover, characterized by the annual *Plantago patagonica* that ranges in cover from 55 to 65%. This association forms a mosaic with rabbitbrush and greasewood associations along drainages.

Globally

This broadly defined shrubland association is characterized by a sparse to moderately dense canopy (10-40% cover)

of shrubs dominated by *Atriplex canescens*, with a sparse to moderate graminoid layer dominated by *Pleuraphis jamesii*. Many stands have the appearance of a shrubby grassland and may form a mosaic with rabbitbrush, greasewood or shadscale shrublands. Associated shrubs may include *Ericameria nauseosa*, *Ephedra torreyana*, *Ericameria nauseosa*, *Grayia spinosa*, several species of *Opuntia*, *Chrysothamnus viscidiflorus*, *Krascheninnikovia lanata*, *Gutierrezia sarothrae*, and *Artemisia bigelovii*. Other graminoids include *Achnatherum hymenoides* and *Sporobolus cryptandrus* on sandy sites, and *Bouteloua gracilis* and *Sporobolus airoides* on fine-textured soils of lowland sites. Forbs generally have low cover and may include *Astragalus nuttallianus*, *Cryptantha crassisejala*, *Descurainia pinnata*, *Mentzelia albicaulis*, *Phacelia crenulata*, *Sphaeralcea grossulariifolia*, and *Chenopodium* spp. Introduced species such as *Bromus tectorum*, *Erodium cicutarium*, and *Salsola kali* are common on some sites. In many sites, the herbaceous layer is sparse because of a history of grazing or other disturbance.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex canescens</i>
Herb (field)	<i>Cryptantha crassisejala</i> , <i>Plantago patagonica</i>
Herb (field)	<i>Bromus tectorum</i> , <i>Pleuraphis jamesii</i> , <i>Vulpia octoflora</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Chrysothamnus viscidiflorus</i> , <i>Ericameria nauseosa</i>
Short shrub/sapling	<i>Atriplex canescens</i>
Short shrub/sapling	<i>Gutierrezia sarothrae</i> , <i>Krascheninnikovia lanata</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Bouteloua gracilis</i> , <i>Pleuraphis jamesii</i> , <i>Sporobolus airoides</i> , <i>Sporobolus cryptandrus</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum

Globally

Bromus tectorum, *Salsola kali*

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G4 (1-Feb-1996).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

As this association is currently defined, it is characterized only by the codominance of *Atriplex canescens* and *Pleuraphis jamesii*. Its relation to several similar associations is also unclear. Most of the information available suggests that the sparse shrub canopy is more typical and that this association should not be classified as a shrubland (Miller et al. 1977, Francis 1986, Von Loh 2000). Because it has a wide distribution (from southern Great Plains to the Mojave Desert), stands occur in diverse habitats (clayey bottomland to sand dunes) and vary from a sparse to moderate shrub canopy. It is likely that, when more information becomes available and the needed classification work is completed, this association will be subdivided.

The diagnostic species require warm sites with somewhat alkaline soils, so this association should be relatively widespread throughout the Colorado Plateau and western Great Plains. That it is not may reflect spotty sampling of the region, or it may indicate that this association has been mostly altered by grazing. This association may represent a form of *Atriplex canescens* / *Sporobolus airoides* Shrubland (CEGL001291) that has been degraded by domestic livestock grazing. The concept of *Atriplex canescens* / *Sporobolus airoides* Shrubland includes *Pleuraphis jamesii* in the herbaceous layer. In addition, the species lists for related and equivalent communities cited in the References section include both *Pleuraphis jamesii* and *Sporobolus airoides* in the herbaceous layer. It is possible that these associations (CEGL001288 and CEGL001291) should be combined, as it appears they are distinguished primarily by

which of the two grasses is dominant. It is possible that summer-long grazing has reduced or eliminated *Sporobolus airoides* from many stands in the Colorado Plateau, leaving *Pleuraphis jamesii* and *Bouteloua gracilis* as more grazing-resistant species. Distinguishing these two associations because of different intensities of historic grazing may not be ecologically valid.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Higher density of cheatgrass outside the plot. Area has been grazed by sheep/cattle for 100+ years; recent grazing evident. More juniper - low shrub on hills. This association grades into a mosaic with adjacent greasewood associations that are widespread south of Bitter Creek Divide.

Capitol Reef National Park Data: The description is based on 2003 field data (1 plot: CARE.0574).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: K.A. Schulz, mod. J. Coles

REFERENCES: BLM 1979a, BLM 1979b, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Diamond 1993, Driscoll et al. 1984, Francis 1986, Miller et al. 1977, Shute and West 1978, Soil Conservation Service 1978, U.S. Bureau of Reclamation 1976, Von Loh 2000, Western Ecology Working Group n.d.

***Atriplex canescens* / *Sporobolus airoides* Shrubland
Fourwing Saltbush / Alkali Sacaton Shrubland**

CODE	CEGL001291
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	<i>ATRIPLEX CANESCENS</i> SHRUBLAND ALLIANCE (A.869) Fourwing Saltbush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)
Chihuahuan Mixed Salt Desert Scrub (CES302.017)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This shrubland occurs in the northern Chihuahua Desert extending into the Trans-Pecos of Texas, southwestern Great Plains, and Colorado Plateau. Stands occupy washes, floodplains and on alluvial flats, extending up lower slopes of alluvial fans or bajadas. Sites are level to gently sloping. Substrates are typically moderately deep, alkaline, calcareous, fine-textured soils or calcareous sands. Cover of bare soil can be high (>50%). The vegetation is characterized by an open to moderately dense (10-50% cover) short-shrub layer dominated by *Atriplex canescens* with a perennial graminoid layer dominated by *Sporobolus airoides*. The shrub layer has greater cover than the herbaceous layer, which may include other scattered shrubs and dwarf-shrubs, such as *Artemisia filifolia*, *Atriplex confertifolia*, *Atriplex obovata*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, *Isocoma pluriflora*, *Krascheninnikovia lanata*, *Lycium* spp., *Opuntia* spp., *Prosopis glandulosa*, and *Sarcobatus vermiculatus*. Associated herbaceous species, such as *Achnatherum hymenoides*, *Elymus elymoides*, *Pascopyrum smithii*, *Pleuraphis jamesii*, *Sphaeralcea coccinea*, *Sporobolus cryptandrus*, *Sporobolus nealleyi*, and *Suaeda* spp., may be present. *Bouteloua gracilis* cover is minor and inconsistent. The *Sporobolus airoides*-dominated herbaceous layer is diagnostic of this community.

DISTRIBUTION

Capitol Reef National Park

Data are not available.

Globally

This shrubland occurs in the northern Chihuahua Desert extending into Trans-Pecos Texas, the southwestern Great Plains and Colorado Plateau in Colorado, New Mexico, Arizona, and Utah. It is reported from California and likely

also occurs in Nevada and Mexico.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

The sampled site is located on a stream terrace in the northern half of the park. The elevation is 1744 m, and the terrace slopes very slightly to the east-northeast. The soil is a deep, well-drained loamy sand derived from alluvium.

Globally

This shrubland occurs on alkaline sites in the northern Chihuahu Desert extending into the Trans-Pecos of Texas, southwestern Great Plains, and Colorado Plateau. Sites are in washes, floodplains and on alluvial flats, extending up lower slopes of alluvial fans or bajadas. Elevation ranges from 915-1890 m (3000-6200 ft.). Sites are level to gently sloping (1-5%), and soils are typically moderately deep, alkaline, calcareous, fine-textured soils such as silt loam, loamy clay or clay (Francis 1986, Shaw et al. 1989, Muldavin et al. 2000b), although some sites in active floodplains may be rapidly drained sandy soils. Cover of bare soil may be high (>50%) (Francis 1986). Evidence of overland flow and erosion, e.g., gullies, rills, plant pedestalling, is common (Soil Conservation Service n.d.).

VEGETATION DESCRIPTION

Capitol Reef National Park

This valley bottom shrubland has *Ericameria nauseosa* and *Atriplex canescens* as co-dominants with 20% total cover. Other shrubs present with less than 5% cover include *Atriplex confertifolia*, *Gutierrezia sarothrae*, and *Sarcobatus vermiculatus*. The sampled site is heavily grazed, and therefore the herbaceous layer was somewhat sparse, totaling less than 10% cover. *Sporobolus airoides* and *Achnatherum hymenoides* dominate the herbaceous layer with a few percent cover each, accompanied by traces of forbs such as *Machaeranthera tanacetifolia* and *Sphaeralcea parvifolia*.

Globally

The association is characterized by an open to moderately dense (10-50% cover) short-shrub layer dominated by *Atriplex canescens* with a perennial graminoid layer dominated by *Sporobolus airoides* but includes sparse *Atriplex canescens* - *Sporobolus airoides*-dominated stands (<10% total vegetation cover). The shrub layer generally has greater cover than the herbaceous layer and may include other scattered shrubs and dwarf-shrubs, such as *Artemisia filifolia*, *Atriplex confertifolia*, *Atriplex obovata*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, *Isocoma pluriflora*, *Krascheninnikovia lanata*, *Lycium berlandieri*, *Lycium pallidum*, *Opuntia imbricata*, *Opuntia leptocaulis*, *Opuntia phaeacantha*, *Prosopis glandulosa*, and *Sarcobatus vermiculatus*. Associated herbaceous species, such as *Achnatherum hymenoides*, *Elymus elymoides*, *Pascopyrum smithii*, *Pleuraphis jamesii*, *Sphaeralcea* spp., *Sporobolus cryptandrus*, *Sporobolus nealleyi*, and *Suaeda* spp., may be present. *Bouteloua gracilis* cover is minor and inconsistent (Francis 1986, Shaw et al. 1989, Muldavin et al. 2000b). Introduced species, such as *Salsola kali*, *Bromus tectorum*, or *Marrubium vulgare*, may be common.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Ericameria nauseosa</i>
Short shrub/sapling	<i>Atriplex canescens</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex canescens</i>
Herb (field)	<i>Sporobolus airoides</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Bromus tectorum, *Marrubium vulgare*, *Salsola kali*

CONSERVATION STATUS RANK

Global Rank & Reasons: G5? (9-Nov-2005). Although this type is widespread, it usually occurs in relatively small

patches. Both of the diagnostic species are resistant to moderate grazing, but this association has likely been converted to semi-natural shrublands in heavily grazed areas.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Stands with relatively low cover of *Atriplex canescens* (10-25%) are included in this association because the shrub density is often variable within stands, but species composition and ecological processes do not change significantly. There are several similar associations that vary according to the abundance of different codominants, especially graminoids. Range-wide review of these types is needed to clarify their extent.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Data are not available.

Capitol Reef National Park Data: The description is based on field data (1 plot: CARE.0478).

Local Description Authors: J. Coles

Global Description Authors: K.A. Schulz, mod. J. Coles

REFERENCES: Baker 1984a, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Diamond 1993, Dick-Peddie 1986, Donart et al. 1978a, Driscoll et al. 1984, Francis 1986, Hansen et al. 2004b, Muldavin et al. 2000b, Shaw et al. 1989, Soil Conservation Service n.d., USFS 1937, Vest 1962a

***Atriplex canescens* Desert Wash Shrubland Fourwing Saltbush Desert Wash Shrubland**

CODE	CEGL003470
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	<i>ATRIPLEX CANESCENS</i> SHRUBLAND ALLIANCE (A.869) Fourwing Saltbush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Wash (CES304.781)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This desert wash shrubland is known from two plots in Utah (Canyonlands and Capitol Reef national parks) and four plots in northern Arizona (Wupatki National Monument) but is likely more widespread. Stands occur on sandy terraces and wash bottoms at 1178 to 1600 m elevation. Sites are flat to gently sloping and occur in and along intermittent washes. Substrates are rapidly drained, sandy or gravelly soils derived from alluvium, cinder and sandstone. Scattered large rocks, gravel and bare ground cover most of the unvegetated surface. Total vegetation cover is 6-25% and is dominated by a scattered to open canopy of *Atriplex canescens*. Associated shrubs include *Artemisia filifolia*, *Atriplex gardneri*, *Brickellia longifolia*, *Ephedra torreyana*, *Ephedra viridis*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, *Fraxinus anomala*, *Lycium andersonii*, *Rhus trilobata*, and *Suaeda moquinii*. Herbaceous cover is sparse (<10% cover) with a variety of grasses and forbs such as *Achnatherum hymenoides*, *Artemisia dracuncululus*, *Muhlenbergia porteri*, *Sporobolus cryptandrus*, *Sphaeralcea parvifolia*, *Sporobolus contractus*, *Stanleya pinnata*, and *Wyethia scabra*. Non-native annuals such as *Bromus tectorum* and *Salsola tragus* are sometimes present.

DISTRIBUTION

Capitol Reef National Park

This rare association is represented by one plot located in a wide, sandy wash bottom in Spring Canyon.

Globally

This desert wash shrubland is known from two plots in Utah (Canyonlands and Capitol Reef national parks) and four plots in northern Arizona (Wupatki National Monument). It is likely more widespread in eastern Utah and southern Arizona along drainages.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This open shrubland was sampled once on a wash bottom. The site slopes gently to the southwest and lies at 1600 m elevation. Sand and gravel cover most of the unvegetated surface, with lesser cover by large rocks. Litter has very little cover. The soil is a rapidly drained, poorly developed gravelly sand derived from alluvium.

Globally

This desert wash shrubland is known from two plots in Utah (Canyonlands and Capitol Reef national parks) and four plots in northern Arizona (Wupatki National Monument) but is likely more widespread. Stands occur on sandy terraces and wash bottoms at 1178 to 1600 m elevation. Sites are flat to gently sloping and occur in and along intermittent washes. Substrates are rapidly drained, sandy or gravelly soils derived from alluvium, cinder and sandstone. Scattered large rocks, gravel and bare ground cover most of the unvegetated surface.

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland is rare within the park, occurring in intermittent washes. Total vegetation cover is around 6% and is dominated by scattered shrubs of *Atriplex canescens*. Associated shrubs include *Fraxinus anomala*, *Rhus trilobata*, and *Ericameria nauseosa*. Sapling *Populus fremontii* may be present along the channel banks. The herbaceous layer contributes sparse cover; the only reported species are *Achnatherum hymenoides* and *Wyethia scabra*.

Globally

Vegetation is sparse to low cover (6-25% total vegetation cover) and is characterized by a scattered to open canopy of *Atriplex canescens*. Associated shrubs include *Artemisia filifolia*, *Atriplex gardneri*, *Brickellia longifolia*, *Ephedra torreyana*, *Ephedra viridis*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, *Fraxinus anomala*, *Lycium andersonii*, *Rhus trilobata*, and *Suaeda moquinii*. Herbaceous cover is sparse (<10% cover) with a variety of species, including scattered grasses and forbs such as *Achnatherum hymenoides*, *Artemisia dracunculul*, *Muhlenbergia porteri*, *Sporobolus cryptandrus*, *Sphaeralcea parvifolia*, *Sporobolus contractus*, *Stanleya pinnata*, and *Wyethia scabra*. Occasional sapling *Populus fremontii* may be present along the channel banks. Non-native annuals such as *Bromus tectorum* and *Salsola tragus* are sometimes present.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tall shrub/sapling	<i>Fraxinus anomala</i>
Short shrub/sapling	<i>Ericameria nauseosa</i>
Short shrub/sapling	<i>Atriplex canescens</i>
Herb (field)	<i>Wyethia scabra</i>
Herb (field)	<i>Achnatherum hymenoides</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tall shrub/sapling	<i>Fraxinus anomala</i>
Short shrub/sapling	<i>Ericameria nauseosa</i>
Short shrub/sapling	<i>Atriplex canescens</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (14-Apr-2003).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: The plot is in a broad wash nearly devoid of vegetation; there is more bare soil and small rocks than anything else in a fairly narrow canyon with small colluvial toe slopes to the east and west.

Capitol Reef National Park Data: The description is based on field data collected in 2005 during accuracy assessment (1 plot: CARE_AA.0147).

Local Description Authors: J. Coles

Global Description Authors: K.A. Schulz

REFERENCES: Hansen et al. 2004b, Howard 2003, Western Ecology Working Group n.d.

***Atriplex canescens* Shrubland
Fourwing Saltbush Shrubland**

CODE	CEGL001281
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	<i>ATRIPLEX CANESCENS</i> SHRUBLAND ALLIANCE (A.869) 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 association is known from the Great Basin north into the southern Columbia Basin and east into Wyoming and the Colorado Plateau. It is common at middle elevations on alluvial fans and toe slopes in deep, sandy soils but will occur at lower elevations along alluvial benches where soils are often finer-textured and possibly saline/alkaline. Parent materials are variable. The vegetation is characterized by a sparse to moderately dense short-shrub layer (10-35% cover) dominated or codominated by *Atriplex canescens*, typically with a variable and often sparse herbaceous layer. Notable codominants in the shrub layer include *Chrysothamnus viscidiflorus*, *Coleogyne ramosissima*, *Ephedra nevadensis*, *Eriogonum nummulare*, *Grayia spinosa*, *Gutierrezia sarothrae*, *Lycium pallidum*, or *Psoralea argemone* spp. *Artemisia bigelovii*, *Artemisia tridentata*, and *Ephedra viridis*, *Krascheninnikovia lanata*, or *Purshia stansburiana* may be present but are not codominants. The herbaceous layer includes low cover of species such as *Achnatherum hymenoides*, *Aristida purpurea*, *Elymus elymoides*, *Pleuraphis jamesii*, and *Sporobolus cryptandrus*. Introduced species, especially *Bromus tectorum*, *Bromus diandrus*, and *Salsola kali*, are common on disturbed sites and can create an herbaceous layer much denser than on undisturbed sites. Winter annual forb cover is variable depending on annual precipitation.

DISTRIBUTION

Capitol Reef National Park

This association is fairly common; however, it was only sampled at one site on the Fremont River north of Notom.

Globally

This shrubland association may occur throughout much of the interior western U.S. It is known from the southern Columbia Basin and Great Basin east into Wyoming and the Colorado Plateau.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on floodplain terraces. The sampled site is gentle (3° slope), occurs at 2256 m elevation, and is oriented to a southeastern aspect. The unvegetated surface has high exposure of bare soil and low cover of downed wood. Parent materials are variable and include sandstones and shale deposited as old alluvium. Soils are well-drained loams.

Globally

This widespread shrubland association occurs throughout much of the western U.S. and is found on bajadas, low stream terraces, valley floors and toe slopes. Sites are flat to gently sloping with any aspect. It is commonly found on deep, sandy soils at middle elevations (1235-2256 m [4050-7400 feet]) on the Colorado Plateau, but will occur at lower elevations (down to 610 m [2000 feet]) along alluvial benches where soils are often finer-textured and possibly saline/alkaline (Beatley 1976) in the Great Basin region. The unvegetated surface is predominantly bare soil and/or sand. Larger rocks and organic material are rare. Parent materials include volcanic tuff, shale and sandstone. At lower elevations, it may occur as a mosaic with *Lycium pallidum* - *Grayia spinosa*- or *Atriplex confertifolia*-dominated shrublands.

VEGETATION DESCRIPTION

Capitol Reef National Park

This association stand is fairly common in the park. The total vegetation cover ranges from 6 to 20% in this sparsely vegetated stand. This short-shrub association is characterized by a sparse canopy of *Atriplex canescens* that ranges in cover from 5 to 15%. The associated shrub layer is sparse in cover and diversity. The herbaceous layer is represented by sparse forbs, is low in diversity, and includes *Lappula occidentalis*. This association forms a mosaic with rabbitbrush and greasewood associations along drainages.

Globally

This broadly defined association is characterized by a sparse to moderately dense shrub layer (10-35% cover) dominated or codominated by *Atriplex canescens*, typically with a variable and often sparse herbaceous layer. Total vegetation cover ranges from sparse to moderate (5-56% cover). Notable codominants in the shrub layer include *Chrysothamnus viscidiflorus*, *Coleogyne ramosissima*, *Ephedra nevadensis*, *Eriogonum nummularum*, *Grayia spinosa*, *Gutierrezia sarothrae*, *Lycium pallidum*, *Psoralea fremontii*, or *Psoralea polydenius*. *Artemisia bigelovii*, *Artemisia tridentata*, *Ephedra viridis*, *Krascheninnikovia lanata*, or *Purshia stansburiana* may be present but are not codominants. The typically sparse herbaceous layer includes low cover of semi-arid grasses such as *Achnatherum hymenoides*, *Aristida purpurea*, *Elymus elymoides*, *Pleuraphis jamesii*, and *Sporobolus cryptandrus*. Common forb species on sandy sites include *Cymopterus ripleyi*, *Dalea searlsiae*, *Lesquerella ludoviciana*, and *Oenothera pallida*, and on disturbed sites *Cryptantha crassisejala*, *Descurainia pinnata*, *Erodium cicutarium*, *Lappula occidentalis*, *Lepidium montanum*, *Plantago patagonica*, and *Rumex hymenosepalus* may be present. Winter annual forb cover is variable depending on annual precipitation. Introduced species such as *Bromus tectorum*, *Bromus diandrus*, and *Salsola kali* are common on disturbed sites and may form a moderately dense herbaceous stratum.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex canescens</i>
Herb (field)	<i>Lappula occidentalis</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex canescens</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Salsola tragus

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: The plot was located along the Fremont River in an area that floods during high rain events. This association is more common downstream along the Fremont River, outside the park.

Capitol Reef National Park Data: The description is based on 2003 and 2004 field data (2 plots: CARE.0427, CARE.8701).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: K.A. Schulz, mod. J. Drake and J. Coles

REFERENCES: Beatley 1976, Bourgeron and Engelking 1994, Cogan et al. 2004, Driscoll et al. 1984, Howard 2003, NVNHP 2003, Ostler et al. 2000, Western Ecology Working Group n.d.

***Atriplex confertifolia* - *Krascheninnikovia lanata* Shrubland
Shadscale - Winter-fat Shrubland**

CODE	CEGL001301
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	<i>ATRIPLEX CONFERTIFOLIA</i> SHRUBLAND ALLIANCE (A.870) Shadscale Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association occurs on shale hills, mesas and valley floors at elevations between 1500 and 1900 m (4920-6235 ft.) in southern, eastern and western Utah, northwestern Colorado, and central Nevada. Slopes are typically gentle to moderate and may be oriented to any aspect. Bare ground, cryptobiotic crusts and gravel cover most of the unvegetated ground surface. Soils are clay loams or loams and are derived from marine shale or from shale-rich alluvium. A mixed sparse short-shrub canopy dominated by *Atriplex confertifolia* and *Krascheninnikovia lanata* characterizes this community, and *Picrothamnus desertorum* is nearly always present. Other shrubs present may include *Artemisia nova*, *Artemisia tridentata* ssp. *wyomingensis*, and *Atriplex canescens*. Total shrub cover rarely exceeds 25%. The herbaceous layer may be sparse to dense, depending on substrate and grazing history. Common species include *Poa fendleriana*, *Pleuraphis jamesii*, *Achnatherum hymenoides*, *Elymus elymoides*, *Sphaeralcea* spp., and *Eriogonum* spp., although in highly disturbed stands *Bromus tectorum* will be overwhelmingly dominant.

DISTRIBUTION

Capitol Reef National Park

This association is rare and was sampled in the South Desert area of the park.

Globally

This association has been documented from southern and western Utah (Fautin 1946), northwestern Colorado and adjacent Utah, and central Nevada (Blackburn et al. 1968a). It may also occur in eastern California (Billings 1949).

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on the valley floor. The sampled site is gentle (4° slope), occurs at 1878 m elevation, and is oriented to a northwestern aspect. The unvegetated surface has high cover of gravel and sparse live vegetation basal cover. Parent materials are variable and include sandstones and shale that have eroded and deposited as alluvium. Soils are well-drained loams.

Globally

This association occurs on shale hills, mesas and valley floors at elevations between 1500 and 1900 m (4920-6235 ft.). Slopes are typically gentle to moderate and may be oriented to any aspect. Bare ground, cryptobiotic crusts and gravel cover most of the unvegetated ground surface. Soils are clay loams or loams and are derived from shale or from shale-rich alluvium.

VEGETATION DESCRIPTION

Capitol Reef National Park

This association is rare within the park. The total vegetation cover ranges from 16 to 30% in this sparsely to moderately vegetated stand. This short-shrub association is characterized by an open canopy of *Atriplex confertifolia* and *Krascheninnikovia lanata* that provide 15 to 25% and 1 to 5% cover, respectively. The associated dwarf-shrub layer is sparse in cover and diversity. The herbaceous layer is low in diversity and provides sparse cover.

Globally

A mixed sparse short-shrub canopy dominated by *Atriplex confertifolia* and *Krascheninnikovia lanata* characterizes this community, and *Picrothamnus desertorum* is nearly always present. Other shrubs present may include *Artemisia nova*, *Artemisia tridentata* ssp. *wyomingensis*, and *Atriplex canescens*. Total shrub cover rarely exceeds 25%. The herbaceous layer may be sparse to dense, depending on substrate and grazing history. Common species include *Poa fendleriana*, *Pleuraphis jamesii*, *Achnatherum hymenoides*, *Elymus elymoides*, *Sphaeralcea* spp., and *Eriogonum* spp., although in highly disturbed stands *Bromus tectorum* will be overwhelmingly dominant.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex confertifolia</i> , <i>Krascheninnikovia lanata</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex confertifolia</i> , <i>Krascheninnikovia lanata</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This association is based on very little quantitative data. As more information on structure and composition becomes

available, the description can be refined.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Saline soils, erosional deposition from hills to the west, the plot and surrounding flat is heavily grazed by cattle; there is very little grass.

Capitol Reef National Park Data: The description is based on 2003 field data (1 plot: CARE.0448).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Beatley 1976, Billings 1949, Blackburn et al. 1968a, Bourgeron and Engelking 1994, Driscoll et al. 1984, Fautin 1946, NVNHP 2003, Western Ecology Working Group n.d.

***Atriplex confertifolia* - *Sarcobatus vermiculatus* Shrubland**
Shadscale - Black Greasewood Shrubland

CODE	CEGL001313
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	<i>ATRIPLEX CONFERTIFOLIA</i> SHRUBLAND ALLIANCE (A.870) Shadscale Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)
Sonora-Mojave Mixed Salt Desert Scrub (CES302.749)
Inter-Mountain Basins Greasewood Flat (CES304.780)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This shrub association is scattered on saline soils on valley floors, alluvial terraces and alluvial fans across the Colorado Plateau. Elevations range from 1350 to 1650 m, slopes range from level to moderately steep (1-50% slopes), and sites can be oriented to any aspect. Soils are fine-textured and poorly drained clays, clay loams and silt loams. Total vegetation cover ranges from less than 20% to more than 50%, with the higher values tending to occur in shrublands located on valley floors and alluvial terraces. The shrub stratum generally consists primarily of *Sarcobatus vermiculatus* shrubs with between 1 and 20% cover. *Atriplex confertifolia* shrubs are scattered throughout the canopy, with between 1 and 5% cover. Other shrubs present with minor cover include *Gutierrezia sarothrae* and *Suaeda moquinii*. The herbaceous layer is variable but can have as much as 35% cover. This layer tends to reflect a degree of disturbance; common species include *Achnatherum hymenoides*, *Astragalus nuttallianus*, *Bromus tectorum*, *Lappula occidentalis*, *Lepidium densiflorum*, *Plantago patagonica*, and *Sphaeralcea parvifolia*. Nonvascular species are generally present and may have as much as 95% cover in undisturbed sites.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon to common in the park occurring in scattered locations from Divide Canyon south. It was sampled in the floodplain of Bitter Spring Creek and in Halls Creek drainage.

Globally

This shrub association is found scattered in saline soils on valley floors, alluvial terraces and alluvial fans across the Colorado Plateau, in Arizona and Colorado and extends west into California and Nevada.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed in abandoned floodplains and on riparian benches. Sampled sites are gentle (1 to 2° slopes), occur between 1341 and 1646 m elevation, and are oriented to southern aspects. The

unvegetated surface is unrecorded. Parent materials are variable and include sandstones and shale that have eroded and deposited as alluvium. Soils are well-drained fine-textured.

Globally

This shrub association is found scattered in saline habitats across the Colorado Plateau. Miller et al. (1977) report this association as occurring in low-lying, internally drained areas such as abandoned stream channels. Recent plot data from eastern Utah and western Colorado indicate that the habitat for this association includes valley toe slopes and alluvial terraces, as well as low-lying areas on valley floors. Elevations range from 1350 to 1650 m, slopes range from level to moderately steep (1-50% slopes), and sites can be oriented to any aspect. Soils are fine-textured and poorly drained clays, clay loams and silt loams.

VEGETATION DESCRIPTION

Capitol Reef National Park

This association is uncommon to common within the park. The vegetation is characterized by an open canopy of *Atriplex confertifolia* and *Sarcobatus vermiculatus* shrubs. The associated short- and dwarf-shrub layers are moderately diverse in terms of species composition and provide low cover, including *Artemisia tridentata*, *Atriplex gardneri*, *Gutierrezia sarothrae*, *Sclerocactus parviflorus*, and *Suaeda moquinii*. The herbaceous layer is moderately diverse in terms of species composition and provides sparse to low cover. Common graminoids include *Achnatherum hymenoides*, *Bromus tectorum*, and *Pleuraphis jamesii*. Forbs commonly present include *Plantago patagonica* and *Sphaeralcea parvifolia*.

Globally

This mixed shrubland association occurs in habitats that are significantly saline, either because of poor drainage or high levels of salts in the soil. Total vegetation cover ranges from less than 20% to more than 50%, with the higher values tending to occur in shrublands located on valley floors and alluvial terraces. Upland sites tend to have sparser vegetation. The shrub stratum generally consists primarily of *Sarcobatus vermiculatus* shrubs not more than 1 m tall, with between 1 and 20% cover. *Atriplex confertifolia* shrubs are scattered throughout the canopy, with between 1 and 5% cover. Other shrubs present with minor cover include *Gutierrezia sarothrae* and *Suaeda moquinii*. The herbaceous layer is variable but can have as much as 35% cover. This layer tends to reflect a degree of disturbance; common species include *Achnatherum hymenoides*, *Astragalus nuttallianus*, *Bromus tectorum*, *Lappula occidentalis*, *Lepidium densiflorum*, *Plantago patagonica*, *Sporobolus airoides*, and *Sphaeralcea parvifolia*. Mosses and ground lichens are generally present and may have as much as 95% cover in undisturbed sites.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex confertifolia</i> , <i>Sarcobatus vermiculatus</i>
Short shrub/sapling	<i>Artemisia tridentata</i>
Herb (field)	<i>Atriplex gardneri</i> , <i>Gutierrezia sarothrae</i>
Herb (field)	<i>Bromus tectorum</i> , <i>Pleuraphis jamesii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex confertifolia</i> , <i>Sarcobatus vermiculatus</i>
Herb (field)	<i>Bromus tectorum</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Descurainia pinnata*, *Erodium cicutarium*, *Salsola kali*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: There is heavy grazing. One stand has an abundance of cheatgrass. One stand is described as a greasewood terrace above the riparian zone.

Capitol Reef National Park Data: The description is based on 1986 field data (3 plots: CARE.9001, CARE.9048, CARE.9216).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Fenemore 1970, Kagan et al. 2004, Miller et al. 1977, NVNHP 2003, Western Ecology Working Group n.d.

***Atriplex confertifolia* / *Achnatherum hymenoides* Shrubland
Shadscale / Indian Ricegrass Shrubland**

CODE	CEGL001311
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	<i>ATRIPLEX CONFERTIFOLIA</i> SHRUBLAND ALLIANCE (A.870) Shadscale Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This plant association is widely scattered on benches, plateaus, and gullies within the *Atriplex confertifolia* zone of Colorado, Idaho, Nevada, Utah and Oregon, and is also purported to occur in California and Wyoming. It is best developed in sites with an alkaline, yet coarse-textured soil. Elevations range from 1250 to 1780 m (4100-5840 ft.) in Utah and Colorado. The association is typically found on well-drained, alkaline soils derived from volcanic tuff or shale that often have been modified by alluvial deposits. Low-growing *Atriplex confertifolia* is the dominant shrub, usually with up to 15% cover, although other shrubs, including *Picrothamnus desertorum*, *Artemisia tridentata* ssp. *wyomingensis*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, *Grayia spinosa*, and *Sarcobatus vermiculatus*, may also be present in low amounts. In high-quality, ungrazed stands *Achnatherum hymenoides* may have as much as 20% cover and dominates the otherwise sparse herbaceous understory. Lesser amounts of other perennial grasses, including *Elymus elymoides*, *Hesperostipa comata*, *Pleuraphis jamesii*, *Poa fendleriana*, and *Poa secunda*, are often present. Forbs vary greatly across the range of this association and never contribute significant cover. Some locally common species include *Eriogonum* spp., *Phlox hoodii*, *Sphaeralcea grossulariifolia*, *Thelypodium flexuosum*, and *Townsendia florifera*. Degraded stands have abundant *Bromus tectorum* in the understory and higher total herbaceous cover.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon in the park. It was sampled on the Bitter Creek Divide and in Halls Creek drainage.

Globally

This plant association ranges from southeastern Oregon, southern Idaho, and Nevada to Utah and western Colorado. It is purported to occur in California and Wyoming. In Idaho, it is known from the South Fork Owyhee River canyon, the Owyhee Mountains lowland front near the Snake River, and the Salmon River canyon near Challis

(Moseley 1987a, Rust et al. unpubl. data 2000b). In Nevada, it has been observed in Grass Valley and elsewhere, including the Nevada Test Site (Rickard and Beatley 1965, Young et al. 1986). It has been documented in the oil shale region of Colorado by several researchers (e.g., Ward et al. 1974, Keammerer 1977), as well as in Dinosaur National Monument. Though widely distributed, its presence is discontinuous in environments dominated by either *Atriplex confertifolia* or *Artemisia tridentata* ssp. *wyomingensis*.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on low slopes and steps-in-slope near plains. Sample sites are gentle (1° slope), occur between 1250 and 1780 m elevation, and are oriented to western aspects. The unvegetated surface has moderate exposure of bare soil and sparse cover by litter. Live vegetation basal area is high. Parent materials are variable and include sandstones and shale deposited as alluvium. Soils are well-drained sandy loams.

Globally

This plant association is widely scattered on benches, plateaus, and gullies within the *Atriplex confertifolia* zone of Colorado, Idaho, Nevada, Utah and Oregon, and is also purported to occur in California and Wyoming. Elevations range from 1250 to 1780 m (4100-5840 ft.) in Utah and Colorado, and slopes vary from gentle to steep. The association is typically found on well-drained, alkaline soils derived from volcanic tuff or shale that often have been modified by alluvial deposits. Soil textures include rocky and gravelly sandy loams and may have an argillic horizon. Many sites show evidence of sheet and gully erosion.

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland association is uncommon within the park. The vegetation is characterized by an open short-shrub canopy of *Atriplex confertifolia* that ranges in cover from 15 to 25% and the bunchgrass *Achnatherum hymenoides* that ranges in cover from 15 to 25%. The associated shrub layer is low in diversity and provides sparse to moderate cover. Dwarf-shrubs provide low to moderate cover and include *Gutierrezia sarothrae* and *Opuntia polyacantha*. The associated herbaceous layer is moderately diverse and provides sparse cover. Graminoids present with sparse to low cover include the annual exotic *Bromus tectorum* and the short bunchgrass *Pleuraphis jamesii*. Forbs are relatively diverse but provide sparse cover.

Globally

Low-growing *Atriplex confertifolia* is the dominant shrub, usually with around 15% cover, though other shrubs, including *Picrothamnus desertorum*, *Artemisia tridentata* ssp. *wyomingensis*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, *Grayia spinosa*, and *Sarcobatus vermiculatus*, may also be present in low amounts. In high-quality, ungrazed stands *Achnatherum hymenoides* may have up to 20% cover and dominates the otherwise sparse herbaceous understory. Lesser amounts of other perennial grasses, including *Elymus elymoides*, *Hesperostipa comata*, *Pleuraphis jamesii*, *Poa fendleriana*, and *Poa secunda*, are often present. Forbs vary greatly across the range of this association and never contribute significant cover. Some locally common species include *Eriogonum* spp., *Phlox hoodii*, *Sphaeralcea grossulariifolia*, *Thelypodium flexuosum*, and *Townsendia florifera*. Stands degraded by excessive livestock grazing have abundant *Bromus tectorum* in the understory and higher total herbaceous cover.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex confertifolia</i>
Herb (field)	<i>Gutierrezia sarothrae</i> , <i>Opuntia polyacantha</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Pleuraphis jamesii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex confertifolia</i>
Herb (field)	<i>Achnatherum hymenoides</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus rubens, *Bromus tectorum*, *Salsola kali*

Globally

Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: G3 (17-Jan-2001). This plant association is widespread but not abundant. Throughout its range, this association is discontinuously distributed, and large stands are uncommon. Its long-term security throughout its range is questionable. Stands undisturbed by livestock grazing, off-highway vehicles, or other activities have healthy understories of *Achnatherum hymenoides* and minimal *Bromus tectorum*. However, such high-quality stands are probably uncommon. The historic range of this type is unknown; however, widespread *Bromus tectorum* invasion and subsequent large-scale wildfires have likely decreased the total number of occurrences. Petroleum extraction from oil shale in Colorado may also be a threat to this association.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This plant association is distinguished from other *Atriplex confertifolia* types by the dominance of *Achnatherum hymenoides* in the herbaceous layer (Young et al. 1986, Rust et al. 2000). Indicators of other *Atriplex confertifolia* associations (e.g., *Picrothamnus desertorum*, *Elymus elymoides*) may be present but in amounts less than those of *Atriplex confertifolia* and *Achnatherum hymenoides*.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: There is light to moderate grazing at these sites. Not enough moisture to support trees or larger shrubs. Big sagebrush cluster occurs just outside of plot. Pinyon-juniper stands surround grassland and more pinyon-juniper and larger shrubs on slickrock to the west.

Capitol Reef National Park Data: The description is based on 1986 and 2003 field data (2 plots: CARE.0516, CARE.9143).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: C. Murphy, mod. J. Coles

REFERENCES: Baker 1982b, Blackburn et al. 1968a, Blackburn et al. 1969b, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Caicco and Wellner 1983g, Driscoll et al. 1984, Kagan et al. 2000, Keammerer 1974b, Keammerer 1977, Moseley 1987a, Moseley 1987b, NVNHP 2003, Rickard and Beatley 1965, Rust et al. unpubl. data 2000b, Ward et al. 1974, Western Ecology Working Group n.d., Young et al. 1986

***Atriplex confertifolia* / *Pleuraphis jamesii* Shrubland
Shadscale / James' Galleta Shrubland**

CODE	CEGL001304
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) Shadscale Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This widespread western shrubland association is reported from the southwestern Great Plains, Colorado Plateau, Great Basin, Columbia Plateau and Mojave Desert mountains. It occurs in a variety of habitats and can be found on

two distinct substrates: coarse-textured, non-saline soils derived from sandstone or gravel or deep, fine-textured, alkaline, often saline soils derived from shale. Stands with coarse-textured soils tend to be on slopes, while those with fine-textured soils tend to be on low, relatively flat positions in the landscape (valley bottoms, basins, etc.). The common trait of these different substrates is that they are very dry either because of low precipitation or because of high internal plant moisture stress from soil salinity. The unvegetated surface is composed largely of bare soil, gravel, and large or small rocks. This shrubland association is characterized by a sparse to open canopy (5-25% cover) of short shrubs dominated by *Atriplex confertifolia* with a sparse to moderate graminoid layer dominated by *Pleuraphis jamesii*. It includes sparsely vegetated stands with as little as 1-2% cover of shrubs and 1% cover of *Pleuraphis jamesii*. Total vegetation cover is widely variable (2-70% in sampled stands). Associated shrubs include *Artemisia bigelovii*, *Artemisia tridentata* ssp. *wyomingensis*, *Atriplex canescens*, *Chrysothamnus viscidiflorus*, *Coleogyne ramosissima*, *Ephedra torreyana*, *Ericameria nauseosa*, *Grayia spinosa*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Opuntia polyacantha*, *Picrothamnus desertorum*, *Sarcobatus vermiculatus*, *Suaeda calceoliformis*, *Suaeda moquinii*, and *Tetradymia canescens* depending on substrate. *Amphipappus fremontii*, *Ambrosia dumosa*, and *Lycium pallidum* occur in the Mojave Desert. If other *Atriplex* species are present, they do not dominate the canopy. Other graminoids include *Achnatherum hymenoides*, *Sporobolus cryptandrus*, and *Elymus elymoides* on sandy sites and *Bouteloua gracilis* and *Sporobolus airoides* on fine-textured soil. Forbs generally have low cover and may include *Sphaeralcea grossulariifolia*, *Eriogonum inflatum*, and species of *Chaenactis*, *Lappula*, *Phacelia*, *Plantago*, and *Chenopodium*. Introduced species such as *Bromus tectorum* and *Salsola kali* are common on some sites.

DISTRIBUTION

Capitol Reef National Park

This association is common to abundant within the park and was sampled at The Castle, Middle Desert, Hartnet Draw, Halls Creek Overlook, Bitter Creek Divide, near the Rainy Day Mine, and Lower South Desert Overlook.

Globally

This widespread shrubland association occurs throughout much of the intermountain western U.S. and is reported from the Columbia Plateau south to the Great Basin, Colorado Plateau, and Mojave Desert mountains and east into the southwestern Great Plains.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on slopes interfluves, steps-in-slope, ridges, hills, and valley floors. Sites are flat to moderately steep (0 to 14° slopes), occur between 1372 and 1951 m elevation, and are oriented to all aspects. The unvegetated surface has sparse to moderate exposure of bare soil and sparse to high cover by gravel and rocks. Litter provides sparse to low cover. Cryptogams are often present and can provide up to 72% cover. Parent materials are variable and include sandstones and shale of the Chinle Formation, Morrison Formation, Entrada Formation, and Moenkopi Formation, typically deposited as alluvium. Soils are rapidly drained to well-drained loam, silts, loamy sands, and sandy loams.

Globally

This widespread association occurs in a variety of habitats throughout much of the intermountain western U.S. and extends south to Mojave Desert mountains and east into the southwestern Great Plains. Elevation ranges from 1184 to 1951 m in the Colorado Plateau. It is found on two distinct substrates: coarse-textured (rocky or sandy), non-saline soils derived from sandstone or gravel, or deep fine-textured, poorly drained, alkaline, often-saline soils derived from shale or shale-derived alluvium. Sites with coarse-textured soils include gravel and cobble outcrops, ridges, mesa escarpments, talus slopes, alluvial fans, mountain and hill slopes, canyon sides, benches and along toe slopes of river bluffs. Fine-textured soil sites include canyon bottoms, plains, alluvial flats, floodplains and basins. Stands with coarse-textured soils can be on flat to moderately steep slopes, while stands with fine-textured soils are typically on flat to gently sloping sites. The common trait of these different substrates is that they are very dry either because of low precipitation (15-23 cm annually) or because of high internal plant moisture stress from soil salinity. The unvegetated surface is composed largely of bare soil, gravel, and large or small rocks. Biological crusts and mosses are important in some stands. Parent materials are variable and in the Colorado Plateau include sandstones and shale of the Burro Canyon Formation, Cedar Mountain Formation, Chinle Formation, Elephant Canyon Formation, Entrada Formation, Kayenta Formation sandstone, Mancos shale, Morrison Formation, Moenkopi Formation, and Wingate Formation typically deposited as alluvium or eolian sand.

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland association is common to abundant within the park. Total vegetation cover ranges from 8 to 70%. This shrub association is characterized by an open canopy of *Atriplex confertifolia* that ranges in cover from 1 to 25%, and the short bunchgrass *Pleuraphis jamesii* that ranges in cover from 1 to 45%. The canopy tree layer can be present and includes sparse cover by *Juniperus osteosperma* and *Pinus edulis* trees. The associated shrub layer is moderate in terms of species diversity and provides sparse to moderate cover. Short and dwarf-shrubs commonly present include *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Gutierrezia sarothrae*, and *Opuntia polyacantha*. The associated herbaceous layer is moderately diverse and typically provides sparse cover. Additional graminoids commonly present include *Achnatherum hymenoides*, *Bromus tectorum*, and *Sporobolus airoides*. Forbs commonly present include *Lappula occidentalis*, *Oenothera caespitosa*, *Plantago patagonica*, and *Sphaeralcea coccinea*. Cryptogam cover is often absent but can provide as much as 72% cover.

Globally

This shadscale shrubland association is characterized by an open canopy (5-25% cover) of short shrubs dominated by *Atriplex confertifolia* with a sparse to moderate graminoid layer dominated by *Pleuraphis jamesii*. This association includes sparsely vegetated stands with as little as 1-2% cover of shrubs and 1% cover of *Pleuraphis jamesii*. Total vegetation cover is widely variable (2-70% in sampled stands). Associated shrubs include *Artemisia bigelovii*, *Artemisia tridentata* ssp. *wyomingensis*, *Atriplex canescens*, *Chrysothamnus viscidiflorus*, *Coleogyne ramosissima*, *Ephedra torreyana*, *Ephedra viridis*, *Ericameria nauseosa*, *Eriogonum microthecum*, *Grayia spinosa*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Lycium pallidum*, *Picrothamnus desertorum*, *Sarcobatus vermiculatus*, *Suaeda calceoliformis*, *Suaeda moquinii*, and *Tetradymia canescens* depending on substrate. *Amphipappus fremontii*, *Ambrosia dumosa*, and *Lycium pallidum* occur in the Mojave Desert. Succulents may include *Echinocereus triglochidiatus*, *Opuntia erinacea*, *Opuntia polyacantha*, *Sclerocactus whipplei*, and *Yucca harrimaniae*. Rarely, tree and tall-shrub species are present and may include *Juniperus osteosperma* and *Fraxinus anomala*. If other *Atriplex* species are present, they do not dominate the canopy. The herbaceous layer is often sparse, less than 10% total cover, but ranges to 30% cover. Other graminoids include *Achnatherum hymenoides*, *Sporobolus cryptandrus*, and *Elymus elymoides* on sandy sites and *Bouteloua gracilis*, *Poa fendleriana*, *Poa secunda*, and *Sporobolus airoides* on finer-textured soil. Forbs generally have low cover and moderate diversity and may include *Astragalus nuttallianus*, *Calochortus flexuosus*, *Calochortus nuttallii*, *Cirsium* sp., *Cryptantha flavoculata*, *Cymopterus purpurascens*, *Descurainia pinnata*, *Eriogonum inflatum*, *Eriogonum lonchophyllum*, *Lappula occidentalis*, *Lepidium montanum*, *Oenothera pallida*, *Phacelia crenulata*, *Plantago patagonica*, *Platyschkuhria integrifolia*, *Rumex hymenosepalus*, *Senecio integerrimus*, *Sphaeralcea coccinea*, *Sphaeralcea grossulariifolia*, and species of *Chaenactis*, *Cryptantha*, *Phacelia*, and *Chenopodium*. Introduced annual species such as *Bromus tectorum*, *Erodium cicutarium*, and *Salsola kali* are common on some sites. Biological soil crusts are variable, with some stands having very little, but cover can be as high as 80%.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Short shrub/sapling	<i>Chrysothamnus viscidiflorus</i> , <i>Ericameria nauseosa</i> , <i>Tetradymia glabrata</i>
Short shrub/sapling	<i>Atriplex confertifolia</i> , <i>Ephedra torreyana</i> , <i>Ephedra viridis</i>
Herb (field)	<i>Gutierrezia sarothrae</i> , <i>Opuntia polyacantha</i> , <i>Tiquilia hispidissima</i>
Herb (field)	<i>Cryptantha crassisepala</i> , <i>Delphinium scaposum</i> , <i>Hymenopappus filifolius</i> , <i>Lappula occidentalis</i> , <i>Lepidium montanum</i> , <i>Platyschkuhria integrifolia</i> , <i>Stanleya pinnata</i> , <i>Tetraneuris acaulis</i> , <i>Thelesperma subnudum</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Aristida purpurea</i> , <i>Bouteloua gracilis</i> , <i>Bromus tectorum</i> , <i>Elymus elymoides</i> , <i>Muhlenbergia pungens</i> , <i>Pleuraphis jamesii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex confertifolia</i>
Short shrub/sapling	<i>Gutierrezia sarothrae</i>
Herb (field)	<i>Pleuraphis jamesii</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Descurainia pinnata*, *Halogeton glomeratus*, *Salsola tragus*, *Sisymbrium altissimum*, *Sonchus asper*, *Tragopogon dubius*

Globally

Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This widespread shrubland association is only defined by the codominance of *Atriplex confertifolia* and *Pleuraphis jamesii*. Stands are found in different regions (from southwestern Great Plains to Great Basin), in different environments (clay bottomlands, dunes, desert mountains) and with different associated species. This association will likely need to be subdivided as more classification information becomes available. Stands of this association with a sparse herbaceous layer are similar to *Atriplex confertifolia* Great Basin Shrubland (CEGL001294). Sparse stands included in the concept of this association are very similar to *Atriplex confertifolia* Sparse Shrubland (CEGL003830). More classification work is needed to clarify differences.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Some sites have cover by large rocks that impede runoff and reduce erosion. One site has wind-throw of Utah juniper trees. One site has evidence of fire. Light to heavy grazing occurs on some sites.

Capitol Reef National Park Data: The description is based on 1986, 1988, and 2003 field data (19 plots: CARE.0402, CARE.0444, CARE.0454, CARE.0513, CARE.0515, CARE.0571, CARE.9004, CARE.9022, CARE.9027, CARE.9077, CARE.9104, CARE.9106, CARE.9213, CARE.9318: CARE.9407, CARE.9408, CARE.9409, CARE.9410, CARE.9417).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: K.A. Schulz, mod. J. Drake and J. Coles

REFERENCES: Annable 1985, Bourgeron and Engelking 1994, Branson and Owen 1970, Branson et al. 1976, CONHP unpubl. data 2003, Campbell 1977, Dastrup 1963, Driscoll et al. 1984, Graham 1937, Harper and Jaynes 1986, Ibrahim et al. 1972, Lusby et al. 1963, NVNHP 2003, Potter et al. 1985, Singh and West 1971, Soil Conservation Service 1978, Tuhy and MacMahon 1988, U.S. Bureau of Reclamation 1976, Von Loh 2000, Welsh 1957, West and Ibrahim 1968, Western Ecology Working Group n.d.

***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	<i>ATRIPLEX CONFERTIFOLIA</i> SHRUBLAND ALLIANCE (A.870) 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 ft.) 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*, 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*, *Poa secunda*, *Dasyochloa pulchella*, 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

Capitol Reef National Park

This association is widespread throughout the park in lower elevation valley floors and associated ridges. It occurs in the South Desert, Hartnet Draw, along Halls Creek drainage and Cathedral Valley. It was sampled in Hartnet Draw.

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

Capitol Reef National Park

This short-shrub association was observed on low ridges and slopes adjacent to the major drainages in the park. The sampled site is moderately steep (10° slope), occurs at 1780 m elevation, and is oriented to a southeastern aspect. This association can be found oriented to any aspect, on steep or level slopes between 1980 and 1700 m elevation. The unvegetated surface has high cover by gravel. Cryptogam cover is sparse. Parent materials are variable and include sandstones and shale that have eroded and deposited as alluvium. Soils are rapidly drained clay loams.

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 ft.) elevation. Soils tend to be alkaline, shallow, well-drained clay loams, 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

Capitol Reef National Park

This association is widespread in the park. The total vegetation cover ranges from 2 to 10% in this sparsely vegetated stand. This short-shrub association is characterized by an open canopy of *Atriplex confertifolia* that ranges in cover from 1 to 5%. The dwarf-shrub layer is sparse in terms of diversity and cover and includes *Kochia americana*. The herbaceous layer is sparse in terms of cover and diversity. Cryptogam cover is sparse.

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*, 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*, *Poa secunda*, *Dasyochloa pulchella*, and *Pleuraphis jamesii*. Forbs are diverse but only contribute more than trace cover in unusually wet years; *Chaenactis douglasii*, *Phacelia crenulata*,

and *Mentzelia albicaulis* are widespread. Disturbed sites have high cover of *Bromus tectorum*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex confertifolia</i>
Herb (field)	<i>Kochia americana</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex confertifolia</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

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

Capitol Reef National Park Inventory Notes: There is sheet flow across the surface, the plot is surrounded by two swales. This is a very rocky surface with rapid drainage.

Capitol Reef National Park Data: The description is based on 2003 and 2004 field data (2 plots: CARE.0458, CARE.8702).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Beatley 1976, Blackburn et al. 1968a, Bourgeron and Engelking 1994, Bradley 1964, Driscoll et al. 1984, Leary and Peterson 1984, NVNHP 2003, Peterson 1984, Rickard and Beatley 1965,

***Coleogyne ramosissima* - *Purshia stansburiana* - *Quercus havardii* var. *tuckeri* Shrubland
Blackbrush - Stansbury's Cliffrose - Tucker Sand Shinnery Oak Shrubland**

CODE	CEGL002348
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	<i>COLEOZYNE RAMOSISSIMA</i> SHRUBLAND ALLIANCE (A.874) Blackbrush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Blackbrush-Mormon-tea Shrubland (CES304.763)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This Colorado Plateau shrub association is characteristic of semi-stabilized sand sheets, dunes and sand-filled pockets in sandstone slickrock in southeastern Utah. Stands occur on plains, ridges, mesa tops, canyon rims, escarpments, valley sides, sand dunes, alluvial terraces and benches with flat to gentle slopes (0-12%) between 1275 and 1670 m (4185-5475 ft.) elevation. Bare soil, sand, and gravel cover much of the unvegetated surface. Litter cover is sparse to low. Covers of bedrock and biological soil crust are variable; either can be absent to sparse or can provide as much as 40% cover. Soils are rapidly drained loamy sands, silt loams, sands, sandy clay loams, or sandy loams derived from eolian sands, alluvium, sandstones or shales. Total vegetation cover ranges from 5 to 70%. The shrub layer is characterized by an open canopy to relatively closed canopy of *Coleogyne ramosissima* accompanied by either or both *Purshia stansburiana* and *Quercus havardii* var. *tuckeri*. Scattered individuals of *Juniperus osteosperma* are present in many stands but not with more than 5% cover. Occasionally *Coleogyne ramosissima* may be absent, but then both *Purshia stansburiana* and *Quercus havardii* var. *tuckeri* are prominent. Associated shrubs include *Artemisia bigelovii*, *Brickellia microphylla*, *Ephedra torreyana*, *Ephedra viridis*, *Eriogonum leptocladon*, *Fraxinus anomala*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, and *Yucca harrimaniae*. The herbaceous layer is moderately diverse in terms of species composition but provides only sparse cover. Common species include the grasses *Achnatherum hymenoides*, *Aristida purpurea*, *Dasyochloa pulchella*, *Pleuraphis jamesii*, and *Muhlenbergia pungens*. Forbs present include *Chaenactis stevioides*, *Chamaesyce fendleri*, *Cryptantha crassisepala*, *Gilia inconspicua*, *Tetranneuris acaulis*, and *Streptanthella longirostris*. The exotic annual grass *Bromus tectorum* is common on some sites.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon and was sampled south of Brimhall Canyon, along the Airport Route, south of Burt's Spring, and at the southern park boundary.

Globally

This association is locally common on sandy sites at middle elevations at Arches, Canyonlands, and Capitol Reef national parks, and Glen Canyon National Recreation Area in the Colorado Plateau of southeastern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This dwarf-shrub association was observed on plains, benches, rims, and escarpment slopes. Sampled sites are gentle (5 to 8° slopes), occur between 1274 and 1538 m elevation, and are oriented to eastern aspects. The unvegetated surface has low to high exposures of bedrock and low to moderate exposure of bare soil. Litter is sparse. Cryptogams are absent to sparse or can provide up to 40% cover. Parent materials are variable and include sandstones of the Dakota and Entrada formations and shale of the Salt Wash Member of the Morrison Formation. Soils are rapidly drained loamy sands and sandy loams.

Globally

This Colorado Plateau shrub association is characteristic of semi-stabilized sand sheets, dunes and sand-filled pockets in sandstone slickrock in southeastern Utah. Stands occur on plains, ridges, mesa tops, canyon rims, escarpments, valley sides, sand dunes, alluvial terraces and benches with flat to gentle slopes (0-12%) between 1275 and 1670 m (4185-5475 ft.) elevation. Bare soil, sand, and gravel cover much of the unvegetated surface. Litter cover is sparse to low. Bedrock and biological soil crust cover is variable and can be absent to sparse or can provide up to 40% cover. Soils are rapidly drained loamy sands, silt loams, sands, sandy clay loams, or sandy loams derived from eolian sands, alluvium, sandstones of the White Rim, Kayenta, Dakota or Entrada formations, or shales of the Moenkopi Formation or Salt Wash Member of the Morrison Formation.

VEGETATION DESCRIPTION

Capitol Reef National Park

This mixed shrubland association is uncommon in the southeastern portion of the park. The total vegetation cover ranges from 10 to 70% in these sparsely to densely vegetated stands. This shrubland association is characterized by an open to relatively closed canopy of *Coleogyne ramosissima*, *Purshia stansburiana*, and *Quercus havardii* var. *tuckeri* short and dwarf-shrubs that range in cover from 1 to 25%, 1 to 45%, and no cover, respectively. The associated short- and dwarf-shrub layer is moderately diverse, provides sparse to moderate cover, and includes *Fraxinus anomala*, *Gutierrezia sarothrae*, and *Ephedra torreyana*. The associated herbaceous layer is moderately

diverse in terms of species composition, provides sparse cover, and includes the grasses *Aristida purpurea*, *Bromus tectorum*, and *Dasyochloa pulchella* and the forb *Gilia inconspicua*. Cryptogams are typically sparse in terms of cover, but one stand had as much as 40% cover.

Globally

This association is locally common on sandy sites throughout the northern Colorado Plateau. Total vegetation cover ranges from 5 to 70%. The shrub layer is characterized by an open to relatively closed canopy of *Coleogyne ramosissima* accompanied by either or both *Purshia stansburiana* and *Quercus havardii* var. *tuckeri*. Scattered individuals of *Juniperus osteosperma* are present in many stands but not with more than 5% cover. Occasionally *Coleogyne ramosissima* may be absent, but then both *Purshia stansburiana* and *Quercus havardii* var. *tuckeri* are prominent. Associated shrubs include *Artemisia bigelovii*, *Brickellia microphylla*, *Ephedra torreyana*, *Ephedra viridis*, *Eriogonum leptocladon*, *Fraxinus anomala*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, and *Yucca harrimaniae*. Exceptionally cool or moist sites support *Cercocarpus intricatus* and *Amelanchier utahensis* as part of the mix. The herbaceous layer is moderately diverse in terms of species composition but provides only sparse cover. Common species include the grasses *Achnatherum hymenoides*, *Aristida purpurea*, *Dasyochloa pulchella*, *Pleuraphis jamesii*, and *Muhlenbergia pungens*. Forbs present include *Chaenactis stevioides*, *Chamaesyce fendleri*, *Cryptantha crassisejala*, *Gilia inconspicua*, *Tetranneuris acaulis*, and *Streptanthella longirostris*. The exotic annual grass *Bromus tectorum* is common on some sites. Biological soil crusts are typically sparse, but one sampled stand had 40% cover.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tall shrub/sapling	<i>Fraxinus anomala</i>
Tall shrub/sapling	<i>Purshia stansburiana</i>
Short shrub/sapling	<i>Psoralea fremontii</i> , <i>Rhus aromatica</i>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> , <i>Ephedra viridis</i>
Herb (field)	<i>Chrysothamnus viscidiflorus</i> , <i>Coleogyne ramosissima</i> , <i>Eriogonum corymbosum</i> , <i>Yucca angustissima</i>
Herb (field)	<i>Rumex hymenosepalus</i>
Herb (field)	<i>Vulpia octoflora</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tall shrub/sapling	<i>Purshia stansburiana</i>
Short shrub/sapling	<i>Cercocarpus intricatus</i> , <i>Ephedra viridis</i> , <i>Quercus havardii</i> var. <i>tuckeri</i>
Herb (field)	<i>Yucca angustissima</i>
Herb (field)	<i>Pleuraphis jamesii</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum

Globally

Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G4 (11-Jan-2006). This association is somewhat restricted in its range and habitat, but most sampled examples appear to be in good condition, with few exotic species present. The range is restricted by the range of *Quercus havardii* var. *tuckeri*, which is limited to southeastern Utah. Most stands of this association are small, less than 5 hectares in size and often less than 1 ha in size.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Quercus havardii var. *tuckeri* is also referred to in Utah as *Quercus undulata* and *Quercus havardii* var. *tuckeri*. The literature for Utah should be reviewed for material relating to this association but using these other names.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Cattle graze some stands. Two stands located in floodplains or channels experience flooding. One stand has alternating patches of slickrock with cryptobiotic soil crusts in between.

Capitol Reef National Park Data: The description is based on 2004 field data (4 plots: CARE.0602, CARE.0650, CARE.0651, CARE.0654).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Western Ecology Working Group n.d.

***Coleogyne ramosissima* / *Pleuraphis jamesii* Shrubland
Blackbrush / James' Galleta Shrubland**

CODE	CEGL001334
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	<i>COLEOGYNE RAMOSISSIMA</i> SHRUBLAND ALLIANCE (A.874) Blackbrush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Blackbrush-Mormon-tea Shrubland (CES304.763)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This shrubland association occurs in the Colorado Plateau and Mojave Desert in areas with hot summers and cold winters. Sites are gently sloping to flat and are found on a variety of landforms from canyon rims and ledges to alluvial fans, valleys and washes with some stands occurring on sand sheets or shale barrens. Elevations range to 1850 m (6070 ft.). Substrates are variable and range from deep, well-drained, sandy soils derived from sandstone to rocky, clayey soils derived from shale. The vegetation is characterized by an open (10-30% cover) short-shrub layer dominated by the deciduous, microphyllous shrub *Coleogyne ramosissima* with a sparse to moderately dense perennial graminoid layer dominated or codominated by *Pleuraphis jamesii*. Shrub associates may be present, including *Atriplex canescens*, *Atriplex confertifolia*, *Ephedra nevadensis*, *Ephedra torreyana*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, and *Opuntia* spp. *Achnatherum hymenoides*, *Calochortus nuttallii*, and several annuals may be present to abundant in the herbaceous layer, especially during wet years. Cover of introduced annual *Bromus* species and *Salsola tragus* may be high in disturbed stands. Occasional *Juniperus osteosperma* or *Pinus edulis* trees are present in some stands.

DISTRIBUTION

Capitol Reef National Park

This association is common in the southern end of the park. It was sampled in along Halls Creek drainage.

Globally

This shrubland association occurs in the Colorado Plateau and Mojave Desert from southwestern Colorado across southern Utah and possibly into Arizona and California.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on lower portions of slopes. The sampled site is gentle (2° slope), occurs at 1280 m elevation, and is oriented to the west. The unvegetated surface is unrecorded. Parent materials are variable and include sandstones and shale eroded to form alluvial deposits. Soils are well-drained and fine in texture.

Globally

This shrubland association occurs in the Colorado Plateau and Mojave Desert in areas with hot summers and cold winters. Elevation ranges from 1200-1850 m (3950-6070 ft.). Sites are located on level to gently sloping plateaus, canyon rims, ledges, hills, alluvial fans, toe slopes, valleys, dunes, and washes, generally not exceeding a 20% gradient. The unvegetated surface is covered by either bare soil, sand or gravel. There is sparse cover by litter and typically early-stage biological soil crusts, although there may be significant cover locally. Substrates are extremely variable, with some stands occurring on stabilized sand sheets, others on shale barrens. Soil textures range from eolian or alluvial sand; to deep, rapidly drained, alkaline loamy sands or sandy loams derived from sandstone; to silt loam, silty clay loam or rocky clay soils derived from shale and sandstone, including Navajo Moenkopi Formation (Utah Environmental and Agricultural Consultants 1973).

VEGETATION DESCRIPTION

Capitol Reef National Park

This association is common on lowlands in the southern portion of the park. The vegetation is characterized by an open to relatively closed canopy of *Coleogyne ramosissima* shrubs, and by the short bunchgrass *Pleuraphis jamesii*. The shrub layer is relatively diverse and provides low to moderate cover. The more abundant short and dwarf-shrubs present include *Atriplex confertifolia*, *Ephedra torreyana*, and *Gutierrezia sarothrae*. The associated herbaceous layer is low in diversity and provides sparse cover.

Globally

The vegetation is characterized by an open to moderately dense (10-60% cover) short-shrub layer dominated by the deciduous, microphyllous shrub *Coleogyne ramosissima* with a sparse to moderately dense perennial graminoid layer typically dominated or codominated by *Pleuraphis jamesii*. Shrub associates may be present, including *Atriplex canescens*, *Atriplex confertifolia*, *Ephedra nevadensis*, *Ephedra torreyana*, *Ericameria nauseosa*, *Eriogonum corymbosum*, *Gutierrezia sarothrae*, *Opuntia* spp., *Psoralea fremontii*, *Sclerocactus whipplei*, and *Yucca angustissima*. Cover of *Pleuraphis jamesii* ranges from 1-5% in stands with sparse herbaceous layers to over 30% where the understory is denser. Additional graminoids include *Achnatherum hymenoides*, *Aristida purpurea*, or the introduced annual *Bromus* species, which may be common in disturbed stands. Forb cover is generally low and is highly variable in species composition among sites. Forbs include *Amsonia tomentosa*, *Astragalus* sp., *Calochortus nuttallii*, *Eriogonum inflatum*, *Eriogonum nutans*, *Heterotheca villosa*, *Ipomopsis polycladon*, *Phacelia* spp., *Sphaeralcea leptophylla*, *Stenotus acaulis*, and the introduced annual forb *Salsola tragus*. Annuals provide abundant cover during wet years. Occasional *Juniperus osteosperma* or *Pinus edulis* trees are present in some stands.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex confertifolia</i> , <i>Coleogyne ramosissima</i> , <i>Psoralea fremontii</i>
Herb (field)	<i>Gutierrezia sarothrae</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Ephedra nevadensis</i>
Short shrub/sapling	<i>Coleogyne ramosissima</i>
Short shrub/sapling	<i>Gutierrezia sarothrae</i>
Herb (field)	<i>Pleuraphis jamesii</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Salsola tragus*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This association is similar to the broadly-defined *Coleogyne ramosissima* Shrubland (CEGL001332), which generally has a sparse to extremely sparse herbaceous layer. This association is separated only by the presence of a developed herbaceous layer in which *Pleuraphis jamesii* has at least 1% cover.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: The site experiences moderate grazing.

Capitol Reef National Park Data: The description is based on 1988 field data (1 plot: CARE.9438).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: K.A. Schulz, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, Bowns and West 1976, CONHP unpubl. data 2003, Cogan et al. 2004, Driscoll et al. 1984, Utah Environmental and Agricultural Consultants 1973, Warren et al. 1982, Wright 1980

***Coleogyne ramosissima* Shrubland
Blackbrush Shrubland**

CODE	CEGL001332
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	<i>COLEOZYNE RAMOSISSIMA</i> SHRUBLAND ALLIANCE (A.874) Blackbrush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Blackbrush-Mormon-tea Shrubland (CES304.763)
Mojave Mid-Elevation Mixed Desert Scrub (CES302.742)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This broadly defined, common shrubland association occurs in the Colorado Plateau, southern Great Basin, Mojave Desert, and Sierra Nevada foothills in areas with hot summers and cold winters. Elevations range from 1065-2133 m (3500-7000 ft.). Sites are on level to steep slopes, rarely exceeding 45%. In Nevada, stands occur on lower foothills and upper bajadas, often with cooler northern and eastern aspects. In the Colorado Plateau, stands occupy plateaus, ridges, dunes, alluvial fans, benches and colluvial slopes oriented to any aspect. The unvegetated surface is dominated by bare ground, except on some sandy sites, where biological soil crusts may provide more than 50% cover. Substrates range from barren shales to alluvium and eolian sands to broken limestone. Soils tend to be shallow, calcareous, sandy-textured on eolian sand sites, and clay-textured on shale sites. There is often a caliche subhorizon. Gravel, boulders and rock outcrops are common. The vegetation is characterized by an open to moderately dense short-shrub layer that is clearly dominated by the evergreen microphyllous shrub *Coleogyne ramosissima*, sometimes in nearly pure stands. Shrub cover is usually around 20%, although it can range as low as 5% or as high as 50%. Other shrub and dwarf-shrub species may be present with low cover, including *Ambrosia dumosa*, *Artemisia filifolia*, *Atriplex canescens*, *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Ephedra funerea*, *Ephedra torreyana*, *Ephedra nevadensis*, *Ephedra viridis*, *Ericameria linearifolia*, *Ericameria teretifolia*, *Gutierrezia sarothrae*, *Gutierrezia microcephala*, *Krascheninnikovia lanata*, *Lycium* spp., *Menodora spinescens*, *Opuntia* spp., and *Yucca baccata*. Occasional *Juniperus* spp., *Pinus edulis*, or *Pinus monophylla* trees are present in some stands. The herbaceous layer generally includes only sparse cover of graminoids and forbs, except during wet years when cover of annuals may be high. Cover of the introduced annual *Bromus* spp. may be high in disturbed stands, but in general, the substrate does not support the growth of more than a trace of grasses.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon to locally common in the southern portion of the park. It was sampled at Halls Creek Overlook, on benches above Halls Creek, and five miles south of Sandy Ranch.

Globally

This widespread and common desert shrubland association occurs in the Colorado Plateau, southern Great Basin, Mojave Desert, and Sierra Nevada foothills.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on slopes, colluvial slopes, steps-in-slope, and plateaus. Sites are gentle (2 to 13° slopes), occur between 1220 and 1610 m elevation, and are oriented to all aspects. The unvegetated surface has moderate to high exposure of bare soil, sparse to low cover of litter, and moderate cover by live vegetation basal area. Cryptogams are absent to sparse. Parent materials are variable and include sandstones of the Navajo, Dakota and Entrada formations, Carmel Formation sandstone and clay, and sandstone colluvium. Soils are rapidly drained to well-drained loamy sands and sandy loams.

Globally

This broadly defined shrubland association occurs in the Colorado Plateau, southern Great Basin, Mojave Desert, and Sierra Nevada foothills in areas with hot summers and cold winters. Elevations range from 1065-2133 m (3500-7000 ft.). Sites are frequently on level to moderate slopes rarely exceeding 20% but have also been found on steep slopes (>45%). In Nevada, stands occur on lower foothills and upper bajadas, often with cooler northern and eastern aspects. In the Colorado Plateau, stands occupy plateaus, ridges, dunes, alluvial fans, canyon rims, bench ledges valleys, plains, and colluvial slopes with any aspect. The upper elevation ecotones are generally narrow, and *Coleogyne ramosissima* may mix with *Artemisia* spp. or *Pinus edulis* and *Juniperus osteosperma*. The lower elevation ecotones tend to be broader, and *Coleogyne ramosissima* may mix with grasslands or with shrublands dominated by *Larrea tridentata*, *Ambrosia dumosa*, *Atriplex* spp., or *Grayia spinosa* (Beatley 1976). Stands described from the Colorado Plateau often occur in a mosaic with pinyon-juniper woodlands (Warren et al. 1982). The unvegetated surface is dominated by bare ground, except on some sandy sites, where biological soil crusts may provide more than 50% cover. Substrates range from barren shales to alluvium and eolian sands to broken limestone. Soils tend to be shallow, calcareous, sandy-textured on eolian sand sites, and clay soils on shale sites. There is often with a caliche subhorizon. Gravel, boulders and rock outcrops are common.

VEGETATION DESCRIPTION

Capitol Reef National Park

This association is uncommon to locally common in the southern portion of the park. The vegetation is characterized by an open to relatively closed canopy of *Coleogyne ramosissima* short shrubs that range in cover from 5 to 35%. The tall shrub *Fraxinus anomala* is occasionally present and provides sparse to low cover. The associated short- and dwarf-shrub layers are moderately diverse, provide sparse to moderate cover, and include *Ephedra viridis*, *Ephedra torreyana*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, *Purshia mexicana*, and *Yucca angustissima*. The associated herbaceous layer is moderately diverse in terms of species composition and provides sparse to low cover. Common graminoids include *Achnatherum hymenoides*, *Bromus tectorum*, *Pleuraphis jamesii*, and *Vulpia octoflora*. Forbs commonly present include *Dalea flavescens*, *Phacelia crenulata*, and *Plantago patagonica*. Cryptogams are typically sparse in terms of cover.

Globally

This common association is characterized by an open to moderately dense short-shrub layer that is clearly dominated by the evergreen microphyllous shrub *Coleogyne ramosissima*. Shrub cover is usually around 20%, although it can range as low as 5% or as high as 50%. It can occur in almost pure stands. Other shrub and dwarf-shrub species may be present with low cover, including *Ambrosia dumosa*, *Artemisia filifolia*, *Atriplex canescens*, *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Ephedra funerea*, *Ephedra torreyana*, *Ephedra nevadensis*, *Ephedra viridis*, *Ericameria linearifolia*, *Ericameria teretifolia*, *Gutierrezia sarothrae*, *Gutierrezia microcephala*, *Krascheninnikovia lanata*, *Lycium* spp., *Menodora spinescens*, *Opuntia* spp., and *Yucca baccata*. Locally, disturbance may reduce abundance of *Coleogyne ramosissima* and favor *Artemisia filifolia* until it nearly codominates. Occasional *Juniperus* spp., *Pinus edulis*, or *Pinus monophylla* trees are present in some stands. The herbaceous layer generally includes only sparse cover of graminoids and forbs, except during wet years when cover of annuals may be high. Cover of the

introduced annual *Bromus* spp. may be high in disturbed stands, but in general, the substrate does not support the growth of more than a trace of grasses. Forbs may include species of *Chaenactis*, *Cryptantha*, *Phacelia*, *Plantago*, and *Streptanthella*. Scattered *Juniperus osteosperma* may also be present.

MOST ABUNDANT SPECIES

Capitol Reef National Park

Stratum

Tall shrub/sapling
Short shrub/sapling
Short shrub/sapling
Herb (field)

Species

Fraxinus anomala
Ericameria nauseosa, *Psoralea fremontii*
Coleogyne ramosissima, *Ephedra torreyana*, *Ephedra viridis*, *Purshia mexicana*
Atriplex confertifolia, *Brickellia microphylla*, *Gutierrezia microcephala*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, *Yucca angustissima*
Cryptantha crassisepala, *Phacelia crenulata*
Bromus tectorum, *Pleuraphis jamesii*, *Vulpia octoflora*

Herb (field)

Herb (field)

Globally

Stratum

Short shrub/sapling

Species

Coleogyne ramosissima

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus rubens, *Bromus tectorum*

Globally

Bromus rubens, *Bromus tectorum*

CONSERVATION STATUS RANK

Global Rank & Reasons: G4G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This widespread plant association is broadly defined by the strong dominance of *Coleogyne ramosissima* without diagnostic codominate shrubs or a developed herbaceous layer. It is similar to the broadly defined *Coleogyne ramosissima* / *Pleuraphis jamesii* Shrubland (CEGL001334) and is separated from it by the lack of a *Pleuraphis jamesii*-dominated herbaceous layer. In cases where the grass element is missing or is greatly reduced because of grazing and not because of edaphic factors, there is potential for misclassification of stands.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Cattle grazing still occurs outside the park in some stands. Blackbrush grows on soil pedestals due to erosion on some sites. Some stands are distributed on knolls.

Capitol Reef National Park Data: The description is based on 1986, 1988, 2003, and 2004 field data (13 plots: CARE.0406, CARE.0511, CARE.0514, CARE.0518, CARE.0559, CARE.561, CARE.0564, CARE.9003, CARE.9007, CARE.9009, CARE.9144, CARE.9312, CARE.9439).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: K.A. Schulz, mod. J. Coles

REFERENCES: Annable 1985, Armstrong 1969, BIA 1979, Beatley 1976, Bourgeron and Engelking 1994, Bowns and West 1976, Bradley 1964, Callison et al. 1985, Cogan et al. 2004, Driscoll et al. 1984, NVNHP 2003, Ostler et al. 2000, Peterson 1984, Schultz et al. 1987, Shields et al. 1959, Warren et al. 1982, Wells 1960, West 1983d, Wright 1980

***Juniperus osteosperma* - (*Pinus edulis*) / *Coleogyne ramosissima* - *Purshia stansburiana* -**

***Quercus havardii* var. *tuckeri* Wooded Shrubland
Utah Juniper - (Two-needle Pinyon) / Blackbrush - Stansbury's Cliffrose - Tucker Sand
Shinnery Oak Wooded Shrubland**

CODE	CEGL003774
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	Extremely xeromorphic evergreen shrubland with a sparse tree layer (III.A.5.N.e.)
ALLIANCE	<i>PINUS EDULIS</i> - <i>JUNIPERUS OSTEOSPERMA</i> WOODED SHRUBLAND ALL. (A.2649) Two-needle Pinyon - Utah Juniper Wooded Shrubland Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)
Colorado Plateau Pinyon-Juniper Shrubland (CES304.766)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association has been documented only in the canyonlands of the Colorado Plateau in eastern Utah. This wooded shrubland association occurs where a thin veneer of sand has been deposited in slickrock depressions, on escarpments, plateaus, benches, ridges, hogbacks, valley sides and slopes, dunes, swales, in slot canyons, and washes. Sites are on flat to steep slopes (70%), occur between 1296 and 1890 m elevation, and are oriented to all aspects. Biological soil crust cover is typically low but can be as high as 45%. Soils are derived from eolian deposits and include rapidly drained loams, loamy sands to sandy clays, and sands. This wooded shrubland association has a mixed shrub canopy, occasionally with scattered trees of *Pinus edulis* and/or *Juniperus osteosperma*. Woody plants tend to be rooted in bedrock fractures; herbaceous plants persist in the thin deposits of sand that cover the substrate. Total vegetation cover is variable, ranging from 2 to 65% depending on the degree of fracturing of the underlying bedrock. The vegetation is characterized by an open canopy of stunted *Juniperus osteosperma* or *Pinus edulis* ranging in cover from 1 to 15% and a shrub understory in which *Coleogyne ramosissima* is always present and is always accompanied by either or both *Purshia stansburiana* and *Quercus havardii* var. *tuckeri*. Shrub cover may often exceed total tree cover. *Pinus edulis*, typically 2-5 m tall, may be present with low cover relative to *Juniperus osteosperma*. The shrub layer may contain as many as ten species, depending on how xeric or mesic the site is. Herbaceous species are rarely important in these stands.

DISTRIBUTION

Capitol Reef National Park

This association is rare at Capitol Reef National Park and was sampled only once in Halls Creek.

Globally

This association is known only from the canyonlands of the Colorado Plateau in eastern Utah. It is reported from Arches, Canyonlands, and Capitol Reef national parks and Glen Canyon National Recreation Area.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This wooded association is apparently rare within the park, as it was sampled only once. The site is on a gently sloping (5°) valley bottom oriented to the west at 114 m elevation. Bedrock and bare soil typically cover most of the unvegetated surface. Litter provides sparse to low cover. Biological soil crust cover is typically low but can be as high as 10%. The soil is derived from alluvium and Entrada sandstone.

Globally

This wooded shrubland association occurs where a thin veneer of sand has been deposited in slickrock depressions, on escarpments, plateaus, benches, ridges, hogbacks, valley sides and slopes, dunes, swales, in slot canyons, and washes. Sites are on flat to steep slopes (70%), occur between 1296 and 1890 m elevation, and are oriented to all aspects. Bedrock and bare soil typically cover most of the unvegetated surface. Litter provides sparse to low cover. Biological soil crust cover is typically low but can be as high as 45%. Soils are rapidly drained sand, sandy loams, sandy clay loams, or loamy sands derived from eolian or alluvium deposits, sandstone and shale bedrock or

colluvium. Parent materials are variable and include Cedar Mesa, Wingate, Kayenta, Entrada (including the Dewey Bridge Member), and Navajo sandstone formations, the Moab Tongue of the Curtis Formation, the Chinle Formation and the Salt Wash Member of the Morrison Formation.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland association with a mixed shrub understory is very rare within the park. Woody plants tend to be rooted in bedrock fractures; herbaceous plants persist in the thin deposits of sand that cover the substrate. Total vegetation cover is around 11% and is limited by the degree of fracturing of the underlying bedrock. The vegetation is characterized by an open canopy of stunted *Juniperus osteosperma* with 3% cover and a shrub understory in which *Coleogyne ramosissima* is accompanied by *Purshia stansburiana* and *Quercus havardii* var. *tuckeri*. Total shrub cover exceeds tree cover. Associated shrubs include *Fraxinus anomala*, *Ephedra viridis*, *Gutierrezia sarothrae*, and *Atriplex canescens*. Herbaceous species are rarely important in this type. *Lepidium montanum* and *Plantago patagonica* were the only herbaceous species reported in the sampled stand.

Globally

This wooded shrubland association has a mixed shrub canopy, occasionally with scattered trees of *Pinus edulis* and/or *Juniperus osteosperma*. Woody plants tend to be rooted in bedrock fractures; herbaceous plants persist in the thin deposits of sand that cover the substrate. Total vegetation cover is variable, ranging from 2 to 65% depending on the degree of fracturing of the underlying bedrock. The vegetation is characterized by an open canopy of stunted *Juniperus osteosperma* or *Pinus edulis* ranging in cover from 1 to 15% and a shrub understory in which *Coleogyne ramosissima* is always present and is always accompanied by either or both *Purshia stansburiana* and *Quercus havardii* var. *tuckeri*. Shrub cover often exceeds total tree cover. *Pinus edulis*, typically 2-5 m tall, may be present with low cover relative to *Juniperus osteosperma*. The shrub layer may contain as many as ten species, depending on how xeric or mesic the site is. Xeric stands most commonly include *Artemisia bigelovii*, *Chrysothamnus viscidiflorus*, *Ephedra torreyana*, *Ephedra viridis*, *Fraxinus anomala*, *Glossopetalon spinescens* var. *meionandrum*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, *Rhus trilobata*, *Sclerocactus whipplei*, and *Yucca harrimaniae*. In more mesic sites, *Amelanchier utahensis*, *Cercocarpus intricatus*, or *Cercocarpus montanus* may be present. Herbs are generally too sparse to form a layer but may be diverse. Grasses include *Achnatherum hymenoides*, *Achnatherum speciosum*, *Aristida purpurea*, *Sporobolus cryptandrus*, *Vulpia octoflora*, and exotic *Bromus tectorum*. Forbs include *Arenaria fendleri*, *Chamaesyce fendleri*, *Cryptantha flava*, *Descurainia pinnata*, *Hedysarum boreale*, *Lepidium montanum*, *Lomatium parryi*, *Machaeranthera grindelioides*, *Plantago patagonica*, *Petradoria pumila*, *Streptanthella longirostris*, and *Tetraneuris acaulis*. Exotic forbs are sometimes present and include *Chenopodium album*, *Erodium cicutarium*, and *Salsola tragus*. Biological soil crust cover is generally sparse (<15%), although some stands have nearly 50% cover, and is usually well-developed.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Tall shrub/sapling	<i>Fraxinus anomala</i>
Short shrub/sapling	<i>Coleogyne ramosissima</i> , <i>Quercus havardii</i> var. <i>tuckeri</i>
Short shrub/sapling	<i>Ephedra viridis</i>
Herb (field)	<i>Gutierrezia sarothrae</i>
Herb (field)	<i>Lepidium montanum</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree (canopy & subcanopy)	<i>Juniperus osteosperma</i>
Shrub/sapling (tall & short)	<i>Purshia stansburiana</i>
Tall shrub/sapling	<i>Fraxinus anomala</i>
Short shrub/sapling	<i>Coleogyne ramosissima</i> , <i>Quercus havardii</i> var. <i>tuckeri</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (15-Mar-2006).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE:

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: This polygon is really a mish-mash of shrubs and juniper with *Atriplex canescens* leaking up from the area below.

Capitol Reef National Park Data: The description is based on field data collected in 2005 during accuracy assessment (1 plot: CARE_AA.0662).

Local Description Authors: J. Coles

Global Description Authors: G. Kittel, mod. K.A. Schulz

REFERENCES: Western Ecology Working Group n.d.

Pinus edulis - Juniperus osteosperma / (Shepherdia rotundifolia, Amelanchier utahensis)

Wooded Shrubland

Two-needle Pinyon - Utah Juniper / (Roundleaf Buffaloberry, Utah Serviceberry) Wooded Shrubland

CODE	CEGL002334
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	Extremely xeromorphic evergreen shrubland with a sparse tree layer (III.A.5.N.e.)
ALLIANCE	<i>PINUS EDULIS - JUNIPERUS OSTEOSPERMA</i> WOODED SHRUBLAND ALL. (A.2649) Two-needle Pinyon - Utah Juniper Wooded Shrubland Alliance

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

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This wooded shrubland association occurs on the slopes of mesas, buttes and plateaus in southern Utah. The typical occurrence is located on the lower and middle sections of a shale slope overlain by rockfall from the sandstone or conglomerate that caps the landform. Most sites are moderately steep to steep (to 85%), occur between 1422 and 2348 m (4665-7700 ft.) elevation, and are oriented to cooler north to northeastern aspects. A smaller number of occurrences, usually at higher elevations, occupy west-facing slopes. The unvegetated surface has sparse to low cover of litter and low to high exposure of bare soil, gravel and large rocks. Large rocks cover as much as 40% of the ground surface. Parent materials are typically shales of the Moenkopi, Chinle, Cutler or Carmel formations, modified by colluvial fragments of overlying conglomerate or sandstones. Soils are rapidly drained silt loams, sandy loams and clay loams. The vegetation is characterized by a sparse to moderately closed canopy (5-30%) of *Pinus edulis*, often accompanied by *Juniperus osteosperma*. In rare cases on barren shales, the tree element is nearly absent. The shrub layer is mixed, but *Amelanchier utahensis* or *Shepherdia rotundifolia* are present (usually both). Other shrubs often present include *Cercocarpus montanus*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Ericameria nauseosa*, *Eriogonum corymbosum*, *Eriogonum microthecum*, *Gutierrezia sarothrae*, *Symphoricarpos longiflorus*, and *Mahonia fremontii*. The herbaceous layer is moderate to high in terms of species diversity and typically provides

sparse to moderate cover. Common graminoids include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Hesperostipa comata*, *Leymus salinus*, and *Pleuraphis jamesii*. Forbs that are occasionally present include *Cryptantha flava*, *Machaeranthera grindelioides*, *Penstemon utahensis*, *Phlox austromontana*, *Lepidium montanum*, *Stanleya pinnata*, *Streptanthella longirostris*, and *Tetraneuris acaulis*.

DISTRIBUTION

Capitol Reef National Park

This association is common and was sampled west of George Peak, in Upper Muley Twist Canyon, west of Lower Muley Trail, at Brinkerhoff Spring, at Pleasant Creek, in South Draw, north of and in the Onion Beds, below Wagon Box Mesa, along Oak Creek, in Deep Creek and Little Sand Flat, and Upper Deep Creek within the park and on Burt Canyon Road outside the park.

Globally

This association is known from the Colorado Plateau of southern and eastern Utah. It may also occur in similar habitats in Arizona and western Colorado; however, *Shepherdia rotundifolia* is somewhat rare east of the La Sal Mountains.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This wooded shrubland association was observed on the slopes of ridges and hills as well as on benches and interfluves. Sites are gentle to steep (2 to 34° slopes), occur between 1555 and 2348 m elevation, and are oriented to all aspects. The unvegetated surface has low to moderate cover of litter and moderate to high cover by rocks and gravel. Two stands have high exposure of bare soil. Parent materials are variable and include sandstones and shale of the Moenkopi Formation, Cutler Formation, Chinle Formation, Carmel Formation, and Navajo Formation. Soils are rapidly drained to well-drained with texture varying from clay loam to silt to sandy loam.

Globally

This common northern Colorado Plateau wooded shrubland occurs on canyon rims, sides, and bottoms, ridges, benches and the colluvial slopes of mesas, buttes and plateaus in southeastern Utah. The typical occurrence is located on the lower and middle sections of a shale slope overlain by rockfall from the sandstone or conglomerate that caps the landform. Sites range from gentle to very steep on all aspects (5-85% slope), but most are moderately steep, occur between 1422 and 2348 m (4665-7700 ft.) elevation, and are oriented to cooler northern to northeastern aspects. The unvegetated surface has sparse to low cover of litter and low to high exposure of bare soil, gravel and large rocks. Large rocks cover as much as 40% of the ground surface. Biological soil crusts provide sparse to low cover. Parent materials are typically shales of the Moenkopi, Chinle, Cutler or Carmel formations, modified by colluvial fragments of overlying conglomerate or sandstones. Soils are rapidly drained silt loams, sandy loams and clay loams. Parent materials are typically shales of the Moenkopi, Chinle, Cutler or Carmel formations, modified by colluvial fragments of overlying conglomerates (Shinarump) or sandstones (Navajo). Soils are rapidly drained silt, silt loam, clay loam, sandy loam, and loamy sand.

VEGETATION DESCRIPTION

Capitol Reef National Park

This association is common within the park. The total vegetation cover ranges from 3 to 90%. This woodland association is characterized by an open canopy, typically 2-5 m tall, of *Pinus edulis* and *Juniperus osteosperma* trees that range in cover from 0 to 35% and 1 to 25%, respectively, and *Shepherdia rotundifolia* and *Amelanchier utahensis* short and tall shrubs that range in cover from <1 to 15% and 0 to 5%, respectively. The shrub layer is moderately diverse and provides sparse to moderate cover. The associated tall shrubs *Fraxinus anomala*, *Rhus trilobata*, and *Mahonia fremontii* are occasionally present. The associated short and dwarf-shrub layers commonly include *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Ericameria nauseosa*, *Eriogonum corymbosum*, *Eriogonum microthecum*, *Gutierrezia sarothrae*, and *Opuntia polyacantha*. The herbaceous layer is moderate to high in terms of species diversity and typically provides sparse to moderate cover. Common graminoids include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Bromus tectorum*, *Hesperostipa comata*, and *Pleuraphis jamesii*. Forbs that are occasionally present include *Cryptantha flava*, *Descurainia pinnata*, *Machaeranthera grindelioides*, *Penstemon utahensis*, *Phlox austromontana*, *Streptanthella longirostris*, and *Tetraneuris acaulis*. Seedling *Pinus edulis* and *Juniperus osteosperma* trees are rarely present and provide sparse cover. Cryptogam cover does not occur or is sparse.

Globally

This mesic wooded shrubland is consistent and predictable in its unique habitat in the eastern Colorado Plateau. Total cover varies from 15% to nearly 90%. The vegetation is characterized by a sparse to moderately closed canopy (5-30%) of *Pinus edulis*, often accompanied by *Juniperus osteosperma*. In a minority of stands with little colluvial rock cover, the trees may be too sparse to be considered a layer, and the community will appear to be a shrubland with very scattered pinyon and juniper. The shrub layer is variable but often has higher total cover than the tree layer. The shrub layer is mixed, but *Amelanchier utahensis* or *Shepherdia rotundifolia* are present (usually both). Other shrubs often present include *Cercocarpus montanus*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Ericameria nauseosa*, *Eriogonum corymbosum*, *Eriogonum microthecum*, *Gutierrezia sarothrae*, *Mahonia fremontii*, *Rhus trilobata*, and *Symphoricarpos longiflorus*. The herbaceous layer is moderate to high in terms of species diversity and typically provides sparse to moderate cover. Common graminoids include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Bromus tectorum*, *Hesperostipa comata*, *Leymus salinus*, and *Pleuraphis jamesii*. Forbs that are occasionally present include *Cryptantha flava*, *Machaeranthera grindelioides*, *Penstemon utahensis*, *Phlox austromontana*, *Lepidium montanum*, *Stanleya pinnata*, *Streptanthella longirostris*, *Stenotus armerioides*, and *Tetaneuris acaulis*. Constant down slope soil movement tends to keep the nonvascular cover low.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Tall shrub/sapling	<i>Amelanchier alnifolia</i> , <i>Amelanchier utahensis</i> , <i>Fraxinus anomala</i> , <i>Rhus trilobata</i>
Tall shrub/sapling	<i>Mahonia fremontii</i>
Short shrub/sapling	<i>Atriplex confertifolia</i> , <i>Chrysothamnus viscidiflorus</i> , <i>Ericameria nauseosa</i> , <i>Eriogonum corymbosum</i> , <i>Rhus trilobata</i> , <i>Shepherdia argentea</i> , <i>Shepherdia rotundifolia</i>
Short shrub/sapling	<i>Artemisia bigelovii</i> , <i>Artemisia tridentata</i> , <i>Cercocarpus montanus</i> , <i>Ephedra torreyana</i> , <i>Ephedra viridis</i> , <i>Fallugia paradoxa</i> , <i>Purshia stansburiana</i>
Herb (field)	<i>Eriogonum corymbosum</i> , <i>Gutierrezia sarothrae</i> , <i>Krascheninnikovia lanata</i> , <i>Yucca harrimaniae</i>
Herb (field)	<i>Chaenactis douglasii</i> , <i>Chamaesyce fendleri</i> , <i>Cryptantha flava</i> , <i>Hymenopappus filifolius</i> , <i>Stanleya pinnata</i> , <i>Stephanomeria minor</i>
Herb (field)	<i>Achnatherum aridum</i> , <i>Achnatherum hymenoides</i> , <i>Achnatherum nelsonii</i> , <i>Achnatherum scribneri</i> , <i>Achnatherum speciosum</i> , <i>Bromus tectorum</i> , <i>Hesperostipa comata</i> , <i>Leymus salinus</i> , <i>Pleuraphis jamesii</i> , <i>Poa fendleriana</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i> , <i>Pinus edulis</i>
Tall shrub/sapling	<i>Amelanchier utahensis</i>
Short shrub/sapling	<i>Shepherdia rotundifolia</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Dactylis glomerata*, *Descurainia pinnata*

Globally

Bromus tectorum, *Lactuca serriola*

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G4 (11-Jan-2006). The range of the principal shrub species only overlaps in southeastern Utah, so this association is likely to be common only within a relatively narrow range. Stands may cover many hectares, covering the sides of entire mesas or canyon walls.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Although this association is now well-documented from several sites, there are two closely related associations: *Pinus edulis* - *Juniperus osteosperma* / *Amelanchier utahensis* Woodland (CEGL002329) and *Pinus edulis* - *Juniperus osteosperma* / *Shepherdia rotundifolia* Woodland (CEGL002335). With better information for all three associations, it may be necessary to lump or split them differently than they are now. This association is one of a series of related Colorado Plateau types that occur on shale slopes covered by sandstone colluvium. It is distinct from others in that it has a developed (albeit sparse) canopy of pinyon and sometimes juniper trees and usually contains *Shepherdia rotundifolia*. Because of the patchy nature of these colluvial slope communities, not every vegetation plot taken in this association will contain all the named species.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: One stand is steep with large rocks and drainage channels; another has a significant drainage channel. One stand shows historic fire scars. One stand has mature, dead Utah juniper. There is wind-throw of trees on two stands. Some stands have active slopes that are steep and erosive. Stands in the northern portion of the park are lightly to moderately grazed by cattle.

Capitol Reef National Park Data: The description is based on 1986, 1988, 2003, and 2004 field data (37 plots: CARE.0423, CARE.0461, CARE.0462, CARE.0468, CARE.0469, CARE.0472, CARE.0475, CARE.0506, CARE.0507, CARE.0529, CARE.0573, CARE.9014, CARE.9028, CARE.9033, CARE.9064, CARE.9117, CARE.9119, CARE.9152, CARE.9153, CARE.9154, CARE.9164, CARE.9166, CARE.9171, CARE.9178, CARE.9211, CARE.9212, CARE.9308: CARE.9314, CARE.9332, CARE.9334, CARE.9339, CARE.9340, CARE.9406, CARE.9422, CARE.9425, CARE.9429, CARE.9431).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Western Ecology Working Group n.d.

***Amelanchier utahensis* Shrubland Utah Serviceberry Shrubland**

CODE	CEGL001067
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) Utah Serviceberry Shrubland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818)
Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This shrubland association occurs at middle elevations in the foothills, mountains and mesas in north-central Utah, the Colorado Plateau and Great Basin of the western U.S. Stands occur on moderate to steep slopes characterized by talus or rockfall from further upslope. It is found on relatively warm southern aspects in the Wasatch Mountains but also occurs on northern aspects or in cold-air drainages at lower elevations and more southern latitudes. Substrates are moderately deep, rocky loams and clays. The sparse to moderately dense tall-shrub layer (10-60% cover) is dominated by the cold-deciduous shrub *Amelanchier utahensis*. *Symphoricarpos oreophilus* often dominates in the short-shrub layer. Other shrub associates may include low cover of *Acer grandidentatum*, *Artemisia tridentata*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Mahonia repens*, *Purshia tridentata*, *Rhus trilobata*, and *Rosa woodsii*. *Quercus gambelii* may also be present, but it is always poorly represented (<5%). Tree species are sometimes present with the tall shrubs or as a very sparse emergent layer. The sparse to moderately dense herbaceous layer is a mix of perennial graminoids and forbs. Introduced species such as *Agropyron cristatum* and *Bromus tectorum* are common in disturbed stands.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon and was sampled near South Draw Road approximately three miles beyond Pleasant Creek and in a tributary of Spring Canyon.

Globally

This shrubland association occurs in the foothills and mountain areas in north-central Utah, Colorado Plateau and Great Basin of the western U.S.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This tall-shrub association was observed on midslopes of talus and rockfall slopes in canyons, as well as in alcoves at the head of canyons. Site are level to steep (to 25°), occur between 1890 and 1932 m elevation, and are oriented generally to northerly aspects. The unvegetated surface has high cover of large rocks and exposed soil, and low cover by litter. Parent materials include Moenkopi or Chinle shales, deposited as colluvium or alluvium. Soils are rapidly drained sandy loams.

Globally

This montane shrubland association occurs the foothills, canyons, mountains and mesas at elevations from 1480-2440 m (4855-8000 ft.). Stands occur on moderate to steep slopes (9-37°) with a high proportion of talus or rockfall. It is found on relatively warm southern aspects in the Wasatch Mountains (Yake and Brotherson 1979) but also occurs on northern aspects or in cold-air drainages at lower elevations and more southern latitudes. Substrates are moderately deep, rocky loams and clays and are rapidly drained.

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland association is distributed in difficult to access locations, such as in heads of box canyons, rockfall areas or steep talus slopes in the park. The total vegetation cover ranges from 26 to 60%. This shrubland association is characterized by an open tall-shrub canopy, typically 1-2 m tall, of *Amelanchier utahensis* shrubs that range in cover from 10 to 25%. Associated shrubs include *Fraxinus anomala*, *Mahonia fremontii*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, and *Shepherdia rotundifolia*. The herbaceous layer is sparse, with less than 3% total cover, and may include *Achnatherum hymenoides* or *Poa fendleriana*. *Pinus edulis* and *Juniperus osteosperma* trees may be scattered throughout some stands.

Globally

The vegetation is characterized by a sparse to moderately dense (10-60% cover) tall-shrub layer dominated by the cold-deciduous shrub *Amelanchier utahensis*. *Symphoricarpos oreophilus* often forms a short-shrub layer. Other shrub associates may include low cover of *Acer grandidentatum*, *Artemisia tridentata*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Fraxinus anomala*, *Mahonia repens*, *Purshia tridentata*, *Rhus trilobata*, and *Rosa woodsii*. *Quercus gambelii* may also be present, but it is always poorly represented (<5% cover). Short trees of *Pinus edulis*, *Juniperus osteosperma*, or *Juniperus scopulorum* may be mixed in with the tall shrubs or emerge above as a very sparse tree layer. The sparse to moderate herbaceous layer is a mixture of perennial graminoids and forbs. Herbaceous species include *Bromus carinatus*, *Koeleria macrantha*, *Achnatherum nelsonii* ssp. *dorei*, *Poa fendleriana*, *Balsamorhiza sagittata*, *Chenopodium fremontii*, *Machaeranthera canescens*, and species of *Astragalus*, *Eriogonum*, *Mertensia*, and *Penstemon* (Yake and Brotherson 1979). Introduced species such as *Agropyron cristatum* and *Bromus tectorum* are common in disturbed stands.

MOST ABUNDANT SPECIES

Capitol Reef National Park

Stratum

Tall shrub/sapling
Short shrub/sapling
Short shrub/sapling

Species

Amelanchier utahensis, *Fraxinus anomala*
Chrysothamnus viscidiflorus, *Shepherdia rotundifolia*
Ephedra viridis

Globally

Stratum

Tall shrub/sapling

Species

Amelanchier utahensis

Short shrub/sapling *Symphoricarpos oreophilus*

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park
Bromus tectorum

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G4 (19-Sep-2000).

CLASSIFICATION COMMENTS

Capitol Reef National Park
Data are not available.

Globally

This association is not well known. More survey work and classification work are needed to further define this type.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Occupies primarily north-facing steep, highly erosive talus slopes or the bottoms of narrow canyons, resulting in a dynamic community. Small patches of this community occur on talus slopes where trees are not present.

Capitol Reef National Park Data: The description is based on 2004 field data and 2005 accuracy assessment data (2 plots: CARE.0628, CARE_AA.0543).

Local Description Authors: J. Von Loh, mod. D. Clark and J. Coles

Global Description Authors: K.A. Schulz, mod. J. Drake

REFERENCES: Bourgeron and Engelking 1994, Carmichael et al. 1978, Cogan et al. 2004, Crane 1982, Driscoll et al. 1984, Eddleman and Jaendl 1994, NVNHP 2003, Yake and Brotherson 1979

***Quercus gambelii* / *Amelanchier utahensis* Shrubland**
Gambel Oak / Utah Serviceberry Shrubland

CODE	CEGL001110
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	<i>QUERCUS GAMBELII</i> SHRUBLAND ALLIANCE (A.920) 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 mountain shrubland occurs in southern Utah and western Colorado. Stands occur in canyons, or on mesas, benches, plateaus, ridges, foothills scarps and mountains. Elevation ranges from 1525 to 2700 m (5000-8860 ft.). Slopes are gentle to steep (1-100%) and may be oriented to any aspect. Soil are generally deep, well-developed and are derived from a variety of sources, including sandstones, shales and metamorphic rocks. The vegetation is characterized by a sparse to dense (10-100+% cover) tall-shrub layer (2-5 m tall) codominated by *Quercus gambelii* and *Amelanchier utahensis*. Common shrub associates include *Artemisia tridentata* and *Symphoricarpos oreophilus*. *Cercocarpus montanus* is absent or poorly represented (<5% cover). Other shrubs and dwarf-shrubs present with low cover may include *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Gutierrezia sarothrae*, *Mahonia repens*, *Opuntia* spp., *Purshia tridentata*, and *Prunus virginiana*. Graminoids, such as *Pascopyrum smithii*, *Achnatherum hymenoides*,

Carex geyeri, *Hesperostipa comata*, or *Poa fendleriana*, dominate the sparse herbaceous layer (<10% total cover). Common forbs include *Achillea millefolium*, *Artemisia ludoviciana*, *Allium acuminatum*, *Comandra umbellata*, *Erigeron speciosus*, *Lathyrus lanszwertii*, *Balsamorhiza sagittata*, *Packera multilobata*, *Phlox austromontana*, *Thalictrum fendleri*, or *Vicia americana*. Occasionally, scattered individual trees are present in the overstory, including *Pinus edulis*, *Pseudotsuga menziesii*, or *Juniperus osteosperma*.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon in the park and was sampled on Dry Bench between North and South Coleman canyons. It also occurs on adjacent U.S. Forest Service-managed lands on Dry Bench.

Globally

This montane shrubland occurs in southern Utah and western Colorado. It occurs in small scattered patches on Dry Bench in Capitol Reef National Park, and on high alluvial terraces in the canyons of Natural Bridges National Monument. It is one of the most abundant and widespread shrubland types in Black Canyon of the Gunnison National Park and Curecanti National Recreation Area.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This tall shrubland association was observed on Dry Bench within the park. Samples sites are gentle (0 to 2° slopes), occur between 2216 and 2225 m elevation, and are oriented to southeastern aspects. The unvegetated surface has low to moderate cover of litter and high exposure of bare soil. Downed wood is common, with 6% cover. Parent materials are Kayenta sandstone that has eroded and become wind-deposited. Soils are rapidly drained loamy sands.

Globally

This mountain shrubland occurs in southern Utah and western Colorado. Elevation ranges from 1525 to 2700 m (5000-8860 ft.). Stands occur in canyons or on mesas, benches, plateaus, ridges, foothills scarps and mountains. Slopes are gentle to steep (1-100%) and may be oriented to any aspect. Soil are generally deep, well-developed and are derived from a variety of sources, including sandstones, shales and metamorphic rocks.

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland is uncommon within the park. The total vegetation cover ranges from 17 to 65% in these sparsely to moderately vegetated stands. This tall-shrub association is characterized by an open canopy typically 1-5 m tall of the tall shrubs *Quercus gambelii* and *Amelanchier utahensis* that range in cover from 5 to 15% and 0 to 5%, respectively. The remaining shrub layer is moderately diverse in terms of composition and provides low to moderate cover. Short and dwarf-shrubs include *Artemisia tridentata* ssp. *vaseyana*, *Artemisia tridentata* ssp. *wyomingensis*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Opuntia fragilis*, and *Purshia tridentata*. The herbaceous layer is diverse in terms of species composition but typically provides sparse cover, less than 10% cover. Graminoids commonly present include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Hesperostipa comata*, and *Poa fendleriana*. The forb present at greater than 1% cover is *Chenopodium desiccatum*.

Globally

This association is characterized by a sparse to dense (10-100+% cover) tall-shrub layer (2-5 m tall) dominated by *Quercus gambelii* and codominated by *Amelanchier utahensis*. Sparse stands tend to occur in areas that have burned recently. Common associates include *Artemisia tridentata* and *Symphoricarpos oreophilus*. *Cercocarpus montanus* is absent or poorly represented (<5% cover). Other shrubs and dwarf-shrubs present with low cover may include *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Gutierrezia sarothrae*, *Mahonia repens*, *Opuntia* spp., *Purshia tridentata*, and *Prunus virginiana*. Graminoids, such as *Pascopyrum smithii*, *Achnatherum hymenoides*, *Carex geyeri*, *Hesperostipa comata*, or *Poa fendleriana*, dominate the sparse herbaceous layer (<10% total cover). Common forbs include *Achillea millefolium*, *Artemisia ludoviciana*, *Allium acuminatum*, *Comandra umbellata*, *Erigeron speciosus*, *Lathyrus lanszwertii*, *Balsamorhiza sagittata*, *Packera multilobata*, *Phlox austromontana*, *Thalictrum fendleri*, or *Vicia americana*. Occasionally, tree species are present in the overstory, including *Pinus edulis*, *Pseudotsuga menziesii*, or *Juniperus osteosperma*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

Stratum

Tall shrub/sapling
Short shrub/sapling
Short shrub/sapling

Species

Amelanchier utahensis, *Quercus gambelii*
Chrysothamnus viscidiflorus
Artemisia tridentata ssp. *vaseyana*, *Artemisia tridentata* ssp. *wyomingensis*, *Ephedra viridis*, *Purshia tridentata*
Opuntia fragilis
Chenopodium desiccatum
Achnatherum hymenoides, *Bouteloua gracilis*, *Hesperostipa comata*, *Poa fendleriana*

Globally

Stratum

Tall shrub/sapling

Species

Amelanchier utahensis, *Quercus gambelii*

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park
Descurainia pinnata

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park
Data are not available.

Globally

This plant association is similar to other montane Gambel oak shrublands except for the codominance of *Amelanchier utahensis* with only minor amounts (<10% or 5% cover, respectively) of *Artemisia tridentata* or *Cercocarpus montanus*.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: There is evidence of an intense fire in one stand resulting in heterogeneous distribution and loss of overstory trees and big sagebrush shrubs. The stands are large.

Capitol Reef National Park Data: The description is based on 2004 field data (3 plots: CARE.0633, CARE.0701, CARE.0703).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: K.A. Schulz, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Carmichael et al. 1978, Cedar Creek Associates, Inc. 1987, Clary 1992, Cogan et al. 2004, Crane 1982, Driscoll et al. 1984, Muldavin et al. 1998b,

***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	<i>QUERCUS GAMBELII</i> SHRUBLAND ALLIANCE (A.920) 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, usually narrow high terraces in canyons of the Colorado Plateau. The terraces are usually at least 3 m above bank full stage and rarely, if ever, flood. Elevations range from 1220 to 1840 m (4000-6035 ft.). 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

Capitol Reef National Park

This uncommon association was sampled at the mouth of a side canyon draining into Halls Creek. It occurs sporadically in the southern end of the Waterpocket Fold, primarily in side canyons that drain into Halls Creek.

Globally

This association has been documented in the Colorado Plateau of eastern 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

Capitol Reef National Park

This tall shrubland association was observed on high terraces near the mouth of a side canyon draining into Halls Creek. The sampled site is gentle (1° slope), occurs at 1369 m elevation, and is oriented to a northwestern aspect. The unvegetated surface has low to moderate cover of litter and exposure of sand. There is low cover by large rocks and gravel. Cryptogams provide up to 8% cover. Parent materials are Navajo sandstone that has eroded and deposited as new alluvium. Soils are rapidly drained sands.

Globally

This association occurs on flat to gently sloping, usually narrow high terraces in canyons of the Colorado Plateau. The terraces are usually at least 3 m above bank full stage and rarely, if ever, flood. Elevations range from 1220 to 1840 m (4000-6035 ft.). 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

Capitol Reef National Park

This Gambel oak shrubland is uncommon within the park. The total vegetation cover ranges from 16 to 30% in this sparsely to moderately vegetated stand. This association is characterized by an open canopy typically 2-5 m tall of the tall shrub or small tree *Quercus gambelii* that ranges in cover from 15 to 25%. An additional tall shrub, *Mahonia fremontii*, provides sparse to low cover. Short and dwarf-shrubs are moderately diverse in terms of species composition but provide sparse cover. The herbaceous layer is diverse but provides sparse cover, with no individual species present at greater than 1% cover. The vine *Clematis ligusticifolia* is present providing sparse cover. Cryptogams occupy a portion of the terrace that does not often flood and provide cover up to 8%.

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. 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*. Exotic annual grass *Bromus tectorum* is common in some stands.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tall shrub/sapling	<i>Quercus gambelii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Quercus gambelii</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum

Globally

Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (12-Jan-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

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

Capitol Reef National Park Inventory Notes: This association is established on terraces that flood only during high water events. The drainage itself floods seasonally. Gambel oak grows throughout the riparian area in side canyons west of Halls Creek. Adjacent slickrock supports pinyon-juniper stands, and surrounding knolls support blackbrush communities.

Capitol Reef National Park Data: The description is based on 2003 field data (1 plot: CARE.0512).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Western Ecology Working Group n.d.

***Quercus havardii* var. *tuckeri* Shrubland**

Tucker Sand Shinnery Oak Shrubland

CODE	CEGL002486
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	<i>QUERCUS HAVARDII</i> VAR. <i>TUCKERI</i> SHRUBLAND ALLIANCE (A.2654) Tucker Sand Shinnery Oak Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Active and Stabilized Dune (CES304.775)
Colorado Plateau Blackbrush-Mormon-tea Shrubland (CES304.763)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This short-shrub association is restricted to dunes, sand sheets and pockets of sand on mesas, plateaus and valley

bottoms in southeastern Utah. Sites are generally on flat or gentle slopes, with a few sites on moderately steep (50%) slopes. Elevations range between 1335 and 1772 m, and aspect is not a major factor in determining the distribution of this association. Bare ground or loose sand cover most of the unvegetated surface, although in less-disturbed sites biological soil crusts can have as much as 30% cover. Soils are rapidly drained, deep loamy sands and sandy loams derived from alluvium or eolian deposits. Total vegetation cover ranges from 10 to 110% in these sparsely to moderately vegetated stands. The vegetation is dominated by patches of *Quercus havardii* var. *tuckeri* shrubs that range in cover from 5 to 85%. Because shrub roots anchor the sandy soil in this erosive habitat, *Quercus havardii* var. *tuckeri* shrubs often occupy hummocks of sand as much as a meter high. Associated shrubs include *Coleogyne ramosissima*, *Ephedra viridis*, *Gutierrezia sarothrae*, *Shepherdia rotundifolia*, and *Opuntia polyacantha*. The herbaceous layer provides sparse cover. Graminoids present often include *Achnatherum hymenoides*, *Muhlenbergia pungens*, *Pleuraphis jamesii*, and *Vulpia octoflora*. Scattered forbs may include *Cryptantha* sp., *Streptanthella longirostris*, *Hymenopappus filifolius*, and *Lepidium montanum*. Scattered *Juniperus osteosperma* trees are present in some stands.

DISTRIBUTION

Capitol Reef National Park

This rare association was sampled within the park south of The Post and adjacent to the park near Burt's Spring.

Globally

This association occurs in southeastern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This shrubland association was observed on dunes and dune-like formations, steps-in-slope, channels, and escarpments. Sites are gentle to steep (5 to 28° slopes), occur between 1493 and 1745 m elevation, and are oriented to northern and western aspects. The unvegetated surface has moderate to high exposure of sand, bare soil, and bedrock and low to moderate cover of litter and live stem basal area. Cryptogams are typically low in cover, but one stand has 20% cover. Parent materials are Dakota, Morrison and Entrada sandstones that have eroded and been distributed to eolian deposits. Soils are rapidly drained to well-drained loamy sands and sandy loams.

Globally

This short-shrub association is restricted to dunes, sand sheets and pockets of sand on mesas, plateaus and valley bottoms in southeastern Utah. Sites are generally on flat or gentle slopes, with a few sites on moderately steep (50%) colluvial slopes. Elevations range between 1335 and 1772 m, and aspect is not a major factor in determining the distribution of this association. Bare ground or sand cover most of the unvegetated surface, although in less-disturbed sites biological soil crusts can have as much as 30% cover. Soils are rapidly drained, deep loamy sands and sandy loams derived from Cedar Mesa, Dakota, Entrada or Morrison formation sandstones that have eroded and been distributed to alluvium or eolian deposits.

VEGETATION DESCRIPTION

Capitol Reef National Park

This Tucker sand shinnery oak shrubland association is rare in the southern portion of the park. The total vegetation cover ranges from 4 to 110% in these sparsely to densely vegetated stands. This shrubland association is characterized by an open to closed canopy of *Quercus havardii* var. *tuckeri* short shrubs that range in cover from 1 to 85%. The canopy tree *Juniperus osteosperma* provides sparse cover in one stand. The associated short- and dwarf-shrub layers are moderate in terms of species composition and provide low to moderate cover. Occasionally associated shrubs include *Coleogyne ramosissima*, *Ephedra viridis*, *Gutierrezia sarothrae*, and *Shepherdia rotundifolia*. The herbaceous layer is low in species composition and provides sparse cover. Graminoids occasionally present include *Achnatherum hymenoides*, *Aristida purpurea*, *Muhlenbergia pungens*, and *Pleuraphis jamesii*. Occasionally associated forbs include *Lepidium montanum* and *Streptanthella longirostris*. Cryptogams provide as much as 20% cover. The site sampled near Burt's Spring is different than the dune sites sampled south of The Post, in that it is located on Dakota sandstone, not in a dune environment. It also has a 10-20% cover of *Fraxinus anomala* and 5-15% of *Purshia stansburiana*, *Rhus trilobata*, *Mahonia fremontii*, and *Lycium andersonii*. These shrubs, if present, are only occasional in the dune sites.

Globally

This uncommon shrubland association has total vegetation cover ranging from 10 to 110% in these sparsely to

densely vegetated stands. This shrubland is dominated by patches of *Quercus havardii* var. *tuckeri* shrubs that range in cover from 5 to 85%. Because shrub roots anchor the sandy soil in this erosive setting, *Quercus havardii* var. *tuckeri* shrubs often occupy hummocks of sand as much as a meter high. Associated shrubs include *Chrysothamnus viscidiflorus*, *Coleogyne ramosissima*, *Eriogonum microthecum*, *Ephedra torreyana*, *Ephedra viridis*, *Fraxinus anomala*, *Gutierrezia sarothrae*, *Shepherdia rotundifolia*, *Opuntia erinacea*, *Opuntia polyacantha*, *Purshia stansburiana*, *Shepherdia rotundifolia*, and *Yucca angustissima*. The herbaceous layer provides sparse cover. Graminoids present often include *Achnatherum hymenoides*, *Muhlenbergia pungens*, *Pleuraphis jamesii*, and *Vulpia octoflora*; forbs may include *Cryptantha* sp., *Streptanthella longirostris*, *Hymenopappus filifolius*, and *Lepidium montanum*. Scattered *Juniperus osteosperma* trees are present in some stands. The herbaceous layer tends to be sparse and depauperate. Grasses present may include *Achnatherum hymenoides*, *Aristida purpurea*, *Muhlenbergia pungens*, *Pleuraphis jamesii*, *Sporobolus cryptandrus*, *Vulpia octoflora*, and the exotic *Bromus tectorum*. Scattered forbs *Chenopodium album*, *Chenopodium atrovirens*, *Comandra umbellata*, *Cryptantha* sp., *Eriogonum shockleyi*, *Hymenopappus filifolius*, *Lepidium montanum*, *Packera multilobata*, *Rumex hymenosepalus*, *Streptanthella longirostris*, and *Tetraneuris acaulis* may be present. Biological soil crusts do not exceed 20% cover and tend to be in an early stage of development (mostly mosses and dark cyanobacteria). Occasional *Juniperus osteosperma* and *Pinus edulis* may be present, and *Juniperus osteosperma* seedlings were observed near one stand.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Tall shrub/sapling	<i>Fraxinus anomala</i> , <i>Rhus trilobata</i>
Tall shrub/sapling	<i>Purshia mexicana</i>
Short shrub/sapling	<i>Coleogyne ramosissima</i> , <i>Ericameria nauseosa</i> , <i>Lycium andersonii</i> , <i>Poliomintha incana</i> , <i>Quercus havardii</i> var. <i>tuckeri</i> , <i>Shepherdia rotundifolia</i>
Short shrub/sapling	<i>Ephedra viridis</i> , <i>Mahonia fremontii</i>
Herb (field)	<i>Artemisia bigelovii</i> , <i>Gutierrezia sarothrae</i> , <i>Yucca angustissima</i> , <i>Streptanthella longirostris</i> , <i>Achnatherum hymenoides</i> , <i>Bromus tectorum</i> , <i>Muhlenbergia pungens</i> , <i>Pleuraphis jamesii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Quercus havardii</i> var. <i>tuckeri</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum

Globally

Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (29-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Stands occupy active dunes and dune-like areas. One stand experienced historic wood-cutting.

Capitol Reef National Park Data: The description is based on 2003 and 2004 field data (5 plots: CARE.0567, CARE.0569, CARE.0604, CARE.0605, CARE.0653).

Local Description Authors: J. Von Loh, mod. D. Clark
Global Description Authors: J. Coles, mod. 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	<i>SYMPHORICARPOS OREOPHILUS</i> SHRUBLAND ALLIANCE (A.2530) Mountain Snowberry Shrubland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This low-statured shrubland is known from Colorado, southern Utah, western Wyoming and central Oregon. It is a poorly described shrubland, documented with plot data between 2070 and 2575 m (6800-8440 ft.) elevation, but it probably occurs 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. This shrubland is often 0.3-0.9 m (1-3 ft.) tall. *Symphoricarpos oreophilus* dominates the shrub canopy. Other shrubs can be present but in much less abundance. 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*.

DISTRIBUTION

Capitol Reef National Park

This association is rare in the park and was sampled on Billings Pass. In general the type is found in the very northwestern corner of the park but mostly occurs on adjacent U.S. Forest Service lands. It usually occupies quaking aspen stand margins or swales on high plateaus.

Globally

This association has currently been described from Zion National Park in southwestern Utah, several locations in southeastern Utah and southwestern Wyoming.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short shrubland association was observed in swales on Billings Pass. The site is gently sloped (7° slope), occurs at 2797 m elevation, and is oriented to a northeastern aspect. The unvegetated surface has moderate cover of litter and basal area cover by live plants. Exposure of bare soil is high. Parent materials are variable and include sandstones and shale that have eroded into boulder colluvium. Soils are rapidly drained sandy clays.

Globally

This low-statured shrubland is known from Colorado, southern Utah and western Wyoming. It is a poorly described shrubland, documented with plot data between 2070 and 2575 m (6800-8440 ft.) elevation, but it probably occurs throughout the known range of the dominant species. 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

Capitol Reef National Park

This shrubland is rare within the park. The total vegetation cover ranges from 11 to 45% in this sparsely to moderately vegetated stand. This short-shrub association is characterized by a relatively closed canopy of *Symphoricarpos oreophilus* that ranges in cover from 5 to 15%. Additional short and dwarf-shrubs provide sparse to low cover and include *Artemisia nova*, *Artemisia tridentata* ssp. *vaseyana*, *Chrysothamnus viscidiflorus*, and *Tetradymia canescens*. The herbaceous layer has high species diversity but provides sparse to low cover. The common graminoids include *Elymus elymoides* and *Koeleria macrantha*. A common forb is *Lupinus sericeus*.

Globally

This low-statured shrubland is often 0.3-0.9 m (1-3 ft.) 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*, *Rosa woodsii*, *Mahonia repens*, and *Artemisia nova*. 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 *Festuca thurberi*, *Elymus trachycaulus*, *Leymus cinereus*, *Pascopyrum smithii*, *Elymus repens*, *Calamagrostis rubescens*, *Carex geyeri*, *Carex hoodii*, *Bromus ciliatus*, *Achnatherum* spp., and *Poa fendleriana*. Forbs are usually present and highly variable. In Colorado, forb species include *Geranium richardsonii*, *Galium boreale*, *Symphyotrichum ascendens*, *Vicia americana*, *Heliomeris multiflora*, and *Potentilla pulcherrima*; in Wyoming, *Eriogonum umbellatum*, *Geranium viscosissimum*, *Balsamorhiza sagittata*, and *Agastache urticifolia*; and in Utah, *Lathyrus brachycalyx*, *Lupinus argenteus*, *Artemisia campestris*, *Mentha x piperita*, *Penstemon* spp., *Mertensia arizonica*, *Mertensia oblongifolia*, *Eriogonum racemosum*, *Tragopogon dubius*, and *Achillea millefolium*. In central Oregon, forb species include *Eriogonum heracleoides*, *Potentilla glandulosa*, *Potentilla gracilis*, *Geum triflorum*, *Lupinus* spp., *Erigeron* spp., and *Clarkia pulchella*. *Achillea millefolium* is common to Colorado, southern Utah, as well as central Oregon stands, especially when degraded.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Chrysothamnus viscidiflorus</i> , <i>Symphoricarpos oreophilus</i> , <i>Tetradymia canescens</i>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>vaseyana</i>
Herb (field)	<i>Artemisia nova</i>
Herb (field)	<i>Elymus elymoides</i> , <i>Koeleria macrantha</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Symphoricarpos oreophilus</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Tragopogon dubius

Globally

Data are not available.

CONSERVATION STATUS RANK

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

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: The plot represents an area within a little swale of about two acres. The vegetation is homogenous in this area. The plot location captures the density and diversity of the vegetation well. The concave swale shape and deeper soil make this a relatively moist site. There is evidence of past cattle grazing.

Capitol Reef National Park Data: The description is based on 2004 field data (1 plot: CARE.0727).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: G. Kittel, mod. J. Coles

REFERENCES: Cogan et al. 2004, Johnson and Clausnitzer 1992, Johnston 1987, Komarkova 1986,

***Fallugia paradoxa* Desert Wash Shrubland
Apache Plume Desert Wash Shrubland**

CODE	CEGL002357
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	Intermittently flooded cold-deciduous shrubland (III.B.2.N.c.)
ALLIANCE	<i>FALLUGIA PARADOXA</i> INTERMITTENTLY FLOODED SHRUBLAND ALL. (A.934) Apache Plume Intermittently Flooded Shrubland Alliance

ECOLOGICAL SYSTEM(S): North American Warm Desert Riparian Woodland and Shrubland (CES302.753)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This Apache plume desert wash association has only been described from Capitol Reef National Park; this summary is derived from plot data collected in the park in 1986 and 2004. It occurs in interrupted patches on banks and point bars in the larger intermittent drainages and wash bottoms such as Grand Wash. Stands are located on gently to moderately sloping (3-20%) sites between 1524 and 1829 m elevation. Aspect is not important in determining the distribution of this association. The unvegetated surface is typical of alluvial terraces and point bars and is composed of sand, gravel, rocks and very little litter. Soils are rapidly drained sands and loamy sands derived from alluvium. Total vegetation cover ranges from 22 to 95% cover. The shrub canopy is characterized by *Fallugia paradoxa* with 6 to 50% cover. Associated shrubs include *Amelanchier utahensis*, *Purshia stansburiana*, *Mahonia fremontii*, *Rhus trilobata*, *Fraxinus anomala*, *Atriplex canescens*, *Chrysothamnus viscidiflorus*, *Shepherdia rotundifolia*, *Ephedra viridis*, *Ericameria nauseosa*, *Gutierrezia microcephala*, and *Gutierrezia sarothrae*. The herbaceous layer is low in species diversity and provides sparse to low cover; a combination of severe occasional flooding and otherwise dry conditions make it difficult for herbaceous species to become established. Commonly associated graminoids include *Achnatherum hymenoides*, the exotic annual *Bromus tectorum*, and *Pleuraphis jamesii*. Forbs are typically rare in this community; however, *Stanleya pinnata* frequently occurs. Scattered *Juniperus osteosperma* and *Pinus edulis* may be present but do not form a layer.

DISTRIBUTION

Capitol Reef National Park

This association is rare to uncommon and was sampled in Capitol Wash, Grand Wash, and Muley Twist.

Globally

This association is documented only from Capitol Reef National Park in southeastern Utah, where it is common. It may occur elsewhere in the central and southern Colorado Plateau and Great Basin.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

The Apache plume desert wash community was observed in the intermittent drainages and wash bottoms within the park. Sites are gentle (1 to 8° slopes), occur between 1524 and 1829 m elevation, and are oriented to all aspects. The unvegetated surface has low to moderate cover of litter and live vegetation basal area and exposure of sand and bare

soil. The cover by large rocks, small rocks and gravel is low to moderate. Parent materials are shale of the Moenkopi Formation and sandstones of the Wingate, Navajo and Morrison formations. Soils are rapidly drained sands and loamy sands.

Globally

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

VEGETATION DESCRIPTION

Capitol Reef National Park

This desert wash community is rare to uncommon within the park, occupying intermittent drainage channels and washes. The total vegetation cover ranges from 22 to 95%. This tall-shrub community is characterized by *Fallugia paradoxa* shrubs that range in cover from 6 to 50%. Canopy trees, typically 2-5 m tall, are sometimes present providing sparse to low cover and include *Juniperus osteosperma* and *Pinus edulis*. The associated shrub layer has moderate to high species composition and provides moderate to dense cover. Commonly associated tall shrubs include *Amelanchier utahensis*, *Purshia stansburiana*, *Mahonia fremontii*, *Rhus trilobata*, and *Fraxinus anomala*. Short and dwarf-shrubs that are typically present include *Atriplex canescens*, *Chrysothamnus viscidiflorus*, *Shepherdia rotundifolia*, *Ephedra viridis*, *Ericameria nauseosa*, *Gutierrezia microcephala*, and *Gutierrezia sarothrae*. The herbaceous layer is low in species diversity and provides sparse to low cover. Commonly associated graminoids include *Achnatherum hymenoides*, the exotic annual *Bromus tectorum*, and *Pleuraphis jamesii*. Forbs are typically rare in this community; however, *Stanleya pinnata* frequently occurs.

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

Capitol Reef National Park

Stratum

Tree canopy

Tall shrub/sapling

Tall shrub/sapling

Short shrub/sapling

Short shrub/sapling

Herb (field)

Herb (field)

Species

Juniperus osteosperma, *Pinus edulis*

Amelanchier utahensis, *Fraxinus anomala*, *Rhus trilobata*, *Shepherdia rotundifolia*

Fallugia paradoxa, *Mahonia fremontii*, *Purshia stansburiana*

Atriplex canescens, *Brickellia longifolia*, *Ericameria nauseosa*, *Rhus trilobata*,
Shepherdia rotundifolia, *Symphoricarpos longiflorus*

Cercocarpus intricatus, *Mahonia fremontii*

Chrysothamnus viscidiflorus

Achnatherum hymenoides, *Bromus tectorum*

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Salsola tragus*, *Tamarix chinensis*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (22-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef 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: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Plots are in washes experiencing episodic flooding, a result being young trees present in the bottom. Some stands experience moderate grazing.

Capitol Reef National Park Data: The description is based on 1986 and 2004 field data (7 plots: CARE.0544, CARE.0545, CARE.0619, CARE.9158, CARE.9184, CARE.9191, CARE.9196).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Rhus trilobata* Intermittently Flooded Shrubland
Skunkbush Intermittently Flooded Shrubland**

CODE	CEGL001121
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	Intermittently flooded cold-deciduous shrubland (III.B.2.N.c.)
ALLIANCE	<i>RHUS TRILOBATA</i> INTERMITTENTLY FLOODED SHRUBLAND ALL. (A.938) Skunkbush Intermittently Flooded Shrubland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This association is known from both mesic riparian and non-riparian situations in Utah, western Colorado, and the Snake River canyon and its tributaries of southern Idaho. Throughout its range, the association occurs at low to mid elevations (701-1676 m [2300-5500 feet] in Idaho and 1555-2000 m [5100-6560 feet] in Colorado), most often along mid-order to large rivers, but also in narrow canyons of small creeks and intermittent drainages. This association often forms linear bands above the high-water line on steep shorelines, along rocky toe slopes at cliff bases, on benches, and in intermittent arroyos, usually where there is minimal floodplain development. Stands also occur on rocky hillsides in association with springs and seeps emanating from canyon walls. In broad river bottoms, stands occur in the floodplain on second terraces between older *Populus* spp. forests on upper terraces and *Salix exigua* shrublands next to the river. In these large floodplains, habitats are in flux with stream meanders, channel cutting, and sediment deposition; sites where this shrubland persists are generally too dry for the establishment of *Populus* and *Salix* spp. The association is found on well-drained, fine silty clay to sandy loam soils overlying coarse alluvium, bedrock or talus. *Rhus trilobata* often forms tall, dense, and nearly impenetrable thickets with 30-98% cover.

Associated shrubs can sometimes be codominant, but no single species has consistently high cover or constancy across the range of the association. Associated shrubs include *Celtis laevigata* var. *reticulata*, *Clematis ligusticifolia*, *Cornus sericea*, *Ericameria nauseosa*, *Ribes aureum*, *Rosa woodsii*, *Salix exigua*, *Salix lasiolepis*, *Salix lutea*, *Shepherdia argentea*, and *Toxicodendron rydbergii*. Saplings of *Populus fremontii*, *Populus angustifolia*, or *Salix amygdaloides* may be present. Total understory herbaceous cover and diversity are low, and herbaceous species are often confined to shrub canopy gaps. *Bromus tectorum* and *Galium aparine* are the most frequently occurring species, but native grasses such as *Elymus canadensis*, *Equisetum* spp., *Hordeum jubatum*, *Muhlenbergia asperifolia*, *Leymus cinereus*, *Pascopyrum smithii*, and *Phragmites australis* are sometimes also present. Forb associates include *Apocynum cannabinum* and *Artemisia ludoviciana*. Non-native species are common in disturbed stands.

DISTRIBUTION

Capitol Reef National Park

This association is rare in the park and is represented by a single plot on Polk Creek.

Globally

This association is known from western Colorado, Utah and southern Idaho. This minor shrubland association is known from the Yampa, San Miguel and Dolores river basins of the western slope of Colorado, along the Green River in northeastern Utah and Idaho, and the Colorado River in western Colorado and eastern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This mesic shrub association occurs on deep sediments deposited on stream terraces. The water table tends to remain high throughout the growing season. The one sampled site slopes gently (not exceeding 2%), lies at 2055 m elevation and is oriented to the east. The unvegetated surface has high cover of litter and moderate cover of gravel, bare soil and dead wood. The soil is a rapidly drained loamy sand derived from alluvium.

Globally

This minor association occurs in mesic, often riparian sites in western Colorado, eastern Utah and southwestern Idaho. Elevation ranges from 940 to 2000 m (3085-6560 ft.). These small shrublands are reported from stream and river bottoms and terraces, and upland in mesic swales and on hill slopes below seeps and springs. Along the Yampa, San Miguel, and Dolores rivers stands often form linear bands on rocky, well-drained benches and toe slopes where it is often confined between the high-water mark of a river and adjacent cliff faces and has access to the high water table. Along the Green River stands occur in the floodplain on second terraces between older *Populus fremontii* forests on upper terraces and *Salix exigua* shrublands next to the river. In large floodplains, habitats are in flux with stream meanders, channel incision, and sediment deposition; sites where this shrubland persists are generally too dry for the establishment of *Populus* and *Salix* spp. Substrates are variable and range from shallow loamy sand to silt loam over coarse alluvium, boulders or bedrock, to fine silty clay with the depth to groundwater between 2-4 m. Adjacent riparian vegetation includes communities dominated by *Schoenoplectus* spp., *Typha* spp., *Phragmites australis*, *Salix exigua*, *Alnus incana*, *Betula occidentalis*, *Populus angustifolia*, and *Populus fremontii*.

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland association is rare in the park, as it requires well-drained, mesic soils. Total vegetation cover exceeds 90%. The vegetation is characterized by *Rhus trilobata* with 35% cover. An adjacent belt of shrubland closer to the stream is dominated by *Salix eriocephala* with 50% cover. A few shrubs of *Salix exigua* and *Betula occidentalis* are also present. The herbaceous layer is poorly developed because of the dense shade and competition by the shrubs and because these terraces are periodically scoured by floods. No herbaceous species were recorded in the sample plot.

Globally

This plant association is characterized by a dense short-shrub layer dominated by 30-90% cover of *Rhus trilobata* sometimes forming near monocultures. However, the tall shrub *Salix exigua* is often present to codominant on mesic sites. Drier sites further from watercourses can have significant amounts of *Artemisia tridentata* ssp. *tridentata*, *Amelanchier utahensis*, or *Chrysothamnus linifolius*. Other associated shrubs include *Ericameria nauseosa*, *Ribes aureum*, *Salix lutea*, *Shepherdia argentea*, *Toxicodendron radicans*, and occasional sapling trees of *Populus fremontii*, *Populus angustifolia*, or *Salix amygdaloides*. In cooler, mesic sites *Cornus sericea*, *Salix ligulifolia*, *Berberis fendleri*, *Rosa woodsii*, and *Clematis ligusticifolia* may be present to abundant. The herbaceous layer is relatively sparse (<20% cover) and is composed primarily of graminoids such as *Elymus canadensis*, *Leymus cinereus*, *Equisetum* spp., *Hordeum jubatum*, *Muhlenbergia asperifolia*, *Pascopyrum smithii*, or *Phragmites australis*. Forb associates include *Apocynum cannabinum*, *Artemisia ludoviciana*, *Equisetum hyemale*, and *Solidago canadensis*. Exotic species are common in disturbed stands and may include *Elaeagnus angustifolia*, *Tamarix ramosissima*, *Lepidium latifolium*, *Cirsium arvense*, *Thinopyrum intermedium*, *Poa pratensis*, *Agropyron cristatum*, *Melilotus officinalis*, and *Helianthus annuus*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tall shrub/sapling	<i>Rhus trilobata</i> , <i>Salix eriocephala</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tall shrub/sapling	<i>Salix exigua</i>

Short shrub/sapling *Rhus trilobata*

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Lepidium latifolium, Tamarix ramosissima

CONSERVATION STATUS RANK

Global Rank & Reasons: G3 (22-Oct-2002). Throughout its relatively broad range (i.e., western Colorado through Utah to southern Idaho), this association is restricted to hot and dry, low to mid-elevation creeks and rivers. At least 35 plots have been sampled and 21 other stand observations documented, however, less than 20% of these occurrences are in good to excellent ecological condition. Further inventories throughout the range of the plant association will likely find more occurrences and possibly support classification of additional, distinct *Rhus trilobata* associations. This association often forms large, dense patches that are resistant to minor or occasional disturbance (e.g., fire, livestock damage). However, exotic species, especially *Bromus tectorum*, frequently occur in the understory. In southern Idaho, most stands are protected from land development. Based on the moderate number of occurrences, broad range, and relative resilience of the *Rhus trilobata* association, it is best ranked as G3 rather than G2. Nevertheless, the association is definitely globally rare, being discontinuously distributed through an ecologically degraded landscape with on-going and growing threats, such as agricultural and housing development, livestock grazing, fires and conversion to exotic species, and hydrologic alteration (e.g., irrigation diversions, hydroelectric development, and groundwater pumping).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This association has been quantitatively described from numerous locations: 28 plots and 12 stand observations from southern Idaho (Cole 1995, 1996, Jankovsky-Jones et al. 2001, Hansen and Hall 2002) and a number of plots from western Colorado (e.g., Kittel et al. 1999a). Several riparian communities dominated by, or with high cover of, *Rhus trilobata* have been documented along the Snake River by Cole (1995, 1996). Due to their degraded stand conditions (indicated by abundant *Bromus tectorum*) and to inconsistency in the cover and constancy of associated or codominant shrubs, these 4 communities are considered synonymous variants of this more broadly defined *Rhus trilobata* association. In addition, no diagnostic herbaceous species useful for differentiating between possible *Rhus trilobata* associations is apparent (Jankovsky-Jones et al. 2001, Hansen and Hall 2002). *Rhus trilobata* - *Salix exigua* has been proposed as a different association, but *Salix exigua* has only moderate constancy in otherwise similar stands sampled from Idaho and Colorado. Although this *Rhus trilobata* plant association occurs in two distinct wetland settings (riverine and canyon-slope seeps or springs), no other distinct *Rhus trilobata* associations have been observed in these different settings. *Rhus trilobata* also occurs as a dominant species in xeric upland stands, especially east of the Continental Divide (Kittel et al. 1999a). These stands are separated by their clearly non-riparian settings and species.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: The plot encompasses two low stream terraces, one of which is about 1 m higher than the other. *Rhus* dominates the upper, *Salix* the lower. Shrubs do intergrade a bit between the terraces. Both are dense with sparse understories. Openings between the shrubs tend to be bare soil.

Capitol Reef National Park Data: The description is based on field data collected in 2005 during accuracy assessment (1 plot: CARE_AA.1244).

Local Description Authors: J. Coles

Global Description Authors: K.A. Schulz, mod. C. Murphy, J. Drake, J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP Ecology Team 2001, Cole 1995, Cole 1996, Driscoll et al. 1984, Goodrich and Neese 1986, Hall and Hansen 1997, Hansen and Hall 2002, IDCDC 2005, Jankovsky-Jones et al. 2001, Kittel and Lederer 1993, Kittel et al. 1999b, Padgett et al. 1989, Welsh et al. 1987,

***Cornus sericea* Shrubland**

Red-osier Dogwood 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	<i>CORNUS SERICEA</i> TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.968) Red-osier Dogwood Temporarily Flooded Shrubland Alliance

ECOLOGICAL SYSTEM(S): Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland (CES304.045)
North Pacific Shrub Swamp (CES204.865)
North Pacific Lowland Riparian Forest and Shrubland (CES204.869)
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 stream banks, 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 ft.), 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*. 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

Capitol Reef National Park

This association is very rare in the park. It was sampled in Upper Deep Creek in a narrow slot of Navajo sandstone.

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

Capitol Reef National Park

This tall-shrub association was observed in a narrow channel eroded through Navajo sandstone cliffs. Sampled sites are gentle (2° slopes), occur between 2439 and 2622 m elevation, and are oriented to eastern aspects. The unvegetated surface is unrecorded. Parent materials are Navajo sandstone. Soils are derived from sandstones and shale that have eroded and deposited as alluvium.

Globally

This tall shrubland association occurs as a narrow stringer adjacent to stream channels, near seeps on moist toe slopes 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 ft.) near the Canadian border in Montana to 2700 m (8800 ft.) 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

Capitol Reef National Park

This riparian shrubland association is very rare in the park, distributed within one slot canyon/drainage in the Upper Deep Creek area. The vegetation is characterized by a closed tall-shrub canopy of *Cornus sericea*. The associated shrub layer is low in diversity in one stand and high in diversity in another and provides low to moderate cover. The tall shrubs *Acer glabrum*, *Cercocarpus ledifolius*, and *Juniperus scopulorum* provide low to moderate cover in one stand. Common short shrubs providing moderate cover include *Arctostaphylos patula* and *Symphoricarpos oreophilus*. The herbaceous layer can be sparse in stands with dense canopy cover or diverse in more open stands. The common graminoid is *Bromus tectorum*. Forbs provide low cover and include the annual *Plantago patagonica*.

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*, *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*, *Sanicula marilandica*, *Angelica arguta*, and *Symphyotrichum laeve*. 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*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Cornus sericea</i> , <i>Purshia tridentata</i>
Herb (field)	<i>Bromus tectorum</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tall shrub/sapling	<i>Cornus sericea</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Agrostis stolonifera, *Cirsium arvense*, *Dactylis glomerata*, *Linaria vulgaris*, *Medicago lupulina*, *Phalaris arundinacea*, *Phleum pratense*, *Poa pratensis*, *Taraxacum officinale*, *Trifolium pratense*

CONSERVATION STATUS RANK

Global Rank & Reasons: G4Q (27-Apr-2000).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This association is 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 surprisingly similar in their acceptance of variability within this type.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: One stand is confined between narrow walls about 5 m apart. It grows in small, wet, almost marsh-like riparian sites.

Capitol Reef National Park Data: The description is based on 1986 field data (2 plots: CARE.9092, CARE.9094).

Local Description Authors: J. Von Loh, mod. D. Clark

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, NVNHP 2003, Padgett et al. 1989, WNHP unpubl. data, Western Ecology Working Group n.d., Youngblood et al. 1985a

***Salix exigua* / Barren Shrubland
Coyote Willow / Barren Shrubland**

CODE	CEGL001200
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	<i>SALIX (EXIGUA, INTERIOR)</i> TEMPORARILY FLOODED SHRUBLAND ALL. (A.947) (Coyote Willow, Sandbar Willow) Temporarily Flooded Shrubland Alliance

ECOLOGICAL SYSTEM(S): North American Warm Desert Riparian Woodland and Shrubland (CES302.753)
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This riparian shrubland is common in the Rocky Mountains, Colorado Plateau and Great Basin. It is composed of nearly pure stands of *Salix exigua*, with few other species. Exposed gravel, cobbles or sand characterize the ground cover, but an undergrowth of a few, scattered forbs and grasses is usually present. This association occurs within the annual flood zone of rivers on point bars, islands, sand or cobble bars, and stream banks.

DISTRIBUTION

Capitol Reef National Park

This vegetation type was sampled as a riparian association along Halls Creek. Pockets of this association occur sporadically along Halls Creek in the southern end of the park. It also occurs along Polk Creek, Oak Creek, upper Spring Canyon, Water Canyon, Swap Canyon, and Pleasant Creek.

Globally

This riparian shrubland association is common along waterways of all sizes at lower to middle elevations in the Great Basin, Colorado Plateau and Rocky Mountains extending out into the western Great Plains along major rivers.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This tall-shrub association was observed on the banks of a creek. The sampled site is gentle (2° slope), occurs at 1433 m elevation, and is oriented to a southeastern aspect. The unvegetated surface is unrecorded. Parent materials are variable and include sandstones and shale deposited as alluvium. Soils are saturated to poorly drained.

Globally

This riparian shrubland is common in the Rocky Mountains, Colorado Plateau and Great Basin. Elevation ranges from 780-2600 m. This association occurs within the annual flood zone of rivers on point bars, islands, sand or cobble bars, and on stream banks occurring along a wide variety of stream reaches, from moderately sinuous and moderate-gradient reaches. It can form large, wide stands on mid-channel islands in larger rivers or narrow stringer bands on small, rocky tributaries. Substrates are typically coarse alluvial deposits of sand, silt and cobbles that are highly stratified vertically from flooding scour and deposition, often consisting of alternating layers of finer textured soil with organic material over coarser alluvium. Occasionally, this association occurs on deep pockets of sand. The lack of soil development and high ground cover of coarse alluvial material are key indicators for this association.

VEGETATION DESCRIPTION

Capitol Reef National Park

This riparian association is uncommon along drainages in the park. The vegetation is characterized by a closed canopy of *Salix exigua* shrubs. The associated shrub layer is low in diversity and provides moderate cover, including *Ericameria nauseosa* and *Tamarix chinensis*. The herbaceous layer is sparse to low in cover and moderately diverse. Graminoids and forbs provide sparse cover, but no species is diagnostic in either group.

Globally

This riparian association is characterized by a sparse to dense, tall-shrub (1.5-3 m) canopy composed of *Salix exigua*, with ground cover of exposed gravel, cobbles or sand. *Salix exigua* may be the only shrub in the community, or other shrubs and trees may be present with relatively low cover, including *Alnus incana*, *Ericameria nauseosa*, *Rhus trilobata*, *Salix monticola*, *Salix ligulifolia*, *Salix irrorata*, *Salix lucida*, *Abies lasiocarpa*, *Acer negundo*, *Populus angustifolia*, *Populus deltoides*, *Populus fremontii*, and *Salix gooddingii*. A sparse herbaceous layer may be present among the bare soil, gravel, cobbles, or boulders, consisting of a wide variety of forbs and graminoids. *Mentha arvensis* and species of *Carex*, *Eleocharis*, *Juncus*, *Schoenoplectus*, and *Equisetum* are often present. Introduced species, such as *Elaeagnus angustifolia*, *Tamarix* spp., *Bromus tectorum*, *Bromus inermis*, *Elymus repens*, *Poa pratensis*, *Agrostis stolonifera* (and other exotic forage species), *Taraxacum officinale*, *Conyza canadensis*, and *Lepidium latifolium*, have been reported from some stands.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tall shrub/sapling	<i>Salix exigua</i> , <i>Tamarix chinensis</i>
Short shrub/sapling	<i>Ericameria nauseosa</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tall shrub/sapling	<i>Salix exigua</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Melilotus officinalis*, *Xanthium strumarium*

Globally

Bromus tectorum, *Melilotus officinalis*, *Tamarix chinensis*, *Xanthium strumarium*

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (15-Jun-2001).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

In the western Great Plains this association includes stands composed of intermediates between *Salix interior* and *Salix exigua* (Dorn 1997, G. Kittel pers. comm. 2001). Until recently these taxa were combined at the species level (Kartesz 1999). More information on the distribution of introgression between *Salix interior* and *Salix exigua* is needed to fully understand the ranges of these two species.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: The stand in Halls Creek experienced moderate historical grazing. Oak Creek and Polk Creek still receive moderate grazing impact.

Capitol Reef National Park Data: The description is based on data collected during the 1988 field season (1 plot: CARE.9202).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: K.A. Schulz, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Carsey et al. 2003a, Christy 1973, Cogan et al. 2004, Cowardin et al. 1979, Culver et al. 1996, Donnelly et al. 2006, Dorn 1997, Driscoll et al. 1984, Durkin et al. 1995b, Hall and Hansen 1997, Hansen et al. 1995, Hansen et al. 2004b, IDCDC 2005, Johnston 1987, Jones and Walford 1995, Kagan et al. 2004, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1996, Kittel et al. 1999a, Kovalchik 1987, Manning and Padgett 1995, Muldavin et al. 2000a, Padgett 1981, Padgett et al. 1988b, Padgett et al. 1989, Richard et al. 1996, Tuhy and Jensen 1982, Von Loh et al. 2002

***Salix exigua* / Mesic Graminoids Shrubland
Coyote Willow / Mesic Graminoids Shrubland**

CODE	CEGL001203
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	<i>SALIX (EXIGUA, INTERIOR)</i> TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.947) (Coyote Willow, Sandbar Willow) Temporarily Flooded Shrubland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)
Western Great Plains Floodplain (CES303.678)
Northwestern Great Plains Canyon (CES303.658)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This riparian association is found primarily in the central Great Plains but also occurs in parts of the Rocky Mountains and Intermountain semi-desert regions. It generally occurs along backwater channels and other perennially wet but less scoured sites such as floodplain swales and irrigation ditches. The vegetation is characterized by the dominance of *Salix exigua* in a moderately dense tall-shrub canopy with a dense herbaceous layer dominated by graminoids. Other common shrubs include saplings of *Populus deltoides* or *Salix amygdaloides*, *Salix eriocephala*, *Salix lutea*, and *Amorpha fruticosa*. Tall perennial grasses can appear to codominate the stand when *Spartina pectinata*, *Panicum virgatum* or other tall grasses are present. Other mesic graminoids, such as *Carex* spp., *Eleocharis* spp., *Juncus* spp., *Pascopyrum smithii*, *Schoenoplectus pungens*, and *Sphenopholis obtusata*, may be present. Common forb species include *Bidens* spp., *Lobelia siphilitica*, *Lycopus americanus*, *Lythrum alatum*, *Polygonum* spp., and *Xanthium strumarium*. Diagnostic features of this association include the nearly pure stands of *Salix exigua* shrubs, with a dense herbaceous layer of at least 30% cover of mesic graminoids.

DISTRIBUTION

Capitol Reef National Park

This rare association was sampled near Halls Creek and South Desert Spring, near the Upper South Desert Overlook. Scattered pockets are likely occur throughout the southern portion of the Waterpocket Fold at and around Navajo sandstone tinajas. It also occurs in upper Cottonwood Canyon in the central portion of the park.

Globally

This association is found primarily in the central Great Plains, but also parts of the Rocky Mountains and Intermountain Semi-desert regions, ranging from Wyoming west to possibly Idaho, south to Utah, and east to Oklahoma.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This tall-shrub association was observed on the basin floor around large waterpockets and at a spring-fed wetland and drainage. Sampled sites are gentle to moderately steep (1 to 22° slopes), occur between 1341 and 2073 m elevation, and one stand is oriented to a southeastern aspect. The unvegetated surface of one stand has high cover of live basal vegetation and moderate exposure of bare soil. Parent materials are variable and include sandstones and shale; some are deposited as alluvium. Soils are poorly drained muck.

Globally

This riparian association is found along alluvial terraces of backwater channels and other perennially wet but less scoured sites such as floodplain swales and irrigation ditches. It is found at elevations from 937 to 2700 m (3075-9100 ft.). This community is found on sandbars, islands, and shorelines of stream channels and braided rivers in Nebraska (Steinauer and Rolfsmeier 2000). Stands usually occur within 1 m vertical distance of the stream channel on point bars, low floodplains, terraces and along overflow channels. It can also occur away from the stream channel in mesic swales or along the margins of beaver ponds and seeps. Sites are usually relatively flat, though rarely they can have moderate or moderately steep slopes. Soils are derived from alluvium and are quite variable in development, ranging from thin (<1 m) and skeletal with depth (10-50% cobbles) to well-developed Mollisols (Kittel et al. 1999a). Textures are typically loamy sands interspersed with layers of silty clays and alternating with coarse sands. Upper layers (10-30 cm) often have 25-30% organic matter (Kittel et al. 1999a), and organic litter covers most of the unvegetated ground surface.

VEGETATION DESCRIPTION

Capitol Reef National Park

This riparian association is uncommon within the park, distributed on saturated and subirrigated soils. The total vegetation cover for these densely vegetated stands ranges from 30 to 130% on a saturated site. This tall-shrub association is characterized by a closed canopy of *Salix exigua* shrubs that on two sites range in cover from 55 to 65%. Canopy trees provided sparse to low cover in one stand associated with a waterpocket and include *Acer negundo*, *Picea pungens*, *Populus angustifolia*, and *Populus fremontii*. The shrub layer is nearly absent from one stand and relatively diverse at the other, providing sparse to low cover, in general. Associated tall shrubs provide sparse cover and include *Betula occidentalis* and *Salix* sp. The herbaceous layer is diverse and provides moderate cover. Graminoids are moderately diverse, provide moderate cover, and include *Carex nebrascensis*, *Equisetum laevigatum*, *Schoenoplectus pungens*, and *Typha latifolia*. Forbs typically provide sparse cover, and the most abundant include *Maianthemum stellatum* and *Stephanomeria minor*.

Globally

This association is characterized by the dominance of *Salix exigua* in the moderately dense tall-shrub canopy with a dense herbaceous layer dominated by graminoids. Others common shrubs may include saplings of *Populus deltoides*, *Salix amygdaloides*, *Salix bebbiana*, *Salix eriocephala*, *Salix geyeriana*, *Salix lucida* ssp. *lasiandra*, *Salix lutea*, *Salix monticola*, *Salix planifolia*, *Amorpha fruticosa*, or *Rosa woodsii*. Tall perennial grasses can appear to codominate the stand when *Spartina pectinata*, *Sorghastrum nutans*, *Panicum virgatum*, or other tall grasses are present. Mesic graminoids dominate the diverse understory and include *Carex pellita*, *Carex nebrascensis*, *Carex rostrata*, *Deschampsia caespitosa*, *Eleocharis palustris*, *Elymus canadensis*, *Equisetum* spp., *Glyceria* spp., *Juncus balticus*, *Juncus longistylis*, *Juncus tenuis*, *Juncus torreyi*, *Luzula parviflora*, *Pascopyrum smithii*, *Polygonum* spp., *Schoenoplectus americanus*, *Schoenoplectus pungens*, *Sphenopholis obtusata*, and others. The sparse forb cover may include *Lobelia siphilitica*, *Bidens* spp., *Geum macrophyllum*, *Lycopus americanus*, *Lythrum alatum*, *Mentha arvensis*, *Typha angustifolia*, *Veronica americana*, and *Xanthium strumarium*. *Agrostis stolonifera*, *Bromus inermis*, *Melilotus* spp., *Poa pratensis*, or *Phleum pratense*, and other introduced forage species may be present to abundant in

disturbed stands of this community. Diagnostic features of this association include the nearly pure stands of *Salix exigua* shrubs, with a dense ground layer of at least 30% cover of graminoids.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tall shrub/sapling	<i>Salix exigua</i>
Herb (field)	<i>Carex nebrascensis</i> , <i>Schoenoplectus pungens</i> , <i>Typha latifolia</i>
Herb (field)	<i>Equisetum laevigatum</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tall shrub/sapling	<i>Salix exigua</i>
Herb (field)	<i>Pascopyrum smithii</i> , <i>Poa pratensis</i> , <i>Schoenoplectus americanus</i> , <i>Sorghastrum nutans</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Cirsium vulgare*, *Conyza canadensis*, *Lactuca serriola*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (7-Apr-1998).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This broadly defined plant association occupies a rather large range and currently includes *Salix exigua* shrublands with herbaceous layers dominated by the introduced mesic, perennial, sod-grass *Poa pratensis*. Classification review of descriptions from the western part of its range need further review to determine if the type should be split. In addition, western stands may all belong to *Salix exigua sensu stricto*, and Great Plains stands may belong to either *Salix exigua* or *Salix interior* (or intermediates). *Salix interior* is an entirely Great Plains and eastward species (Kartesz 1999). In Nebraska, this community intergrades and is a successional stage that appears after both Riverine Sand Flats - Bars Sparse Vegetation (CEGL002049) and *Salix exigua* Temporarily Flooded Shrubland (CEGL001197), which is more frequently disturbed and lacks many of the more mesic herbaceous species.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Light to heavy grazing are evident at one site; one stand is severely trampled. One stand is around a waterpocket, the other is spring-fed. Good habitat for avifauna.

Capitol Reef National Park Data: The description is based on 1986 and 2003 field data (2 plots: CARE.0447, CARE.9053).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: K.A. Schulz, mod. J. Drake and J. Coles

REFERENCES: Bourgeron and Engelking 1994, Butler et al. 2002, CONHP unpubl. data 2003, Carsey et al. 2003a, Cogan et al. 2004, Cooper and Cottrell 1990, Driscoll et al. 1984, Hansen et al. 1995, Hoagland 1998c, Hoagland 2000, IDCDC 2005, Jones 1992b, Jones and Walford 1995, Kittel 1994, Kittel and Lederer 1993, Kittel et al. 1996, Kittel et al. 1999a, Lauver et al. 1999, Padgett et al. 1988b, Padgett et al. 1989, Steinauer and Rolfmeier 2000, Walford et al. 2001, 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	<i>BETULA OCCIDENTALIS</i> SEASONALLY FLOODED SHRUBLAND ALL. (A.996) 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 and foothills 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. 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 stream bank. Other shrub species include *Alnus incana*, *Cornus sericea*, *Dasiphora fruticosa* ssp. *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 dominated by disturbance-induced species, including most commonly *Agrostis stolonifera*, *Cirsium arvense*, *Phleum pratense*, and *Poa pratensis*. Native 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 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

Capitol Reef National Park

This association is rare and has not been found within the park. It was sampled on the Baker Ranch Ditch and an unnamed drainage outside the park boundary on Fishlake National Forest.

Globally

This association is known from mountainous regions of Washington, Idaho, Montana, Wyoming, north into Alberta, and may extend south into Colorado and Nevada.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This tall-shrub association was observed on channel banks and beds. Sampled sites are gentle (4 to 8° slopes), occur between 2365 and 2385 m elevation, and are oriented to a northern aspect. The unvegetated surface has low to moderate cover of litter and high cover of live plant basal area. Downed wood is common, with up to 5% cover. Parent materials are variable and include sandstones and shale that have eroded and deposited as colluvial deposits. Soils are rapidly drained and composed of organic material in the form of peat.

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 stream banks and canyon bottoms 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 ft.). Stands also occur along small floodplains of steep-gradient, narrow streams where the valley side slope meets the stream edge. In high-gradient situations, the community often occurs as narrow

stringers where *Betula occidentalis* forms a closed canopy crowding the stream bank. Broader stands occur around seeps adjacent to the stream channel, or along isolated springs on hill slopes 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

Capitol Reef National Park

This riparian shrub association is rare and occurs outside the park boundary. The total vegetation cover ranges from 84 to 220% in these densely vegetated stands. This tall-shrub association is characterized by a moderately closed tall-shrub canopy of *Betula occidentalis* that ranges in cover from 15 to 45%. In one stand the canopy trees, typically 2-10 m tall, of *Juniperus scopulorum* and *Pinus edulis* provide cover ranging from 15 to 25% and 1 to 5%, respectively. The associated shrub layer is moderate to high in species diversity and provides moderate to dense cover. Commonly associated tall shrubs include *Amelanchier utahensis*, *Salix exigua*, *Salix boothii*, and *Shepherdia argentea*. The common short and dwarf-shrubs include *Artemisia tridentata*, *Ericameria nauseosa*, *Rhus trilobata*, *Ribes aureum*, *Ribes inerme*, and *Rosa woodsii*. The herbaceous layer is relatively diverse and can be sparse in terms of cover in stands with dense canopy cover or provide low cover in more open stands. The common graminoids include *Carex microptera*, *Juncus balticus*, *Poa fendleriana*, and *Poa pratensis*. Forbs commonly observed include *Achillea millefolium*, *Cirsium scariosum*, *Geranium caespitosum* var. *parryi*, *Maianthemum stellatum*, and *Taraxacum officinale*. The vine *Clematis ligusticifolia* provides sparse cover in one stand.

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*, *Salix exigua*, *Shepherdia argentea*, *Jamesia americana*, *Amelanchier utahensis*, *Juniperus scopulorum*, *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 *Maianthemum stellatum*, *Heracleum sphondylium*, *Thalictrum fendleri*, *Equisetum arvense*, *Mentha arvensis*, *Solidago gigantea*, and *Rudbeckia laciniata*. Graminoid species include *Calamagrostis canadensis*, *Poa palustris*, *Carex utriculata*, *Carex pellita*, *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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus scopulorum</i> , <i>Pinus edulis</i>
Tall shrub/sapling	<i>Amelanchier utahensis</i> , <i>Betula occidentalis</i> , <i>Salix boothii</i> , <i>Salix exigua</i> , <i>Shepherdia argentea</i>
Short shrub/sapling	<i>Ericameria nauseosa</i> , <i>Rhus trilobata</i> , <i>Ribes aureum</i> , <i>Ribes inerme</i> , <i>Rosa woodsii</i>
Short shrub/sapling	<i>Artemisia tridentata</i>
Herb (field)	<i>Achillea millefolium</i> , <i>Cirsium scariosum</i> , <i>Geranium caespitosum</i> var. <i>parryi</i> , <i>Maianthemum stellatum</i> , <i>Taraxacum officinale</i>
Herb (field)	<i>Carex microptera</i> , <i>Juncus balticus</i> , <i>Poa fendleriana</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tall shrub/sapling	<i>Betula occidentalis</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Poa pratensis

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 stream banks, 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 ft.) 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

Capitol Reef 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

Capitol Reef National Park Inventory Notes: Sampled sites occur outside the park on Fishlake National Forest. Association has not been observed on Capitol Reef National Park but has become established on perennial streams within the forest. There are signs of historic grazing. An irrigation ditch is nearby. Surrounding uplands support pinyon-juniper / big sagebrush woodland.

Capitol Reef National Park Data: The description is based on 2004 field data (2 plots: CARE.0637, CARE.0638).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: G. Kittel, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, Chadde et al. 1988, Crowe and Clausnitzer 1997, 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, NVNHP 2003, Padgett et al. 1989, Weixelman et al. 1996, Western Ecology Working Group n.d.

Grayia spinosa Shrubland Spiny Hop-sage Shrubland

CODE

CEGL002358

PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Deciduous shrubland (III.B.)
PHYSIOGNOMIC GROUP	Extremely xeromorphic deciduous shrubland (III.B.3.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural extremely xeromorphic deciduous shrubland (III.B.3.N.)
FORMATION	Extremely xeromorphic deciduous subdesert shrubland without succulents (III.B.3.N.a.)
ALLIANCE	<i>GRAYIA SPINOSA</i> SHRUBLAND ALLIANCE (A.1038) Spiny Hop-sage Shrubland Alliance

ECOLOGICAL SYSTEM(S): Not assigned

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This global summary is based on the local description from Arches National Park. More information will be added when it becomes available. This association occurs on benches, plains, and alluvial fans. Soils are rapidly drained clay loam. This spiny hop-sage community is common but may occur as smaller patches in alluvial flat shrublands. Total vegetation cover ranges from 5 to 25%, most of which is concentrated in an open canopy of *Grayia spinosa* shrubs. Associated shrubs include *Coleogyne ramosissima*, *Ephedra viridis*, *Gutierrezia sarothrae*, and the succulents *Opuntia polyacantha* and *Yucca harrimaniae*. The herbaceous layer contributes little to the community, being both sparse and depauperate. Herbaceous species include *Pleuraphis jamesii*, *Chamaesyce fendleri*, and *Lepidium montanum*. Biological soil crusts provide less than 5% cover.

DISTRIBUTION

Capitol Reef National Park

This association was sampled in a side canyon west of the Halls Creek drainage. It is located where a landslide flowed east over the Navajo sandstone of the Fold, thus creating a broad, steep slope with deep soils.

Globally

This association occurs the Great Basin and the eastern Mojave Desert and east into the Colorado Plateau of southern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on benches occurring as steps-in-slope. The site is gentle (3° slope), occurs at 1423 m elevation, and is oriented to a northeastern aspect. The unvegetated surface has high cover of live vegetation basal area and exposure of bare soil. Cryptogam cover is sparse. Parent materials are Navajo sandstones that have eroded to sandy pockets. It is located in the southern portion of the park within the Waterpocket Fold. Soils are rapidly drained loamy sands.

Globally

This global summary is based on the local description from Arches National Park. More information will be added when it becomes available. This association occurs on benches, plains, and alluvial fans. Soils are rapidly drained clay loam. This spiny hop-sage community is common but may occur as smaller patches in alluvial flat shrublands.

VEGETATION DESCRIPTION

Capitol Reef National Park

This community is rare within the park. The total vegetation cover ranges from 24 to 60% in this moderately vegetated stand. This short-shrub community is characterized by an open canopy of *Grayia spinosa* shrubs that range in cover from 15 to 25%. The dwarf-shrub layer is sparse in terms of diversity and cover and includes *Opuntia phaeacantha*. The herbaceous layer is somewhat diverse and provides sparse to low cover. Graminoids are low in diversity and include low cover by *Hesperostipa comata*, *Achnatherum hymenoides*, and the annual exotic *Bromus tectorum*. Forbs are moderately diverse, and sparse to low cover is provided by *Chaenactis stevioides*, *Cryptantha crassisepala*, *Phacelia crenulata*, and *Plantago patagonica*. Cryptogams provide sparse cover, less than 5%.

Globally

Total vegetation cover ranges from 5 to 25%, most of which is concentrated in an open canopy of *Grayia spinosa* shrubs. Associated shrubs include *Coleogyne ramosissima*, *Ephedra viridis*, *Gutierrezia sarothrae*, and the succulents *Opuntia polyacantha* and *Yucca harrimaniae*. The herbaceous layer contributes little to the community,

being both sparse and depauperate. Herbaceous species include *Pleuraphis jamesii*, *Chamaesyce fendleri*, and *Lepidium montanum*. Biological soil crusts provide less than 5% cover.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Grayia spinosa</i>
Herb (field)	<i>Bromus tectorum</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Grayia spinosa</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Descurainia pinnata*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (22-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE:

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: This is a relict area that has never been grazed. Plot is good representation of this somewhat isolated *Grayia spinosa* community. This sloping to flat area with *Grayia spinosa* is surrounded by scattered juniper, pinyon pine, cliffrose, and a healthy stand of *Hesperostipa comata*. Slope south of plot has scattered *Grayia spinosa*, but this plot is in the only place in the park where *Grayia spinosa* occurs with such density.

Capitol Reef National Park Data: The description is based on 2003 field data (1 plot: CARE.0558).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: G. Kittel and K.A. Schulz

REFERENCES: Western Ecology Working Group n.d.

***Sarcobatus vermiculatus* / *Artemisia tridentata* Shrubland
Black Greasewood / Basin Big Sagebrush Shrubland**

CODE	CEGL001359
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Deciduous shrubland (III.B.)
PHYSIOGNOMIC GROUP	Extremely xeromorphic deciduous shrubland (III.B.3.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural extremely xeromorphic deciduous shrubland (III.B.3.N.)
FORMATION	Intermittently flooded extremely xeromorphic deciduous subdesert shrubland (III.B.3.N.b.)
ALLIANCE	<i>SARCOBATUS VERMICULATUS</i> INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.1046) Black Greasewood Intermittently Flooded Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Greasewood Flat (CES304.780)
Inter-Mountain Basins Playa (CES304.786)
Northwestern Great Plains Shrubland (CES303.662)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This mixed bottomland shrubland is characteristic of stream terraces and floodplains of the Intermountain West. The presence of other shrubs in the canopy indicates less saline conditions than found in *Sarcobatus vermiculatus* Disturbed Shrubland (CEGL001357). Soils are deep and generally sandy, but a few sites are on well-drained silt loams. The sagebrush element may be either *Artemisia tridentata* ssp. *tridentata* or *Artemisia tridentata* ssp. *wyomingensis*, and either the sagebrush or *Sarcobatus vermiculatus* may have the greater cover. *Atriplex canescens*, *Ericameria nauseosa*, and *Chrysothamnus viscidiflorus* are other common minor elements of the shrub canopy. Total shrub cover is between 5 and 30%. The understory is variable; cover by herbaceous species may be sparse to dense, or exotic species may dominate the field layer.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon within the park and was sampled in the areas around Cedar Mesa campground and in Upper Cathedral Valley.

Globally

Data are not available.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on benches of basin floors. Sites are gentle (1 to 2° slopes), occur between 1646 and 1951 m elevation, and are oriented to eastern exposures. The unvegetated surface is unrecorded. Parent materials are variable and include sandstones and shale that have been wind-distributed and deposited. Soils are fine sands.

Globally

This minor shrub association occurs on stream terraces, alluvial fans, floodplains, toe slopes and valley floors. Elevations range from 1300 to 1950 m. Slopes are generally gentle, and the upper soil layers are somewhat saline. Soils are deep and generally sandy, but a few sites are on well-drained silt loams. Bare soil and litter cover most of the ground surface. Biological soil crusts are commonly present and can provide as much as 60% cover.

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland association is uncommon within the park. The vegetation is characterized by a somewhat open to closed canopy of *Sarcobatus vermiculatus* and *Artemisia tridentata* shrubs. Stands support the canopy tree *Juniperus osteosperma* that provides low to moderate cover. The associated shrub layer is diverse in terms of species composition and provides low to moderate cover. Common shrubs include *Ericameria nauseosa* and *Gutierrezia sarothrae*. The herbaceous layer is diverse in terms of species composition and provides moderate cover. Common graminoids are mostly bunch grasses and include *Achnatherum hymenoides*, *Aristida purpurea*, *Bromus tectorum*, *Hesperostipa comata*, and *Sporobolus airoides*. Forbs provide sparse cover.

Globally

This mixed bottomland shrubland is characteristic of stream terraces and floodplains of the Intermountain West. The sagebrush element may be either *Artemisia tridentata* ssp. *tridentata* or *Artemisia tridentata* ssp. *wyomingensis*, and either the sagebrush or *Sarcobatus vermiculatus* may have the greater cover. *Atriplex canescens*, *Ericameria nauseosa*, and *Chrysothamnus viscidiflorus* are other common minor elements of the shrub canopy. Total shrub cover is between 5 and 50%. The understory is variable; cover by herbaceous species may be sparse to dense, or exotic species may dominate the field layer. Common graminoids include the exotic annual grass *Bromus tectorum*. Common forbs include *Chaenactis stevioides*, *Cryptantha crassisejala*, *Descurainia pinnata*, and *Salsola tragus*. Scattered *Juniperus osteosperma* may be present in some stands.

MOST ABUNDANT SPECIES

Capitol Reef National Park

Stratum

Tree canopy

Species

Juniperus osteosperma

Short shrub/sapling	<i>Sarcobatus vermiculatus</i>
Short shrub/sapling	<i>Artemisia tridentata</i>
Herb (field)	<i>Gutierrezia sarothrae</i>
Herb (field)	<i>Achnatherum hymenoides, Bromus tectorum, Hesperostipa comata, Sporobolus airoides</i>

Globally

Stratum

Short shrub/sapling

Short shrub/sapling

Species

Sarcobatus vermiculatus

Artemisia tridentata ssp. *tridentata*, *Artemisia tridentata* ssp. *wyomingensis*

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G4 (1-Feb-1996).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Sites receive moderate to heavy grazing.

Capitol Reef National Park Data: The description is based on 1986 field data (2 plots: CARE.9051, CARE.9063).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Lesica and DeVelice 1992, MTNHP 2002b, Western Ecology Working Group n.d.

***Sarcobatus vermiculatus* / *Atriplex confertifolia* - (*Picrothamnus desertorum*, *Suaeda moquinii*) Shrubland**

Black Greasewood / Shadscale - (Bud Sagebrush, Shrubby Seepweed) Shrubland

CODE	CEGL001371
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Deciduous shrubland (III.B.)
PHYSIOGNOMIC GROUP	Extremely xeromorphic deciduous shrubland (III.B.3.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural extremely xeromorphic deciduous shrubland (III.B.3.N.)
FORMATION	Intermittently flooded extremely xeromorphic deciduous subdesert shrubland (III.B.3.N.b.)
ALLIANCE	<i>SARCOBATUS VERMICULATUS</i> INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.1046) Black Greasewood Intermittently Flooded Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Greasewood Flat (CES304.780)
Inter-Mountain Basins Wash (CES304.781)
Inter-Mountain Basins Playa (CES304.786)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This short-shrub association occurs on high alluvial terraces and canyon bottoms, as well as in the outer ring of palustrine or lacustrine wetlands on basin floors. Stands are reported from scattered sites in the Colorado Plateau of southeastern Utah, the Great Basin of northern Nevada, and the Columbia Basin of southeastern Oregon. This association is located high enough above the flood zone or water table that there is rarely standing water on the ground surface. Sites are generally level or gently sloping and occur between 1125 and 1300 m (3700-4300 ft.) elevation in Nevada and between 1525 and 1830 m (5000-6000 ft.) elevation in Utah. Most of the unvegetated ground surface is bare soil. Parent materials include alluvium, lake bottom deposits and eolian loess. Soils are deep, saline, well-drained sands, sandy loams or sandy clays. Total vegetation cover rarely exceeds 40%; the vegetation is characterized by a mixed shrub canopy of *Sarcobatus vermiculatus* generally accompanied by lesser amounts of *Atriplex confertifolia* and *Suaeda moquinii*. Other associated shrubs are sparse and variable, including *Allenrolfea occidentalis*, *Picrothamnus desertorum*, *Atriplex canescens*, *Gutierrezia sarothrae*, *Tetradymia spinosa*, and *Opuntia polyacantha*. The herbaceous layer provides sparse to moderate cover. Graminoids vary throughout the range, but common species include *Bromus tectorum*, *Distichlis spicata*, *Elymus elymoides*, *Sporobolus airoides*, *Sporobolus contractus*, and *Sporobolus cryptandrus*. Forbs provide variable cover as they tend to be dominated by annual exotics, such as *Bassia hyssopifolia*, *Lepidium perfoliatum*, *Salsola tragus*, and *Halogeton glomeratus*.

DISTRIBUTION

Capitol Reef National Park

This association is common within the park and was sampled downstream from Ackland Springs and along Halls Creek drainage south of Lake Mead. It occurs all along the Halls Creek drainage.

Globally

This association has been documented from the Great Basin, Columbia Basin and Colorado Plateau in northern Nevada, southeastern Oregon and southeastern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on benches in large drainages and on canyon and basin floors. Sites are gentle (1 to 3° slopes), occur between 1524 and 1829 m elevation, and are oriented to northeastern exposures. The unvegetated surface is unrecorded. Parent materials are variable and include sandstones and shale that have deposited as alluvium. Soils are sandy clays.

Globally

This short-shrub association occurs on high alluvial terraces and canyon bottoms, as well as in the outer ring of palustrine or lacustrine wetlands on basin floors. Stands are reported from scattered sites in the Colorado Plateau of southeastern Utah, the Great Basin of northern Nevada, and the Columbia Basin of southeastern Oregon. This association is located high enough above the flood zone or water table that there is rarely standing water on the ground surface. Sites are generally level or gently sloping and occur between 1125 and 1300 m (3700-4300 ft.) elevation in Nevada and between 1525 and 1830 m (5000-6000 ft.) elevation in Utah. Most of the unvegetated ground surface is bare soil. Parent materials are variable and include alluvium, lake bottom deposits and eolian loess. Soils are deep, saline, well-drained sands, sandy loams or sandy clays.

VEGETATION DESCRIPTION

Capitol Reef National Park

This association is common within the park. The vegetation is characterized by a somewhat open to closed canopy of *Sarcobatus vermiculatus* and *Atriplex confertifolia* shrubs. The associated shrub layer is diverse in terms of species composition and provides low to moderate cover. Dwarf-shrubs common to this association include *Gutierrezia sarothrae*, *Opuntia polyacantha*, and *Suaeda moquinii*. The herbaceous layer is moderately diverse in terms of species composition and provides moderate cover. Common graminoids are mostly bunch grasses and include *Bromus tectorum*, *Sporobolus airoides*, *Sporobolus contractus*, and *Sporobolus cryptandrus*. Forbs provide sparse cover.

Globally

This association is found on valley bottoms and the outer reaches of floodplains in the Great Basin and Colorado Plateau. Total vegetation cover rarely exceeds 40% in these stands growing on saline soils. The vegetation is characterized by a mixed shrub canopy of *Sarcobatus vermiculatus* generally accompanied by lesser amounts of *Atriplex confertifolia* and *Suaeda moquinii*. Other associated shrubs are sparse and variable, including *Allenrolfea*

occidentalis, *Picrothamnus desertorum*, *Atriplex canescens*, *Gutierrezia sarothrae*, *Tetradymia spinosa*, and *Opuntia polyacantha*. The herbaceous layer provides sparse to moderate cover. Graminoids vary throughout the range, but common species include *Bromus tectorum*, *Distichlis spicata*, *Elymus elymoides*, *Sporobolus airoides*, *Sporobolus contractus*, and *Sporobolus cryptandrus*. Forbs provide variable cover as they tend to be dominated by annual exotics, such as *Bassia hyssopifolia*, *Lepidium perfoliatum*, *Salsola tragus*, and *Halogeton glomeratus*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex confertifolia</i> , <i>Sarcobatus vermiculatus</i>
Herb (field)	<i>Gutierrezia sarothrae</i> , <i>Opuntia polyacantha</i> , <i>Suaeda moquinii</i>
Herb (field)	<i>Bromus tectorum</i> , <i>Pleuraphis jamesii</i> , <i>Sporobolus airoides</i> , <i>Sporobolus cryptandrus</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex confertifolia</i> , <i>Sarcobatus vermiculatus</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Halogeton glomeratus*, *Portulaca oleracea*, *Salsola tragus*

Globally

Bassia hyssopifolia, *Bromus tectorum*, *Halogeton glomeratus*, *Lepidium perfoliatum*, *Salsola tragus*

CONSERVATION STATUS RANK

Global Rank & Reasons: G5? (10-Nov-2005). Although widespread, this association is nowhere common.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

The concepts of this association and that of *Sarcobatus vermiculatus* / *Suaeda moquinii* Shrubland (CEGL001370) are not clearly distinguished; the two may need to be combined for consistency and ease of identification.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Sites receive moderate to heavy grazing and periodic flooding.

Capitol Reef National Park Data: The description is based on 1986 and 1987 field data (2 plots: CARE.9015, CARE.9355).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Bourgeron and Engelking 1994, Bundy et al. 1996, Driscoll et al. 1984, Kagan et al. 2004, NVNHP 2003, Western Ecology Working Group n.d.

***Sarcobatus vermiculatus* / *Distichlis spicata* Shrubland**

Black Greasewood / Saltgrass Shrubland

CODE	CEGL001363
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Deciduous shrubland (III.B.)
PHYSIOGNOMIC GROUP	Extremely xeromorphic deciduous shrubland (III.B.3.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural extremely xeromorphic deciduous shrubland (III.B.3.N.)
FORMATION	Intermittently flooded extremely xeromorphic deciduous subdesert shrubland (III.B.3.N.b.)
ALLIANCE	<i>SARCOBATUS VERMICULATUS</i> INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.1046)
	Black Greasewood Intermittently Flooded Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Greasewood Flat (CES304.780)
Inter-Mountain Basins Wash (CES304.781)
Inter-Mountain Basins Playa (CES304.786)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This association is reported from western Montana to Washington, south to Nevada, Utah and Colorado. Elevation ranges from approximately 600-2300 m. It forms expansive shrublands on broad floodplains along large rivers and streams, on the margins of upland seeps, and forms an outer ring around playas above the *Distichlis spicata* - dominated center. Flooding is generally intermittent. Substrates are deep, alkaline, saline and generally fine-textured soils with a high water table. However, in southern Colorado's San Luis Valley, stands grow between salt flat depressions (playas) on sandy hummocks approximately 1.2 m above the lakebed. The vegetation is characterized by a fairly open to moderate shrub canopy (18-60% cover) dominated by *Sarcobatus vermiculatus* with an herbaceous layer dominated by the rhizomatous graminoid *Distichlis spicata* (10-80% cover). Associated shrubs and dwarf-shrubs may include *Ericameria nauseosa*, *Gutierrezia sarothrae*, and *Tetradymia canescens*. *Sporobolus airoides* may codominate the graminoid layer, and *Hordeum jubatum* is common in disturbed stands. *Juncus balticus* and *Leymus cinereus* are also present in some stands. The forb layer is generally sparse and composed of species such as *Iva axillaris* and *Ipomopsis* spp. Introduced species may be present to abundant in disturbed stands.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon within the park and was sampled at Bull Springs, along Polk Creek, and in the South Desert along Deep Creek.

Globally

This shrubland association occurs throughout much of the interior West from western Montana to Washington, south to Nevada, Utah and Colorado.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on saturated sand deposits near a spring and seep. The site is gently sloped (7° slope), occurs at 1786 m elevation, and is oriented to a southeastern exposure. The unvegetated surface has high cover of litter and low to moderate basal area cover of live stems. Exposure of bare soil is moderate, as much as 30% cover. Parent material is the Entrada sandstone formation that has eroded to form alluvial deposits. Soils are rapidly drained silty clays.

Globally

This shrubland occupies alkaline flatlands and valley bottoms. These areas are usually closed basins or have poor drainage. Elevation ranges from approximately 600-2300 m. Stands form expansive shrublands on broad floodplains along large rivers and streams, fill low-gradient drainages below springs and seeps, or form an outer ring around playas above the *Distichlis spicata*-dominated center. Flooding is generally intermittent. Substrates are deep, alkaline, saline and generally fine-textured soils with a perennial high water table. However, in southern Colorado's San Luis Valley, stands grow between salt flat depressions (playas) on sandy hummocks approximately 1.2 m above the lakebed. Biological crusts are important on some sites.

VEGETATION DESCRIPTION

Capitol Reef National Park

This shrubland association is uncommon within the park. The total vegetation cover ranges from 51 to 75% in this moderately to densely vegetated stand. This short-shrub association is characterized by a somewhat open to closed canopy of *Sarcobatus vermiculatus* shrubs that range in cover from 5 to 15% and the perennial grass *Distichlis spicata* that ranges in cover from 45 to 55%. The associated shrub layer is sparse in terms of species composition and cover and includes *Ericameria nauseosa*. The remaining herbaceous layer includes only the bunchgrass *Sporobolus airoides*.

Globally

The vegetation is characterized by a fairly open to moderate shrub canopy (18-60% cover) dominated by *Sarcobatus*

vermiculatus with an herbaceous layer dominated by the rhizomatous graminoid *Distichlis spicata* (10-80% cover). Associated shrubs and dwarf-shrubs may include *Ericameria nauseosa*, *Gutierrezia sarothrae*, and *Tetradymia canescens*. *Sporobolus airoides* may codominate the graminoid layer, and *Hordeum jubatum* is common in disturbed stands. *Juncus balticus* and *Leymus cinereus* are also present in some stands. The forb layer is generally sparse and composed of species such as *Iva axillaris* and *Ipomopsis* spp. Introduced species, such as *Bromus tectorum*, *Lepidium latifolium*, *Lepidium perfoliatum*, and *Bassia hyssopifolia*, may be present to abundant in disturbed stands.

The stand described by Baker (1982b) for the Piceance Basin had patches of *Sarcobatus vermiculatus* alternating with wide expanses of *Distichlis spicata*. A few species of annuals also were present but could not be identified. Cover of *Sarcobatus* in this stand was not high. Baker (1982b) reports that many *Sarcobatus*-dominated communities are in the literature for Colorado, with understories of exotic annual weeds. His stand was one of only a few stands from western Colorado that still contains a native perennial grass understory.

Data from Costello (1944b) for the San Juan Valley show dominance of *Sarcobatus*, with >60% cover, and *Chrysothamnus* spp. are associated. The understory consists primarily of *Distichlis spicata* and *Sporobolus airoides*, with *Bouteloua gracilis*, *Iva axillaris*, and *Muhlenbergia richardsonis* commonly present. Costello (1944b) also reported on *Sarcobatus*-dominated stands in western Colorado and Wyoming with several associated shrub species, including *Artemisia tridentata*, *Atriplex gardneri*, *Atriplex confertifolia*, and *Kochia americana*. Herbaceous species include *Elymus lanceolatus*, *Salsola* spp., and *Sporobolus airoides*.

Hanson (1929) reports that the appearance of greasewood stands varies greatly with depth to water table and salt concentration in the soil. It can form almost pure, tall stands, or in places be much more open with shrubs and grasses associated.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Ericameria nauseosa</i> , <i>Sarcobatus vermiculatus</i>
Herb (field)	<i>Distichlis spicata</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Ericameria nauseosa</i> , <i>Sarcobatus vermiculatus</i>
Short shrub/sapling	<i>Gutierrezia sarothrae</i>
Herb (field)	<i>Distichlis spicata</i> , <i>Hordeum jubatum</i> , <i>Sporobolus airoides</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Tamarix chinensis

Globally

Bromus tectorum, *Lepidium latifolium*, *Lepidium perfoliatum*

CONSERVATION STATUS RANK

Global Rank & Reasons: G4 (1-Feb-1996).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Sporobolus airoides is often a codominant in the understory of this association, it is somewhat unclear how to distinguish it from *Atriplex canescens* / *Sporobolus airoides* Shrubland (CEGL001291).

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Site includes a spring that supports diverse wetland species. The spring

flows into a cattle-watering trough. There are tamarisk and giant reed stands nearby.

Capitol Reef National Park Data: The description is based on 2004 field data (1 plot: CARE.0615).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: M.S. Reid, mod. K.A. Schulz and J. Coles

REFERENCES: Baker 1982b, Bourgeron and Engelking 1994, Branson et al. 1976, CONHP unpubl. data 2003, Carsey et al. 2003a, Costello 1944b, Crawford 2001, Daubenmire 1970, Donnelly et al. 2006, Driscoll et al. 1984, Franklin and Dyrness 1973, Hansen et al. 1995, Hanson 1929, IDCDC 2005, Jones 1992b, Jones and Walford 1995, Kagan et al. 2000, Kittel et al. 1999a, Kittel et al. 1999b, MTNHP 2002b, Mueggler and Stewart 1980, NVNHP 2003, Ungar et al. 1969, WNHP unpubl. data, Western Ecology Working Group n.d.

***Sarcobatus vermiculatus* / *Sporobolus airoides* Shrubland**

Black Greasewood / Alkali Sacaton Shrubland

CODE	CEGL001368
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Deciduous shrubland (III.B.)
PHYSIOGNOMIC GROUP	Extremely xeromorphic deciduous shrubland (III.B.3.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural extremely xeromorphic deciduous shrubland (III.B.3.N.)
FORMATION	Intermittently flooded extremely xeromorphic deciduous subdesert shrubland (III.B.3.N.b.)
ALLIANCE	<i>SARCOBATUS VERMICULATUS</i> INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.1046) Black Greasewood Intermittently Flooded Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Greasewood Flat (CES304.780)
Inter-Mountain Basins Wash (CES304.781)
Inter-Mountain Basins Playa (CES304.786)
Central Mixedgrass Prairie (CES303.659)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This association occurs in the Columbia and Wyoming basins, Colorado Plateau and western Great Plains from eastern Oregon, central and northeastern Wyoming, northwestern and southeastern Colorado, and eastern Utah. Stands of this type usually occur as small, relict patches on level to gently sloping valley floors, on alluvial fans along intermittent washes and streams, and on abandoned stream terraces with fine-textured to sandy, alkaline soils derived from alluvium. The water table rarely reaches the surface, and these sites flood only occasionally. Elevations range from 1180 to 1950 m (3870-6400 ft.) in Colorado and Utah. *Sarcobatus vermiculatus* typically dominates the open to moderately dense shrub layer with between 10 and 50% cover and includes sparse and open steppe stands with 5-10% shrub cover. Other shrubs present with low cover may include *Atriplex canescens*, *Ericameria nauseosa*, and *Artemisia tridentata* ssp. *tridentata*. The herbaceous understory is typically dominated by *Sporobolus airoides*, usually with a number of other species present, including *Pascopyrum smithii*, *Hordeum jubatum*, *Hesperostipa comata*, *Bouteloua gracilis*, *Elymus elymoides*, *Elymus lanceolatus* ssp. *lanceolatus*, and *Distichlis spicata*. Forbs generally contribute little cover, although several weedy or exotic forbs may be abundant.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon in the park and is represented by plots in Hartnet Draw and the lower South Desert.

Globally

This association occurs in the Columbia and Wyoming basins, Colorado Plateau and western Great Plains from eastern Oregon, central and northeastern Wyoming, northwestern and southeastern Colorado, and eastern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This alkaline shrubland association occurs on low-level stream terraces and valley floors. Sites are gentle (1 to 3° slopes) and between 1700 and 1950 m elevation. The unvegetated surface has sparse to high exposure of bare soil and cover by vascular cryptogams, depending on the amount of grass present. Litter provides low cover in most

stands. Soils are well-drained loams and sandy loams derived from alluvium.

Globally

Stands of this type usually occur as small, relict patches on level to gently sloping valley floors and on abandoned stream terraces with fine-textured to sandy, alkaline soils derived from alluvium. Elevations range from 1180 to 1950 m (3870-6400 ft.) in Colorado and Utah. The water table is usually within 1 m of the surface for at least part of the growing season, although it may be a perched water table held by a hard pan just below the ground surface.

VEGETATION DESCRIPTION

Capitol Reef National Park

This association is uncommon within the park. Total vegetation cover ranges from 6 to 50%. This association is characterized by an open canopy of *Sarcobatus vermiculatus* shrubs with between 1 and 25% cover and the perennial bunchgrass *Sporobolus airoides* with between 1 and 15% cover. Associated shrubs include *Opuntia polyacantha*, *Ephedra torreyana*, *Atriplex canescens*, *Atriplex confertifolia*, and *Suaeda moquinii*. The herbaceous layer provides sparse cover. Cryptogam cover is variable, ranging from sparse to 80% cover.

Globally

Sarcobatus vermiculatus dominates the shrub layer with between 10 and 50% cover. Other shrubs with low cover may include *Atriplex canescens*, *Atriplex confertifolia*, *Allenrolfea occidentalis*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Suaeda torreyana*, and *Artemisia tridentata* ssp. *tridentata*. The herbaceous understory contains and is often dominated by *Sporobolus airoides*, usually with other species such as *Pascopyrum smithii*, *Hordeum jubatum*, *Bouteloua gracilis*, *Elymus elymoides*, *Elymus lanceolatus* ssp. *lanceolatus*, and *Distichlis spicata*. Forbs generally contribute little cover, although several weedy or exotic forbs may be abundant.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Sarcobatus vermiculatus</i>
Herb (field)	<i>Opuntia polyacantha</i> , <i>Suaeda moquinii</i>
Herb (field)	<i>Sporobolus airoides</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Sarcobatus vermiculatus</i>
Herb (field)	<i>Sporobolus airoides</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G3? (1-Dec-2000). This association has been named from the Thunder Basin National Grassland of northeastern Wyoming, and it apparently also occurs along the North Platte and Sweetwater rivers in central Wyoming. It is ranked G3 because it has been described from a limited geographic range, and many stands seem to contain exotic plants. The lack of detailed descriptions or stand data make the rank questionable. As additional data become available and the full range of the association becomes better understood, this rank should be revisited. It appears that many stands in the Colorado Plateau that historically were this association have been degraded by grazing and water table collapse.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This association was moved from a sparsely vegetated to a shrubland alliance based on literature and plot review that

indicated that, although some stands are sparse (<10% total vegetation cover), most are not and some have rather dense cover (50% cover of shrubs). This description is based on information from northeastern Wyoming, northwestern and southeastern Colorado and southern Utah. A general vegetation description and habitat description from central Wyoming are also available. The plant species listed for this association also occur in *Sarcobatus vermiculatus* / *Pascopyrum smithii* - (*Elymus lanceolatus*) Shrub Herbaceous Vegetation (CEGL001508), and this type may also be similar to *Sarcobatus vermiculatus* / *Distichlis spicata* Shrubland (CEGL001363). These three associations apparently are differentiated on the basis of the relative amounts of the various grass species in the undergrowth. Grass dominance varies with soil salinity and aeration, and this association may represent the more saline but well-aerated conditions. Also compare this association with *Sarcobatus vermiculatus* / *Distichlis spicata* - (*Puccinellia nuttalliana*) Shrub Herbaceous Vegetation (CEGL002146).

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Sites are on broad floodplain terraces and may flood during very large events. One site exhibits erosion from sheet flow. Sites are lightly to heavily grazed by cattle. There is pinyon-juniper woodland on the uplands above a wash and rabbitbrush near the wash on one site.

Capitol Reef National Park Data: The description is based on 2003 field data and data collected in 2005 during accuracy assessment (3 plots: CARE.0449, CARE.0457, CARE_AA.1142).

Local Description Authors: J. Von Loh, mod. D. Clark and J. Coles

Global Description Authors: G.P. Jones, mod. J. Coles and K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Jones 1992b, Kagan et al. 2004, Shaw et al. 1989, Terwilliger et al. 1979a, Terwilliger et al. 1979b, Warren n.d.,

***Sarcobatus vermiculatus* Disturbed Shrubland
Black Greasewood Disturbed Shrubland**

CODE	CEGL001357
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Deciduous shrubland (III.B.)
PHYSIOGNOMIC GROUP	Extremely xeromorphic deciduous shrubland (III.B.3.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural extremely xeromorphic deciduous shrubland (III.B.3.N.)
FORMATION	Intermittently flooded extremely xeromorphic deciduous subdesert shrubland (III.B.3.N.b.)
ALLIANCE	<i>SARCOBATUS VERMICULATUS</i> INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.1046) Black Greasewood Intermittently Flooded Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Greasewood Flat (CES304.780)
Inter-Mountain Basins Wash (CES304.781)
Inter-Mountain Basins Playa (CES304.786)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This shrubland association occurs on saline soils of terraces, swales, alluvial fans, valley floors, toe slopes and ridges throughout the Colorado Plateau and Great Basin. It is distinguished from other *Sarcobatus vermiculatus* associations in that disturbance has removed most or all of the native herbaceous understory. Black greasewood will increase in density at the expense of grasses such as *Sporobolus airoides* under heavy grazing, since the shrub is only moderately palatable to livestock. Soil textures in these communities range from sandy loam to silty clay and may have a white salt crust on the soil surface. *Sarcobatus vermiculatus* dominates the sparse to moderately dense shrub layer, usually with a minor component of *Ericameria nauseosa*, *Suaeda moquinii*, *Opuntia polyacantha*, *Atriplex canescens*, or *Atriplex confertifolia*. If *Artemisia tridentata* is present, it is with very low cover. The understory ranges from sparse to dense in cover, but native species typically have very low cover. The dominant herbaceous species tend to be weedy and/or exotic; *Vulpia octoflora*, *Bromus tectorum*, *Descurainia pinnata*, *Salsola tragus*, *Alyssum desertorum*, and *Halogeton glomeratus* are typical understory species.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon within the park and was sampled east of Cedar Mesa campground, along Halls Creek, and along South Draw.

Globally

This association is likely to be widespread on floodplains and valley floors throughout the interior western United States. It is currently documented from the Uinta Basin (eastern Utah), Great Basin (central Utah, central Nevada, eastern California), northwestern New Mexico (Francis 1986) and Colorado Plateau (western Colorado).

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on valley floors and alluvial flats. Sites are gentle (1 to 5° slopes), occur between 1470 and 1700 m elevation, and are oriented to southeastern and northeastern exposures. The unvegetated surface has moderate to high exposure of bare soil and sparse to low cover by litter. Gravel is abundant on one site, as much as 90% cover. Parent materials are variable and include sandstones and shale that have eroded and become water-borne or wind-deposited. Soils are rapidly drained sandy clays and sandy loams.

Globally

This widespread but patchy shrubland association occurs on terraces, swales, coppice dunes, alluvial fans, valley floors, toe slopes and ridges throughout the Colorado Plateau and Great Basin. Elevations range between 1200 and 2073 m (3940-6800 ft.), and slopes tend to be gentle. Soils are typically derived from mixed alluvium. Soil textures range from sandy loam to silty clay and tend to be alkaline, often with a white salt crust on the soil surface. Biological soil crusts may provide up to 25% cover in some stands. Bare ground values tend to be high, unless *Bromus tectorum* is a major component of the system, in which case litter cover values are high.

VEGETATION DESCRIPTION

Capitol Reef National Park

This association is uncommon within the park. The total vegetation cover ranges from 2 to 80% . This short-shrub association is characterized by an open canopy of *Sarcobatus vermiculatus* shrubs that range in cover from 1 to 25%. The associated shrub layer is moderately diverse in terms of species composition and provides sparse to low cover. Common short and dwarf-shrubs include the succulent *Opuntia polyacantha*, in addition to species that provide sparse to low cover in individual stands, including *Picrothamnus desertorum*, *Atriplex canescens*, and *Atriplex confertifolia*. The herbaceous layer is moderately diverse in terms of species composition and provides sparse to moderate cover. Common graminoids include the exotic annual *Bromus tectorum* and the short bunchgrass *Pleuraphis jamesii*. Forbs occasionally present include *Eriogonum inflatum*, *Lappula occidentalis*, *Mentzelia albicaulis*, and *Sphaeralcea parvifolia*.

Globally

This association occurs where conditions support *Sarcobatus vermiculatus*, but disturbance has removed most or all of the native herbaceous understory. *Sarcobatus vermiculatus* dominates the sparse to moderately dense shrub layer with a cover of 10-60%. Other shrubs commonly present include *Atriplex gardneri*, *Ericameria nauseosa*, *Grayia spinosa*, *Suaeda moquinii*, *Opuntia polyacantha*, *Atriplex canescens*, and *Atriplex confertifolia*. If *Artemisia tridentata* is present, it is with very low cover. The understory ranges from sparse to dense in cover, but native species typically have very low cover. The dominant herbaceous species tend to be weedy and/or exotic; *Vulpia octoflora*, *Bromus tectorum*, *Descurainia pinnata*, *Salsola tragus*, *Alyssum desertorum*, and *Halogeton glomeratus* are typical understory dominants.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex confertifolia</i> , <i>Sarcobatus vermiculatus</i>
Herb (field)	<i>Atriplex canescens</i> , <i>Opuntia polyacantha</i> , <i>Picrothamnus desertorum</i>
Herb (field)	<i>Atriplex argentea</i> , <i>Helianthus petiolaris</i> , <i>Lappula occidentalis</i> , <i>Mentzelia albicaulis</i> , <i>Plantago patagonica</i>
Herb (field)	<i>Bromus tectorum</i> , <i>Pleuraphis jamesii</i>

Globally

<u>Stratum</u>	<u>Species</u>
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Short shrub/sapling *Sarcobatus vermiculatus*

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park
Bromus tectorum, Salsola tragus

Globally
Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park
Data are not available.

Globally

Stands included in this association are often affected by livestock grazing, and either lack an understory or possess an understory dominated by weedy or exotic herbaceous species.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Some sites receive grazing by cattle. Sites represent disturbed areas, including slope wash from precipitation events.

Capitol Reef National Park Data: The description is based on 1986, 2003, and 2004 field data (5 plots: CARE.0413, CARE.0520, CARE.0613, CARE.0614, CARE.9322).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, Brotherson et al. 1986, Dastrup 1963, Donovan et al. 1996, Driscoll et al. 1984, Francis 1986, Ganskopp 1986, Graham 1937, Groeneveld and Crowley 1988, NVNHP 2003, Shantz and Piemeisel 1940, Western Ecology Working Group n.d., Young et al. 1986

***Krascheninnikovia lanata* / *Pleuraphis jamesii* Dwarf-shrubland**
Winter-fat / James' Galleta Dwarf-shrubland

CODE	CEGL001322
PHYSIOGNOMIC CLASS	Dwarf-shrubland (IV)
PHYSIOGNOMIC SUBCLASS	Evergreen dwarf-shrubland (IV.A.)
PHYSIOGNOMIC GROUP	Extremely xeromorphic evergreen dwarf-shrubland (IV.A.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural extremely xeromorphic evergreen dwarf-shrubland (IV.A.2.N.)
FORMATION	Extremely xeromorphic evergreen subdesert dwarf-shrubland (IV.A.2.N.a.)
ALLIANCE	<i>KRASCHENINNIKOVIA LANATA</i> DWARF-SHRUBLAND ALLIANCE (A.1104) Winter-fat Dwarf-shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This minor dwarf-shrubland association is reported from throughout the Colorado Plateau. Stands typically occur on alluvial flats and plains. Sites are typically flat to gently sloping, occurring on any aspect. Soils are generally moderately deep, calcareous, moderately alkaline and derived from sandstone, shale or alluvium. Soil texture ranges from sandy loam to silty clay. The ground surface has high cover of bare soil (70-90%). Vegetation is characterized by a sparse to moderately dense dwarf-shrub layer dominated by *Krascheninnikovia lanata* and sometimes codominated by *Gutierrezia sarothrae*. Other woody species may include scattered *Artemisia tridentata*, *Artemisia bigelovii*, *Chrysothamnus viscidiflorus*, *Opuntia imbricata*, *Opuntia polyacantha*, or *Yucca glauca*. The herbaceous layer has sparse to moderately dense cover dominated or codominated by *Pleuraphis jamesii* with scattered perennial

forbs. Associated graminoids may include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Elymus elymoides*, *Hesperostipa comata*, and *Sporobolus airoides*. Scattered perennial forbs may be present, such as *Chaetopappa ericoides*, *Helianthus petiolaris*, *Machaeranthera pinnatifida*, and *Sphaeralcea* spp. Exotic annuals may include *Bromus tectorum*, *Salsola kali*, and *Sisymbrium altissimum*.

DISTRIBUTION

Capitol Reef National Park

This rare association is represented by a plot on a terrace in the Strike Valley near Bitter Creek Divide.

Globally

This dwarf-shrubland association is reported from alluvial flats in northwestern New Mexico in the upper Rio Puerco basin, in western Colorado on the margins of the Grand Valley and in eastern Utah in flats above the Green River floodplain. It likely occurs throughout the Colorado Plateau.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This dwarf-shrub association was sampled once on a terrace. The site slopes gently (4°), lies at 1686 m elevation and is oriented to the east. The unvegetated surface has high exposure of bare soil and moderate cover of litter, gravel and biological soil crusts. The soil is a rapidly drained sandy loam derived from alluvium.

Globally

This minor dwarf-shrubland association is reported from northwestern New Mexico, western Colorado and eastern Utah, but likely occurs throughout the Colorado Plateau. Elevations range from 1400-2050 m. Climate is temperate and semi-arid. Annual precipitation ranges from 20-30 cm with most occurring during the growing season, often as short-duration, convectional thunderstorms. Stands occur on plains, alluvial flats, valley floors, canyon bottoms, benches, alluvial fans and stabilized sand dunes. Sites are flat to moderately sloping, occurring on any aspect. Soils are generally moderately deep, calcareous, moderately alkaline and derived from sandstone, shale or alluvium, but include rapidly drained sandy loam derived from eolian sands and sheet wash deposits. Soil texture ranges from sand to silty clay. The ground surface has high cover of bare soil (70-90%).

VEGETATION DESCRIPTION

Capitol Reef National Park

This association is rare within the park and was sampled only once. Total vegetation cover does not exceed 30%. The vegetation is characterized by an open canopy of *Krascheninnikovia lanata* with around 8% cover and the perennial bunchgrass *Pleuraphis jamesii* with around 5% cover. Associated shrubs with lesser cover include *Mahonia fremontii*, *Artemisia tridentata*, and *Atriplex canescens*. Other herbaceous species present include *Achnatherum hymenoides* (may be codominant) and *Hesperostipa comata*. Pinyon and juniper trees may be scattered throughout the stand.

Globally

This association is characterized by a sparse to moderately dense dwarf-shrub layer dominated by *Krascheninnikovia lanata* and sometimes codominated by *Gutierrezia sarothrae*, and a sparse to moderately dense herbaceous layer dominated by the perennial graminoid *Pleuraphis jamesii*. Scattered *Artemisia tridentata*, *Atriplex canescens*, *Artemisia bigelovii*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Opuntia imbricata*, *Opuntia polyacantha*, or *Yucca glauca* may also be present in the woody layer. Other graminoids present in minor amounts may include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Elymus elymoides*, *Hesperostipa comata*, and *Sporobolus airoides*. Scattered perennial forbs may be present, such as *Chaetopappa ericoides*, *Helianthus petiolaris*, *Machaeranthera pinnatifida*, *Oenothera pallida*, *Sphaeralcea coccinea*, and *Sphaeralcea parvifolia*. Exotic annuals may include *Bromus tectorum*, *Salsola kali*, and *Sisymbrium altissimum*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Krascheninnikovia lanata</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Pleuraphis jamesii</i>

Globally

Stratum

Short shrub/sapling
Herb (field)

Species

Gutierrezia sarothrae, *Krascheninnikovia lanata*
Bromus tectorum, *Pleuraphis jamesii*

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park
Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G4 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park
Data are not available.

Globally

Stands described by Francis (1986) were generally too sparse to be classified as dwarf-shrublands and may be better classified in a shrub herbaceous association. Current and past livestock management can have a large impact on cover and composition of the woody and herbaceous layers. Both *Krascheninnikovia lanata* (winter-fat) and *Pleuraphis jamesii* are valuable livestock forage and are negatively impacted by heavy use. *Gutierrezia sarothrae* increases under heavy livestock use. Significant small mammal burrows and plant pedestalling caused by wind erosion were reported from the Utah stands.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Anomalous *Krascheninnikovia lanata* patch here may be due to soils. Some slight soil crusting. Pinyon-juniper invading from toe slopes to the west.

Capitol Reef National Park Data: The description is based on field data collected in 2005 during accuracy assessment (1 plot: CARE_AA.0757).

Local Description Authors: J. Coles

Global Description Authors: K.A. Schulz, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Francis 1986, Gates et al. 1956, Von Loh 2000

***Krascheninnikovia lanata* Dwarf-shrubland**

Winter-fat Dwarf-shrubland

CODE	CEGL001320
PHYSIOGNOMIC CLASS	Dwarf-shrubland (IV)
PHYSIOGNOMIC SUBCLASS	Evergreen dwarf-shrubland (IV.A.)
PHYSIOGNOMIC GROUP	Extremely xeromorphic evergreen dwarf-shrubland (IV.A.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural extremely xeromorphic evergreen dwarf-shrubland (IV.A.2.N.)
FORMATION	Extremely xeromorphic evergreen subdesert dwarf-shrubland (IV.A.2.N.a.)
ALLIANCE	<i>KRASCHENINNIKOVIA LANATA</i> DWARF-SHRUBLAND ALLIANCE (A.1104) Winter-fat Dwarf-shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This association is known from Colorado Plateau west into to the Great Basin and northern Mojave Desert and east into the northern panhandle of Texas and is likely to be more widespread in similar habitats in the southwestern Great Plains. It is an alkaline dwarf-shrub association that occurs primarily on sand sheets, slopes and plains often on

eolian deposits near canyon walls and in alkaline flats in and around playas and along washes. Sites are flat to steep (to 40% slope) and occur between 800 and 1770 m (2620-5800 ft.) elevation. Soils are rapidly drained loamy sands or sandy loams derived from alluvium from a variety of parent materials and sandstones that have eroded and been re-deposited by wind and water. It occurs on low to high levels of soil salinity and alkalinity. Total vegetation cover ranges from 5 to 45% and is characterized by the dwarf-shrub *Krascheninnikovia lanata* with cover between 5 and 30%. In southern Nevada, scattered *Ambrosia dumosa*, *Atriplex polycarpa*, *Larrea tridentata*, *Lycium andersonii*, *Sphaeralcea ambigua*, and *Suaeda moquinii* may be present. The herbaceous layer is poorly developed but may contain tufts of the grass *Achnatherum hymenoides*. Forbs commonly present include *Eriogonum* spp., *Opuntia polyacantha*, *Oenothera pallida*, *Plantago patagonica*, and *Sphaeralcea parvifolia*. Biological soil crusts may provide as much as 45% cover. Introduced annuals *Bromus tectorum*, *Bromus rubens*, and *Salsola tragus* may be abundant on some sites.

DISTRIBUTION

Capitol Reef National Park

This association is rare within the park and is represented by a single plot sampled in the South Desert.

Globally

This association is known from the Colorado Plateau west into the Great Basin and northern Mojave Desert.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This dwarf-shrubland occurs on the deep soils of valley floors. The one sampled site is on a gently sloping valley floor at 1880 m elevation. Most of the unvegetated surface is exposed soil, but litter, gravel and biological soil crusts contribute low cover. The soil is a rapidly drained sandy loam derived from valley fill.

Globally

This association is known from the Colorado Plateau west into the Great Basin and northern Mojave Desert and in the panhandle of Texas. It is an alkaline dwarf-shrub association that occurs primarily on sand sheets, slopes and plains often on eolian deposits near canyon walls and in alkaline flats in and around playas and along washes. Sites are gentle to steep (to 40% slope) and occur between 800 and 1770 m (2620-5800) feet elevation. Soils are rapidly drained loamy sands from alluvium derived from a mixture of rocks such as granodiorite, quartzite, latite, limestone and basalt in southern Nevada (Faden 1977), and sandy loams derived from Navajo and Entrada sandstones in southeastern Utah that have eroded and been re-deposited by wind and water. It occurs on low to high levels of soil salinity and alkalinity.

In Texas, this community occurs on shallow soils on ridges and on foot slopes along the Canadian River. In general, the soils are derived from sedimentary rocks and are shallow. It would seem that this shrub is able to grow on a variety of soils but prefers the shallower, rocky areas. It is often found growing in association with other shrubs but may grow alone in small colonies. When this community is found, it is never extensive and rarely occupies more than a third of an acre. There is usually some evidence of deer browsing on this species, and in areas where it is accessible, domestic livestock will browse it as well.

VEGETATION DESCRIPTION

Capitol Reef National Park

This winter-fat shrubland is rare within the park. Total vegetation cover is around 30%, with an additional 10-15% cover provided by biological soil crusts. A sparse shrub canopy is dominated by *Krascheninnikovia lanata* with 20% cover. Associated shrubs include *Atriplex confertifolia* and *Chrysothamnus viscidiflorus* with low cover. The herbaceous layer shows evidence of disturbance, being dominated by the exotic herbaceous species *Malcolmia africana* and *Halogeton glomeratus*.

Globally

On the Colorado Plateau, total vegetation cover ranges from 5 to 45% and is characterized by the dwarf-shrub *Krascheninnikovia lanata* with cover between 5 and 30%. In southern Nevada, scattered *Ambrosia dumosa*, *Atriplex polycarpa*, *Larrea tridentata*, *Lycium andersonii*, *Sphaeralcea ambigua*, and *Suaeda moquinii* may be present (Faden 1977). The herbaceous layer is poorly developed but may contain tufts of the grass *Achnatherum hymenoides*. Forbs commonly present include *Eriogonum* spp., *Opuntia polyacantha*, *Oenothera pallida*, *Plantago patagonica*, and *Sphaeralcea parvifolia*. Biological soil crusts provide up to 45% cover. Introduced annuals *Bromus tectorum*,

Bromus rubens, and *Salsola tragus* may be abundant on some sites.

In Texas, this small community is dominated by *Krascheninnikovia lanata*, with some other short shrubs also being present in lesser amounts. Associated shrubs present in the community include *Dalea formosa*, *Mimosa borealis*, *Atriplex canescens*, and occasionally small *Prosopis glandulosa*. The community gives the appearance of being droughty and forbs are few. *Tetaneuris scaposa*, *Gutierrezia sarothrae*, *Chaetopappa ericoides*, *Paronychia jamesii*, and *Eriogonum longifolium* are the most common. The most common grasses are *Aristida purpurea*, *Hesperostipa neomexicana*, *Bouteloua gracilis*, and *Bouteloua curtipendula*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Krascheninnikovia lanata</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Krascheninnikovia lanata</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Halogeton glomeratus, *Malcolmia africana*

Globally

Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: G5? (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This is a broadly defined association that includes stands from the Colorado Plateau, Great Basin and northern Mojave Desert characterized by the dominance of *Krascheninnikovia lanata* without a notable herbaceous layer. The herbaceous layer is typically absent or sparse or dominated by introduced species such as *Bromus tectorum* or *Salsola tragus*. This is a very-small-patch association as presently defined from Lake Meredith National Recreation Area, Texas. The concept will need further review to determine if it is a viable association or should be considered as patches within a broader association.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Rabbitbrush occupies a narrow wash running through the plot.

Capitol Reef National Park Data: The description is based on field data collected in 2005 during accuracy assessment (1 plot: CARE_AA.1402).

Local Description Authors: J. Coles

Global Description Authors: K.A. Schulz and J. Drake

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Faden 1977, Mitchell et al. 1966, NVNHP 2003, Western Ecology Working Group n.d.

***Atriplex corrugata* Dwarf-shrubland Mat Saltbush Dwarf-shrubland**

CODE	CEGL001437
PHYSIOGNOMIC CLASS	Dwarf-shrubland (IV)
PHYSIOGNOMIC SUBCLASS	Evergreen dwarf-shrubland (IV.A.)

PHYSIOGNOMIC GROUP Extremely xeromorphic evergreen dwarf-shrubland (IV.A.2.)
PHYSIOGNOMIC SUBGROUP Natural/Semi-natural extremely xeromorphic evergreen dwarf-shrubland (IV.A.2.N.)
FORMATION Facultatively deciduous subdesert dwarf-shrubland (IV.A.2.N.b.)
ALLIANCE *ATRIPLEX CORRUGATA* DWARF-SHRUBLAND ALLIANCE (A.1109)
Mat Saltbush Dwarf-shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Mat Saltbush Shrubland (CES304.783)
Inter-Mountain Basins Shale Badland (CES304.789)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This dwarf-shrubland association is found on lower hill slopes, clay barrens and alkaline flats on Colorado Plateau portions of northwestern New Mexico, western Colorado and Utah. Sites are gently sloping to moderately steep ridges and hills shaped into badlands by water and wind erosion. Soils are typically derived from Mancos shale or other marine shales. They are moderately deep, strongly saline, moderately alkaline, fine-textured (clayey), poorly developed and typically have high erosion rates. The soil surface is mostly barren. The vegetation is characterized by a very sparse to moderate cover (5-25%) of woody vegetation dominated by the halophytic dwarf-shrub *Atriplex corrugata*. There is typically very low species diversity, but depending on soil salinity and moisture, other plants may be present, including the shrubs *Atriplex gardneri*, *Atriplex confertifolia*, *Tetradymia spinosa*, *Picrothamnus desertorum*, *Suaeda calceoliformis*, and *Krascheninnikovia lanata*. The herbaceous layer is very sparse. Only scattered perennial forbs, such as *Xylorhiza glabriuscula*, *Xylorhiza venusta*, and *Sphaeralcea grossulariifolia*, and the perennial grasses *Achnatherum hymenoides*, *Elymus elymoides*, and *Pleuraphis jamesii* have been reported. Annuals are seasonally present and may include *Eriogonum inflatum*, *Phacelia splendens*, *Plantago tweedyi*, and *Atriplex argentea*. Introduced species such as *Bromus tectorum* and *Salsola kali* may be present.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon to common in the park. It was sampled on shale badlands at the park boundary on Notom Road, in Dry Wash/Bentonite Hills, and east of the Burr Trail Switchbacks.

Globally

Shrublands in this association are found on lower hill slopes and alkaline flats on Colorado Plateau portions of northwestern New Mexico, western Colorado and eastern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This dwarf-shrub association was observed on shale badlands slopes, cliffs, and alluvial flats within the park. Sampled sites are gentle to moderately steep (1 to 15° slopes), occur between 1555 and 1646 m elevation, and are oriented to southern aspects. The unvegetated surface has sparse to high cover of bare soil and gravel. Parent materials are shale of the Mancos and Morrison formations. Soils are rapidly drained silt loams and silty clays.

Globally

This dwarf-shrubland association is found on lower hill slopes, clay barrens and alkaline flats on Colorado Plateau portions of northwestern New Mexico, western Colorado and eastern Utah. Climate is semi-arid with most of the highly variable precipitation falling in July and August as high-intensity thunderstorms. Mean annual precipitation is approximately 23 cm. Elevation ranges from 1300-1975 m (4265-6480 ft.). Sites are gently sloping to moderately steep ridges and hills shaped into badlands by water and wind erosion. Soils are typically derived from Mancos shale or, less often, from other Paleozoic or Mesozoic marine shales. They are moderately deep, strongly saline, moderately alkaline, fine-textured (clayey), poorly developed and typically have high erosion rates. The soil surface is mostly barren. In the Badger Wash Basin in Colorado, a relatively lush stand had 25% *Atriplex corrugata*, 60% bare ground, 8% litter and 8% algal crusts (Branson et al. 1976).

VEGETATION DESCRIPTION

Capitol Reef National Park

This mat saltbush dwarf-shrubland association is uncommon to common within badlands formations of the park. The total vegetation cover ranges from 1 to 15%. This dwarf-shrub association is characterized by a sparse canopy of mat-forming *Atriplex corrugata* that range in cover from 1 to 5%. The associated shrub layer is low in species

diversity, provides sparse cover, and includes *Atriplex gardneri*, *Gutierrezia sarothrae*, and *Sclerocactus parviflorus*. The herbaceous layer is typically low in species diversity and provides sparse cover. Graminoids are rarely present and can include the exotic annual *Bromus tectorum* and the bunch grasses *Achnatherum hymenoides* and *Pleuraphis jamesii*. Forbs occasionally present include *Eriogonum inflatum*.

Globally

These shrublands are found on the slopes of marine shale badlands and alkaline flats on the Colorado Plateau. Stands have very sparse to moderate cover (1-25%) of woody vegetation dominated by the halophytic evergreen dwarf-shrub *Atriplex corrugata*. Sparse stands are often solely dominated by this plant. Stands typically have very low species diversity. Depending on soil salinity and moisture, other plants may be present, including the shrubs *Atriplex gardneri*, *Atriplex confertifolia*, *Tetradymia spinosa*, *Gutierrezia sarothrae*, *Picrothamnus desertorum*, *Suaeda calceoliformis*, and *Krascheninnikovia lanata*. The herbaceous layer is very sparse. Scattered perennial forbs, such as *Xylorhiza glabriuscula*, *Xylorhiza venusta*, and *Sphaeralcea grossulariifolia*, and the perennial grasses *Achnatherum hymenoides*, *Aristida purpurea*, *Elymus elymoides*, and *Pleuraphis jamesii* have been reported. Annuals are seasonally present and may include *Eriogonum inflatum*, *Phacelia splendens*, *Plantago tweedyi*, *Stenogonum salsuginosum*, and *Atriplex argentea*. Introduced species include *Bromus tectorum*, *Halogeton glomeratus*, *Malcolmia africana*, and *Salsola kali*. Perennial plants may be pedestalled due to soil erosion.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex corrugata</i> , <i>Atriplex gardneri</i> , <i>Gutierrezia sarothrae</i>
Herb (field)	<i>Eriogonum inflatum</i>
Herb (field)	<i>Pleuraphis jamesii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex corrugata</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park
Bromus tectorum, *Halogeton glomeratus*

Globally

Bromus tectorum, *Malcolmia africana*

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Vegetation cover in this association may vary greatly depending on soil chemistry and slope. Some stands should be classified as shrublands with 25-30% shrub cover (Branson et al. 1976, Potter et al. 1985). However, most stands are in the 3-20% shrub cover range and should be classified in a sparsely vegetated alliance (West and Ibrahim 1968, Ibrahim et al. 1972, Harper and Jaynes 1986, Von Loh 2000). Further investigation is needed throughout its range to resolve this issue. *Atriplex corrugata* also occurs as an element in mat saltbush shrublands dominated by other species of *Atriplex* (e.g., *Atriplex gardneri* (including *Atriplex cuneata*) and *Atriplex confertifolia*). It is not always clear in the field where to draw the line between these three classes of mat saltbush shrublands, as the mix of the three species may change with small changes in slope, soil texture, topographic position and aspect.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Sites occupy dissected badland formations with shale soils. Sheet erosion is common. There is some grazing.

Capitol Reef National Park Data: The description is based on 1986 and 2003 field data (8 plots: CARE.0407, CARE.0414, CARE.0428, CARE.9013, CARE.9147, CARE.9183, CARE.9221, CARE.9654).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: K.A. Schulz, mod. J. Coles

REFERENCES: Baker 1984a, Bourgeron and Engelking 1994, Branson 1966, Branson et al. 1967, Branson et al. 1976, CONHP unpubl. data 2003, Collins 1984, Dastrup 1963, Driscoll et al. 1984, Graham 1937, Harper and Jaynes 1986, Ibrahim et al. 1972, Lusby et al. 1963, Potter et al. 1985, Romme et al. 1993, Shantz 1925, Shute and West 1978, Tuhy and MacMahon 1988, U.S. Bureau of Reclamation 1976, Von Loh 2000, Welsh 1957, West and Ibrahim 1968

***Atriplex gardneri* / *Achnatherum hymenoides* Dwarf-shrubland**

Gardner's Saltbush / Indian Ricegrass Dwarf-shrubland

CODE	CEGL001444
PHYSIOGNOMIC CLASS	Dwarf-shrubland (IV)
PHYSIOGNOMIC SUBCLASS	Evergreen dwarf-shrubland (IV.A.)
PHYSIOGNOMIC GROUP	Extremely xeromorphic evergreen dwarf-shrubland (IV.A.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural extremely xeromorphic evergreen dwarf-shrubland (IV.A.2.N.)
FORMATION	Facultatively deciduous subdesert dwarf-shrubland (IV.A.2.N.b.)
ALLIANCE	<i>ATRIPLEX GARDNERI</i> DWARF-SHRUBLAND ALLIANCE (A.1110) Gardner's Saltbush Dwarf-shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Mat Saltbush Shrubland (CES304.783)
Inter-Mountain Basins Shale Badland (CES304.789)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association occurs as small, scattered stands on shale badlands and soils in Utah, Colorado, Montana and possibly Wyoming and Oregon. Stands occupy low hills, plains, mesa tops and swales with gentle to moderate slopes and variable aspects between 1525 and 2200 m (5000-7220 ft.) elevation. The unvegetated surface consists almost entirely of bare ground or shale fragments with little to no litter; in Utah, the surface is modified by a slope wash of gravels from nearby pediments. Soils are shallow, alkaline silty clay loams, derived from marine or freshwater shales of the Chinle, Mancos, Green River, Wasatch, Morrison or other formations. This is generally a sparsely vegetated community, with total vegetation cover rarely exceeding 25% and often as low as 5%. The vegetation is characterized by a sparse canopy of the dwarf-shrub *Atriplex gardneri* with between 1 and 10% cover. Associated shrubs are limited to scattered individuals of *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Ephedra viridis*, *Ephedra torreyana*, *Eriogonum microthecum*, *Krascheninnikovia lanata*, and *Picrothamnus desertorum*, which together may contribute another 5-10% cover to the dwarf-shrub canopy. The herbaceous layer may have greater cover than the shrub layer, up to 25%, but is often reduced as a result of grazing. It generally only contains a few species, among which *Achnatherum hymenoides* is the most conspicuous. Other grasses include *Elymus elymoides*, *Pleuraphis jamesii*, and *Poa secunda*; the forb component is sparse and variable, with species such as *Phlox hoodii*, *Lappula occidentalis*, and *Sphaeralcea* spp. contributing only trace cover.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon in the park. It was sampled in the South Desert just north of the Fremont River and south of Cedar Mesa campground where shale soils are prevalent. It is also found scattered in the Hartnet area and along Halls Creek drainage as it passes through the Mancos shale.

Globally

This association has been reported from southeastern Utah, eastern Montana and northwestern Colorado. It may also occur in southern Wyoming and southeastern Oregon.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This dwarf-shrub association was observed on shale badlands within the park. One stand has become established on a flat site at 1585 m elevation. It occurs on low ridges and slopes in the valley floors. The unvegetated surface is unrecorded. Parent materials are shale of the Morrison and Mancos formations. Soils are fine-textured sandy clays.

Globally

This association occurs as small, scattered stands on shale badlands and related surfaces in Utah, Colorado, Montana and possibly Wyoming and Oregon. Stands occupy low hills, plains, mesa tops and swales with gentle to moderate slopes and variable aspects between 1525 and 2200 m (5000-7220 ft.) elevation. The unvegetated surface consists almost entirely of bare ground or shale fragments with little to no litter. In Utah, the surface is modified by a slope wash of gravels from nearby pediments. Soils are shallow, alkaline silty clay loams, derived from marine or freshwater shales of the Chinle, Mancos, Green River, Wasatch, Morrison or other formations.

VEGETATION DESCRIPTION

Capitol Reef National Park

This dwarf-shrubland association is uncommon within the park. The vegetation is characterized by an open to closed canopy of mat-forming *Atriplex gardneri* dwarf-shrubs, and the bunchgrass *Achnatherum hymenoides*. The associated shrub layer is diverse, providing low to moderate cover, and includes *Chrysothamnus viscidiflorus*, *Ephedra viridis*, and *Ephedra torreyana*. The herbaceous layer is diverse and provides low to moderate cover. Graminoids commonly present include the exotic annual *Bromus tectorum* and the short bunchgrass *Pleuraphis jamesii*. Forbs occasionally present include *Descurainia pinnata*, *Gilia leptomeria*, and *Lappula occidentalis*.

Globally

This is generally a sparsely vegetated community, with total vegetation cover rarely exceeding 25% and often as low as 5%. The vegetation is characterized by a sparse canopy of the dwarf-shrub *Atriplex gardneri* with between 1 and 10% cover. Associated shrubs are limited to scattered individuals of *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Ephedra viridis*, *Ephedra torreyana*, *Eriogonum microthecum*, *Krascheninnikovia lanata*, and *Picrothamnus desertorum*, which together may contribute another 5-10% cover to the dwarf-shrub canopy. The herbaceous layer may have greater cover than the shrub layer, up to 25%, but is often reduced as a result of grazing. It generally only contains a few species, among which *Achnatherum hymenoides* is the most conspicuous. Other grasses include *Elymus elymoides*, *Pleuraphis jamesii*, and *Poa secunda*; the forb component is sparse and variable, with *Phlox hoodii*, *Lappula occidentalis*, and *Sphaeralcea* spp. contributing only trace cover.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Ephedra torreyana</i> , <i>Ephedra viridis</i>
Herb (field)	<i>Atriplex confertifolia</i> , <i>Atriplex gardneri</i> , <i>Chrysothamnus viscidiflorus</i>
Herb (field)	<i>Bassia scoparia</i> , <i>Enceliopsis nudicaulis</i> , <i>Platyschkuhria integrifolia</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Bromus tectorum</i> , <i>Elymus elymoides</i> , <i>Pleuraphis jamesii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex gardneri</i> , <i>Picrothamnus desertorum</i>
Herb (field)	<i>Achnatherum hymenoides</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bassia scoparia, *Bromus tectorum*, *Descurainia pinnata*, *Salsola kali*, *Sisymbrium altissimum*

Globally

Bromus tectorum, *Halogeton glomeratus*, *Salsola kali*

CONSERVATION STATUS RANK

Global Rank & Reasons: G3 (10-Nov-2005). Because grazing tends to eliminate cover by *Achnatherum hymenoides*, this may be the rarest of the *Atriplex gardneri* dwarf-shrubland associations.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: One site has light grazing.

Capitol Reef National Park Data: The description is based on 1986 field data (4 plots: CARE.9021, CARE.9025, CARE.9081, CARE.9130).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Baker 1983c, Baker and Kennedy 1985, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, DeVelice 1992, Driscoll et al. 1984, MTNHP 2002b, Singh and West 1971

***Atriplex gardneri* / *Pleuraphis jamesii* Dwarf-shrubland
Gardner's Saltbush / James' Galleta Dwarf-shrubland**

CODE	CEGL001441
PHYSIOGNOMIC CLASS	Dwarf-shrubland (IV)
PHYSIOGNOMIC SUBCLASS	Evergreen dwarf-shrubland (IV.A.)
PHYSIOGNOMIC GROUP	Extremely xeromorphic evergreen dwarf-shrubland (IV.A.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural extremely xeromorphic evergreen dwarf-shrubland (IV.A.2.N.)
FORMATION	Facultatively deciduous subdesert dwarf-shrubland (IV.A.2.N.b.)
ALLIANCE	<i>ATRIPLEX GARDNERI</i> DWARF-SHRUBLAND ALLIANCE (A.1110) Gardner's Saltbush Dwarf-shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Mat Saltbush Shrubland (CES304.783)
Inter-Mountain Basins Shale Badland (CES304.789)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association occurs on barren shale slopes and flats in the northern Colorado Plateau of Colorado and Utah. The vegetation is generally sparse and consists of an open canopy of dwarf-shrubs consisting primarily or entirely of *Atriplex gardneri* and an open to sparse herbaceous stratum in which *Pleuraphis jamesii* is conspicuous. Other grasses, such as *Achnatherum hymenoides* and *Poa secunda*, and a diversity of forbs that are typical of shale badlands are also usually present with sparse cover. The substrate is fine-textured soil derived from marine shale, but there is often a layer of gravel or small rocks on the ground surface.

DISTRIBUTION

Capitol Reef National Park

This association is fairly common in the southern portions of the park. It is also found occasionally in the Hartnet area in the northern section of the park. It was sampled northeast of The Post and may be found elsewhere within the park where shale soils are prevalent.

Globally

This association is known from the Colorado Plateau of eastern Utah, including the Grand Valley and the Four Corners area of western Colorado.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This dwarf-shrub association was observed on shale badlands within the park. One stand is on a gentle slope (3° slope), at 1890 m elevation, and oriented to the northwest. The unvegetated surface is clay soils. Parent materials are shale of the Morrison and Mancos formations. Soils may be rapidly drained sandy clays.

Globally

This association occurs on slopes of ridges, hills, eroded pediment slopes and badlands of the Colorado Plateau in eastern Utah and western Colorado. Elevation ranges between 1225 and 1975 m (4020-6480 ft.) on slopes from gentle to steep (10-65%). The substrate is a saline, alkaline, well to rapidly drained sandy loam, sandy clay loam, silt loam, clay loam or silty clay derived from marine shale, including the Brushy Basin Member of the Morrison Formation, Chinle shale, Mancos shale, or Moenkopi Formation. The soil surface often has a coating of gravel or small rocks, although large rocks may be present.

VEGETATION DESCRIPTION

Capitol Reef National Park

This dwarf-shrubland association is fairly common in the southern portion of the park. The vegetation is characterized by an open to closed canopy of *Atriplex gardneri* dwarf-shrubs and the short bunchgrass *Pleuraphis jamesii*. The canopy tree *Juniperus osteosperma* was present in each sampled stand; however, this association is typically found without *Juniperus osteosperma*. *Pinus edulis* was present in one stand. The associated shrub layer can be diverse, providing low to moderate cover, and may include the short shrubs *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, and *Shepherdia rotundifolia*. Associated dwarf-shrubs provide low cover and may include *Artemisia bigelovii*, *Atriplex confertifolia*, *Gutierrezia microcephala*, and *Xylorhiza tortifolia*. The herbaceous layer is diverse and provides sparse to low cover. Graminoids commonly present include the bunchgrass *Achnatherum hymenoides*. Forbs occasionally present include *Astragalus amphioxys* and *Lappula occidentalis*.

Globally

This association occurs on alkaline shale badlands, often where the soil surface is modified by a layer of gravel or small rocks. The vegetation is characterized by a typically sparse canopy (1-10% cover) of *Atriplex gardneri* with a sparse to moderate understory of the short bunchgrass *Pleuraphis jamesii*. Total vegetation is generally sparse, rarely exceeding 20%. Occasionally stands have an open to closed canopy of *Atriplex gardneri* dwarf-shrubs. Other low shrubs and cacti are often present with low cover, including *Atriplex confertifolia*, *Artemisia bigelovii*, *Artemisia nova*, *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Ephedra torreyana*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Opuntia polyacantha*, *Picrothamnus desertorum*, *Sclerocactus whipplei*, *Shepherdia rotundifolia*, or *Yucca angustissima*. Scattered *Juniperus osteosperma* trees may also be present. The generally sparse herbaceous layer is composed of a mixture of grasses and forbs. *Pleuraphis jamesii*, *Achnatherum hymenoides*, and *Poa secunda* are the most abundant grasses. A diversity of forbs that are typical of shale badlands is also usually present with sparse cover, including *Astragalus amphioxys*, *Astragalus mollissimus*, *Calochortus nuttallii*, *Cymopterus purpurascens*, *Eriogonum inflatum*, *Lappula occidentalis*, *Oenothera caespitosa*, *Plantago patagonica*, *Platyschukhria integrifolia*, *Sphaeralcea coccinea*, *Sphaeralcea leptophylla*, and *Xylorhiza venusta*. Biological soil crusts provide as much as 25% cover.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Ericameria nauseosa</i> , <i>Shepherdia rotundifolia</i>
Herb (field)	<i>Artemisia bigelovii</i> , <i>Atriplex confertifolia</i> , <i>Atriplex gardneri</i> , <i>Chrysothamnus viscidiflorus</i> , <i>Gutierrezia microcephala</i> , <i>Xylorhiza tortifolia</i>
Herb (field)	<i>Astragalus amphioxys</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Pleuraphis jamesii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex gardneri</i>
Herb (field)	<i>Pleuraphis jamesii</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Descurainia pinnata*, *Sonchus asper*

Globally

Ceratocephala testiculata, *Malcolmia africana*

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: One site has light grazing.

Capitol Reef National Park Data: The description is based on 1986 field data (3 plots: CARE.9038, CARE.9218, CARE.9323).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Ibrahim et al. 1972, Singh and West 1971, U.S. Bureau of Reclamation 1976, Utah Environmental and Agricultural Consultants 1973, West and Ibrahim 1968, Western Ecology Working Group n.d.

***Atriplex gardneri* / *Xylorhiza venusta* Dwarf-shrubland
Gardner's Saltbush / Charming Woody-aster Dwarf-shrubland**

CODE	CEGL001446
PHYSIOGNOMIC CLASS	Dwarf-shrubland (IV)
PHYSIOGNOMIC SUBCLASS	Evergreen dwarf-shrubland (IV.A.)
PHYSIOGNOMIC GROUP	Extremely xeromorphic evergreen dwarf-shrubland (IV.A.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural extremely xeromorphic evergreen dwarf-shrubland (IV.A.2.N.)
FORMATION	Facultatively deciduous subdesert dwarf-shrubland (IV.A.2.N.b.)
ALLIANCE	<i>ATRIPLEX GARDNERI</i> DWARF-SHRUBLAND ALLIANCE (A.1110) Gardner's Saltbush Dwarf-shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Mat Saltbush Shrubland (CES304.783)
Inter-Mountain Basins Shale Badland (CES304.789)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This dwarf-shrub association occurs on badland topography developed in marine shales in southeastern Utah and is likely to occur in similar habitats in western Colorado. Stands occupy low ridges and the sides of pediments with gentle to moderate slopes and variable aspects between approximately 1300 and 1500 m elevation. The unvegetated surface consists almost entirely of bare ground with little to no litter. Soils are shallow, silty clay-textured, and derived from shales of the Mancos or Morrison formations. The vegetation is characterized by a sparse canopy of the dwarf-shrub *Atriplex gardneri* with between 1 and 15% cover. Sometimes *Atriplex gardneri* is the only shrub present, but more often the shrub layer includes scattered individuals of *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Eriogonum bicolor*, *Krascheninnikovia lanata*, and *Picrothamnus desertorum*. The herbaceous layer generally only contains a few species, among which *Xylorhiza venusta* is the most conspicuous. Other forbs include *Eriogonum cernuum*, *Eriogonum inflatum*, *Sphaeralcea* spp., and *Machaeranthera grindelioides*; grasses provide only trace cover.

DISTRIBUTION

Capitol Reef National Park

This association is rare in the park. It was sampled east of Cedar Mesa campground. It also occurs east of the Burr Trail Switchback in the Mancos shale where it very likely continues south outside the park boundary.

Globally

This association has been described only from southeastern Utah. It may also occur on Mancos shale badlands in western Colorado.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This dwarf-shrub association was observed on shale badlands in the southern portion of the park. The sampled site occurs on low slopes and ridges in the Mancos shale. It can be found on variable exposures and around 1500 m elevation. The unvegetated surface is typically Mancos or Morrison clays, with little to no litter. Parent materials are shale of Morrison and Mancos formations. Soils are clays.

Globally

This dwarf-shrub association occurs on badland topography developed in marine shales in southeastern Utah and is likely to occur in similar habitats in western Colorado. Stands occupy low ridges and pediments with gentle to moderate slopes and variable aspects between approximately 1300 and 1500 m (4265-4920 ft.) elevation. The unvegetated surface consists almost entirely of bare ground with little to no litter. Soils are shallow, silty clay-textured, and derived from shales of the Mancos or Morrison formations.

VEGETATION DESCRIPTION

Capitol Reef National Park

This dwarf-shrubland association is rare within the park. The vegetation is characterized by an open to closed canopy of *Atriplex gardneri* dwarf-shrubs and the forb *Xylorhiza venusta*. The associated shrub layer is diverse, providing low to moderate cover, and includes *Chrysothamnus viscidiflorus*. The herbaceous layer is diverse, but with no one species providing greater than 1% cover.

Globally

This association is apparently restricted to Mancos shale badlands in the Colorado Plateau of southeastern Utah and possibly western Colorado. The vegetation is characterized by a sparse canopy of the dwarf-shrub *Atriplex gardneri* with between 1 and 15% cover. The associated shrub layer is diverse, providing low to moderate cover, and includes *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Eriogonum bicolor*, *Krascheninnikovia lanata*, and *Picrothamnus desertorum*. The herbaceous layer generally only contains a few species, among which *Xylorhiza venusta* is the most conspicuous. Other forbs include *Eriogonum cernuum*, *Eriogonum inflatum*, *Sphaeralcea* spp., and *Machaeranthera grindelioides*; grasses provide only trace cover.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex gardneri</i> , <i>Chrysothamnus viscidiflorus</i>
Herb (field)	<i>Phacelia crenulata</i> , <i>Xylorhiza venusta</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex gardneri</i>
Herb (field)	<i>Xylorhiza venusta</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Malcolmia africana

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Data are not available.

Capitol Reef National Park Data: The description is based on 1986 field data (1 plot: CARE.9047).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Singh and West 1971, West and Ibrahim 1968,

***Atriplex gardneri* Dwarf-shrubland
Gardner's Saltbush Dwarf-shrubland**

CODE	CEGL001438
PHYSIOGNOMIC CLASS	Dwarf-shrubland (IV)
PHYSIOGNOMIC SUBCLASS	Evergreen dwarf-shrubland (IV.A.)
PHYSIOGNOMIC GROUP	Extremely xeromorphic evergreen dwarf-shrubland (IV.A.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural extremely xeromorphic evergreen dwarf-shrubland (IV.A.2.N.)
FORMATION	Facultatively deciduous subdesert dwarf-shrubland (IV.A.2.N.b.)
ALLIANCE	<i>ATRIPLEX GARDNERI</i> DWARF-SHRUBLAND ALLIANCE (A.1110) Gardner's Saltbush Dwarf-shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Mat Saltbush Shrubland (CES304.783)
Inter-Mountain Basins Shale Badland (CES304.789)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This dwarf-shrubland association is reported from northern and eastern Utah, western Colorado and Montana. Sites are flat to steep (58%). Soils are calcareous, alkaline, and typically saline and fine-textured. One site has a gravelly/cobbly substrate. Total vegetation cover is generally sparse, rarely exceeding 15%. The vegetation is composed solely of or dominated by *Atriplex gardneri* without an herbaceous layer. Associated shrubs may include minor cover of *Atriplex confertifolia*, *Atriplex corrugata*, *Chrysothamnus viscidiflorus*, *Ephedra torreyana*, *Eriogonum corymbosum*, *Gutierrezia sarothrae*, *Picrothamnus desertorum*, *Sarcobatus vermiculatus*, and/or *Tetradymia spinosa*. No herbaceous layer is reported, though scattered grasses such as *Achnatherum hymenoides*, *Pleuraphis jamesii*, and *Elymus elymoides* may be present. Invasive species such as *Bromus tectorum*, *Halogeton glomeratus*, and *Malcolmia africana* are present in some stands. Biological soil crusts may cover as much as 50% of the ground surface. The dominance of *Atriplex gardneri* and the lack of a significant herbaceous layer are diagnostic of this association.

DISTRIBUTION

Capitol Reef National Park

This association is fairly common in the park. It was sampled at The Castle, near The Post, east of Rockwater Spring, and in Divide Canyon within the park.

Globally

This dwarf-shrubland association is reported from northern and eastern Utah, western Colorado and Montana, but likely has a wider distribution in the interior West. *Atriplex gardneri* is common on shales that cover large areas of the Colorado Plateau, such as the Moenkopi, Mancos, and Morrison formations.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This dwarf-shrub association was observed on alluvial fans, slopes, and ridges of shale badlands within the park.

Sites are gentle to steep (2 to 32° slopes), occur between 1524 and 1802 m elevation, and are oriented to southwestern and northwestern aspects. The unvegetated surface has high exposure of bare soil and low to high exposure of gravel. Litter is typically sparse, less than 10% cover. Parent materials are shale of the Mancos, Morrison, and Moenkopi formations. Soils are rapidly drained sandy loams, silt loams, and clays.

Globally

This dwarf-shrubland association is reported from northern and eastern Utah, western Colorado and Montana. Elevation ranges from 1311-1802 m. Climate is temperate and semi-arid. Utah stands occur in Curlew Valley, a dry Pleistocene lakebed north of the Great Salt Lake, and alluvial fans and hillsides along the Green River and slopes of badland ridges and canyon sides, colluvial slopes, ridges, hills, badlands, mesas, and benches along the Colorado River. Sites are flat to steep (58%). Soils are calcareous, alkaline, and typically saline and fine-textured, often derived from alluvium or shale from Chinle, Moenkopi, Mancos, and Morrison formations. One site has a gravelly/cobbly substrate. Bare soil covers much of the unvegetated surface.

VEGETATION DESCRIPTION

Capitol Reef National Park

This association is fairly common within badlands formations of the park. The vegetation is characterized by an open canopy of *Atriplex gardneri* dwarf-shrubs that range in cover from 5 to 15%. The associated dwarf-shrub layer is low in species diversity, provides sparse to low cover, and includes *Atriplex confertifolia* and *Ephedra torreyana*. The herbaceous layer is low in species composition, provides sparse cover, and is typified by the forb *Eriogonum inflatum*. Graminoids are often absent from stands.

Globally

This association is broadly defined as a dwarf-shrubland composed solely of or dominated by *Atriplex gardneri* without an herbaceous layer. Total vegetation is generally sparse, rarely exceeding 15%, and sometimes as low as 1%. Associated shrubs may include scattered *Atriplex confertifolia*, *Atriplex corrugata*, *Chrysothamnus viscidiflorus*, *Ephedra torreyana*, *Eriogonum corymbosum*, *Gutierrezia sarothrae*, *Picrothamnus desertorum*, *Sarcobatus vermiculatus*, and/or *Tetradymia spinosa*. No herbaceous layer is reported, though scattered clumps of grass such as *Achnatherum hymenoides*, *Pleuraphis jamesii*, and *Elymus elymoides* or occasional *Eriogonum inflatum* may be present. Invasive species such as *Bromus tectorum*, *Halogeton glomeratus*, and *Malcolmia africana* are present in some stands. Biological soil crusts may cover up to 50% of the ground surface; those stands that are protected from grazing are advanced in development and include *Collema* sp., *Fulgensia* sp., *Psora* sp., mosses, and dark cyanobacteria. The dominance of *Atriplex gardneri* and the lack of a significant herbaceous layer are diagnostic of this association.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex confertifolia</i> , <i>Atriplex gardneri</i> , <i>Chrysothamnus viscidiflorus</i> , <i>Ephedra torreyana</i> , <i>Eriogonum corymbosum</i> , <i>Gutierrezia sarothrae</i>
Herb (field)	<i>Eriogonum inflatum</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex gardneri</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Salsola tragus*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This association is poorly defined and is only referred to as a "pure, evidently stable stand of saltsage" in Mitchell et al. (1966). Mitchell et al. (1966) investigated the relatively sharp boundaries between the *Atriplex gardneri* and the *Krascheninnikovia lanata* communities at their study site; no edaphic factor was identified to explain the abrupt change. This association is separated from other *Atriplex gardneri*-dominated associations by the lack of codominant shrubs or significant herbaceous layer. This may be a seral community in areas with a history of over-grazing by livestock. More classification work is needed to further define this association.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Badlands soils are subject to sheet erosion on slopes. One site has light grazing.

Capitol Reef National Park Data: The description is based on 1986 and 2003 field data (9 plots: CARE.0405, CARE.0408, CARE.0460, CARE.0517, CARE.9020, CARE.9039, CARE.9085, CARE.9219, CARE.9222).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: K.A. Schulz, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, Branson et al. 1976, Driscoll et al. 1984, Gates et al. 1956, Johnston 1987, MTNHP 2002b, MTNHP unpubl. data, Mitchell et al. 1966, Von Loh 2000,

***Artemisia frigida* - (*Bouteloua gracilis*, *Achnatherum hymenoides*, *Poa secunda*) - Lichens
Rocky Mesa Dwarf-shrubland
Fringed Sagebrush - (Blue Grama, Indian Ricegrass, Curly Bluegrass) - Lichens Rocky
Mesa Dwarf-shrubland**

CODE	CEGL002344
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	<i>ARTEMISIA FRIGIDA</i> DWARF-SHRUBLAND ALLIANCE (A.2565) Fringed Sagebrush Dwarf-shrubland Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This shrubland association is described from the Colorado Plateau and western slope of the southern Rocky Mountains and is typically found on exposed, wind-blown sites. Stands occur on mid to upper slopes and tops of mesas, hills and ridges, but also occurs on midslopes of mountains, active slopes and on valley terraces. Site are flat to moderately steep (to 53 % slope) on all aspects between 2315 and 2965 m elevation. Various amounts of bedrock, large and small rocks, and bare soil compose the majority of the ground surface, with sparse to low cover of litter. Parent materials are frequently volcanic (basalt) rocks that are present as bedrock, boulders and gravel, Mesozoic shale, and Quaternary landslide deposits. Soils are shallow, rapidly drained and range from coarse sand and sandy loam to sandy clay loam and sandy clay. The sparse to dense vegetation (4-85% cover) is characterized by the presence of *Artemisia frigida*, a suffrutescent plant that occurs as both a dwarf-shrub and forb. The other characteristic species are perennial graminoids *Bouteloua gracilis*, *Achnatherum hymenoides*, and *Poa secunda*, ranging from absent to 35% cover. Other common shrubs and dwarf-shrubs include *Artemisia nova*, *Chrysothamnus viscidiflorus*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Tetradymia canescens*, and the cactus *Pediocactus simpsonii*. The herbaceous layer is sparse to moderate and often composed of low-growing cushion plants. Species are often diverse, but have sparse to low cover, and may include *Festuca brachyphylla*, *Hymenoxys richardsonii*, *Paronychia sessiliflora*, *Penstemon strictus*, *Poa fendleriana*, *Stenotus armerioides*, *Stephanomeria spinosa*, and

Tetranneuris torreyana. Cryptogam cover varies from low to moderate and is occasionally as high as 55%, mostly composed of crustose and foliose lichens.

DISTRIBUTION

Capitol Reef National Park

This association has not been found in the park to date but was sampled on rocky basalt substrates of Billings Pass, north of Billings Pass, and Deep Creek Ridge adjacent to the park boundary.

Globally

This dwarf-shrubland association is described from the Colorado Plateau and western slope of the southern Rocky Mountains.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This dwarf-shrub association was observed on midslopes of mountains and ridges and knobs of plateaus in the northwestern corner of the park. Sample sites are flat to moderately steep (0 to 13° slopes), occur between 2798 and 2965 m elevation, and occupy northeastern to southeastern aspects. The unvegetated surface has moderate to high cover of gravel and low to moderate cover of large rocks. Litter is sparse to low in cover. Some sites have lichens providing high cover between shrubs. Parent materials are volcanic basalt rocks that are present as boulders and gravel. Soils are rapidly drained clay loams to sandy clays.

Globally

This shrubland association is described from the Colorado Plateau and western slope of the southern Rocky Mountains and is typically found on exposed, wind-blown sites. Stands occur on mid to upper slopes and tops of mesas, hills and ridges, but also midslopes of mountains, active slopes and on valley terraces. Site are flat to moderately steep (to 53 % slope) on all aspects between 2315 and 2965 m elevation. Various amounts of bedrock, large and small rocks, and bare soil compose the majority of the ground surface, with sparse to low cover of litter. Parent materials are frequently volcanic (basalt) rocks that are present as bedrock, boulders and gravel, Mesozoic shale, and Quaternary landslide deposits. Soils are shallow, rapidly drained and range from coarse sand and sandy loam to sandy clay loam and sandy clay. Lichens often provide high cover between shrubs.

VEGETATION DESCRIPTION

Capitol Reef National Park

This association is not known from the park to date but was sampled within the one-mile buffer adjacent to the park. It occurs on volcanic exposures. The total vegetation cover ranges from 9 to 85% in these sparsely to moderately vegetated stands. This dwarf-shrub association is characterized by *Artemisia frigida* that ranges in cover from 5 to 25%. The remaining short- and dwarf-shrub layer is low in terms of species composition, provides sparse cover, and includes *Artemisia nova*, *Chrysothamnus viscidiflorus*, and *Tetradymia canescens*. Associated graminoids are low to moderate in diversity, provide low to moderate cover, and include *Bouteloua gracilis*, *Elymus elymoides*, *Elymus lanceolatus*, *Festuca ovina*, and *Poa fendleriana*. Forbs are moderate to high in species diversity, provide sparse cover, and include *Allium cernuum*, *Erigeron* sp., *Hymenoxys richardsonii*, *Stephanomeria spinosa*, *Paronychia sessiliflora*, and *Penstemon strictus*. Various species of lichens cover the inter-shrub spacing.

Globally

This association has sparse to dense vegetation (4-85% cover) and is characterized by the presence of *Artemisia frigida*, a suffrutescent plant that occurs as both a dwarf-shrub and forb. The other characteristic species are perennial graminoids *Bouteloua gracilis*, *Achnatherum hymenoides*, and *Poa secunda*, ranging from absent to 35% cover. Other common shrubs and dwarf-shrubs include *Artemisia nova*, *Chrysothamnus viscidiflorus*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Tetradymia canescens*, and the cactus *Pediocactus simpsonii*. The herbaceous layer is sparse to moderate and often composed of low-growing cushion plants. Species are often diverse, but have sparse to low cover, and may include *Allium cernuum*, *Elymus elymoides*, *Elymus lanceolatus*, *Erigeron* sp., *Eriogonum* spp., *Festuca brachyphylla*, *Hymenoxys richardsonii*, *Paronychia sessiliflora*, *Penstemon strictus*, *Poa fendleriana*, *Stenotus armerioides*, *Stephanomeria spinosa*, and *Tetranneuris torreyana*. Cryptogam cover varies from low to moderate and is occasionally as high as 55%, mostly composed of crustose and foliose lichens.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Chrysothamnus viscidiflorus</i>
Herb (field)	<i>Artemisia frigida</i> , <i>Artemisia nova</i>
Herb (field)	<i>Hymenoxys richardsonii</i> , <i>Paronychia sessiliflora</i>
Herb (field)	<i>Bouteloua gracilis</i> , <i>Carex duriuscula</i> , <i>Elymus lanceolatus</i> , <i>Festuca ovina</i> , <i>Poa fendleriana</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Artemisia frigida</i> , <i>Gutierrezia sarothrae</i> , <i>Krascheninnikovia lanata</i>
Herb (field)	<i>Hymenoxys richardsonii</i> , <i>Paronychia sessiliflora</i> , <i>Stenotus armerioides</i> , <i>Tetranneuris torreyana</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Bouteloua gracilis</i> , <i>Carex duriuscula</i> , <i>Elymus lanceolatus</i> , <i>Poa fendleriana</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park
Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (17-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park
Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE:

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Sites are grazed by cattle and elk. The ground surface is comprised of volcanic boulders, thin soils, and pebbles.

Capitol Reef National Park Data: This description is based on 1987 and 2004 field data (6 plots: CARE.0661, CARE.0708, CARE.0713, CARE.0723, CARE.9700, CARE.9702).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: K.A. Schulz

REFERENCES: Western Ecology Working Group n.d.

***Eriogonum leptocladon* / *Muhlenbergia pungens* Shrubland [Provisional]
Sand Wild Buckwheat / Sandhill Muhly Shrubland**

CODE	CEGL002821
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	<i>ERIOGONUM (CORYMBOSUM, LEPTOCLADON) DWARF-SHRUBLAND ALLIANCE</i> (A.1126) (Crispleaf Wild Buckwheat, Sand Wild Buckwheat) Dwarf-shrubland Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Blackbrush-Mormon-tea Shrubland (CES304.763)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association is only known from Capitol Reef National Park; this summary is derived from 1986 plot data. It occurs on sand dunes and to a lesser extent adjacent sand sheets. The site slopes gently (3%) to the west at 1738 m elevation. The well-drained soil is sandy and is derived from eolian deposits. Total vegetation cover does not exceed 50% and is characterized by an open canopy of *Eriogonum leptocladon* with about 15% cover and by *Muhlenbergia pungens* with 5-10% cover. Associated shrubs providing low to moderate cover include *Ephedra torreyana*, *Artemisia bigelovii*, and *Gutierrezia sarothrae*. The herbaceous layer provides low to moderate cover. Associated herbaceous species include *Cirsium calcareum*, *Pleuraphis jamesii*, and the exotic *Tragopogon dubius*.

DISTRIBUTION

Capitol Reef National Park

This association is rare and was sampled in the vicinity of Solomons Temple in the northern portion of the park.

Globally

This association is known only from Capitol Reef National Park. It may occur sporadically elsewhere in the Colorado Plateau in habitats with blowing sand.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on sand dunes occupying low hills surrounding sandy lowlands. The site is gentle (2° slope), occurs at 1738 m elevation, and is oriented to the west. The unvegetated surface is unrecorded. Parent materials are variable and include sandstones and shale eroded from the Entrada Formation and wind blown to form eolian deposits. Soils are well-drained and sandy in texture.

Globally

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

VEGETATION DESCRIPTION

Capitol Reef National Park

This short-shrub association is rare on sand hills in the northern portion of the park. The total vegetation cover does not exceed 50%. This shrubland association is characterized by an open to relatively closed canopy of *Eriogonum leptocladon* short shrubs that range in cover from 10-20% and by the ring-forming *Muhlenbergia pungens* with 5-10% cover. Associated shrubs providing low to moderate cover include the dwarf-shrub *Ephedra torreyana*, *Artemisia bigelovii*, and *Gutierrezia sarothrae*. The herbaceous layer provides low to moderate cover. Associated grasses are moderately diverse and provide sparse to low cover. The most abundant forbs include *Cirsium calcareum*, *Pleuraphis jamesii*, and the exotic *Tragopogon dubius*.

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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Eriogonum leptocladon</i>
Herb (field)	<i>Gutierrezia sarothrae</i>
Herb (field)	<i>Tragopogon dubius</i>
Herb (field)	<i>Muhlenbergia pungens</i>

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Salsola tragus, *Tragopogon dubius*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (25-Aug-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Taxonomically *Eriogonum corymbosum* Benth. is a huge and complex species group involving numerous variants and putative hybrids with *E. lonchophyllum*, *E. leptocladon*, and *E. brevicaule* (Welsh 1993). As the ecological amplitude of the taxon is broad, occurring on sites ranging from sand deposits to rocky mesas and clayey badlands, it seems appropriate to include associations characterized by related taxa such as *Eriogonum lonchophyllum*, *Eriogonum leptocladon*, and *Eriogonum brevicaule* in the same alliance.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: The site experiences moderate grazing. It represents a very continuous community established on sandy soils and a few angular gravel spots.

Capitol Reef National Park Data: The description is based on 1986 field data (1 plot: CARE.9054).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Achnatherum hymenoides* Colorado Plateau Herbaceous Vegetation**
Indian Ricegrass Colorado Plateau Herbaceous Vegetation

CODE	CEGL002343
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	<i>ACHNATHERUM HYMENOIDES</i> HERBACEOUS ALLIANCE (A.1262) Indian Ricegrass Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This herbaceous vegetation association usually occurs in small patches (<1 hectare) on upland eolian sand deposits, as well as on sandy alluvial terraces and point bars along intermittent washes in eastern Utah and northwestern Colorado. It is likely to occur in small patches throughout the Colorado Plateau. Disturbance is usually a factor; upland sites often have blowing sand, and wash sites are subject to periodic flooding. Sites are flat to gently sloping (not exceeding 10%) between 1220 and 1815 m elevation. The unvegetated surface has high cover by bare soil or sand, low cover by litter, and biological soil crusts may have up to 30% cover. Soils are rapidly drained sands or sandy loams derived from alluvium or eolian deposits. Total vegetation cover in upland sites with blowing sand is usually quite sparse, rarely exceeding 10%. Sites on sandy terraces and point bars may have as much as 30% cover by vascular plants, with another 25% cover provided by biological soil crusts. *Achnatherum hymenoides* is the dominant species, ranging in cover between 3 and 15%. A scattering of shrubs may be present, with no species exceeding 1% cover and the total not exceeding 5% cover. Associated shrubs include *Amsonia tomentosa*, *Artemisia*

filifolia, *Atriplex canescens*, *Ephedra torreyana*, *Ephedra viridis*, *Poliomintha incana*, *Vancleavea stylosa*, *Gutierrezia sarothrae*, and *Opuntia polyacantha*. Some stands may contain scattered *Juniperus osteosperma* trees or saplings. Associated graminoids include the short bunch grasses *Aristida purpurea*, *Sporobolus cryptandrus*, and *Pleuraphis jamesii*. Forbs present include *Abronia fragrans* and *Sphaeralcea parvifolia*.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon and was sampled in the Halls Creek drainage, in Capitol Gorge, and along Spring Canyon Trail within the park.

Globally

This association is documented from eastern Utah and northwestern Colorado. It is likely to occur in small stands, 0.1 to 1 ha in size, scattered throughout the Colorado Plateau.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This herbaceous vegetation association was observed on stream terraces and sandy deposits in canyons that rarely flood. Sites are flat to gentle (0 to 6° slopes), occur between 1220 and 1829 m elevation, and are oriented to eastern aspects. The unvegetated surface has low to moderate cover of litter and exposure of bare soil. The basal area of live plants provides moderate cover. Parent materials are variable and include sandstones of the Entrada Formation and Kayenta Formation that are distributed as alluvial deposits. Soils are rapidly to well-drained loamy sands.

Globally

This herbaceous vegetation association occurs on upland eolian sand deposits, as well as on sandy alluvial terraces and point bars along intermittent washes in eastern Utah and northwestern Colorado. It is likely to occur in small patches throughout the Colorado Plateau. Sites are flat to gently sloping (not exceeding 10%) between 1220 and 1815 m elevation. The unvegetated surface has high cover by bare soil or sand, low cover by litter, and biological soil crusts may have up to 30% cover. Soils are rapidly drained sands or sandy loams derived from alluvium or eolian deposits.

VEGETATION DESCRIPTION

Capitol Reef National Park

This association is uncommon along sandy drainages within the park. The total vegetation cover ranges from 27 to 75% cover. This grassland association is characterized by the tall bunchgrass *Achnatherum hymenoides* that ranges in cover from 25 to 65%. The shrub layer is low in terms of species diversity and provides sparse cover. Associated short and dwarf-shrubs include *Ephedra viridis*, *Eriogonum microthecum*, *Gutierrezia sarothrae*, and *Opuntia polyacantha*. The herbaceous layer is low in terms of species diversity and provides low to moderate cover. Associated graminoids include *Bouteloua gracilis*, *Bromus tectorum*, *Hesperostipa comata*, and *Vulpia octoflora*. Forbs present include *Artemisia ludoviciana* and *Erodium cicutarium*. Cryptogams can be present and provide as much as 20% cover.

Globally

Small patches (usually less than 1 hectare) of this distinctive grassland type occur sporadically in the Colorado Plateau of southeastern Utah. Total vegetation cover in upland sites with blowing sand rarely exceeds 10%. Sites on sandy terraces and point bars may have up to 30% cover by vascular plants, with another 25% cover provided by biological soil crusts. *Achnatherum hymenoides* is the dominant species, ranging in cover between 3 and 15%. A scattering of shrubs may be present, with no species exceeding 1% cover and the total not exceeding 5% cover. Associated shrubs include *Amsonia tomentosa*, *Artemisia filifolia*, *Atriplex canescens*, *Ephedra torreyana*, *Ephedra viridis*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, *Poliomintha incana*, and *Vancleavea stylosa*. Some stands may contain scattered *Juniperus osteosperma* trees or saplings. Associated graminoids include the short bunch grasses *Aristida purpurea*, *Sporobolus cryptandrus*, and *Pleuraphis jamesii*. Forbs present include *Abronia fragrans* and *Sphaeralcea parvifolia*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Ephedra nevadensis</i> , <i>Ephedra viridis</i>

Herb (field) *Eriogonum microthecum, Gutierrezia sarothrae*
Herb (field) *Amsonia tomentosa* var. *stenophylla*, *Artemisia ludoviciana*, *Erodium cicutarium*,
Lepidium montanum, *Machaeranthera canescens*, *Machaeranthera tanacetifolia*
Herb (field) *Achnatherum hymenoides*, *Bouteloua gracilis*, *Bromus tectorum*, *Hesperostipa comata*

Globally

Stratum

Species

Herb (field) *Achnatherum hymenoides*

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Erodium cicutarium*

Globally

Bromus tectorum, *Salsola tragus*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (16-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Occupies sandy canyon floors that do not flood often and on sand dunes. Cryptobiotic crusts stabilize soils on some stands.

Capitol Reef National Park Data: The description is based on 1986, 2003, and 2004 field data (4 plots: CARE.0509, CARE.0618, CARE.9089, CARE.9358).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***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	<i>HESPEROSTIPA COMATA</i> BUNCH HERBACEOUS ALLIANCE (A.1270) 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 grassland occurs on the Great Basin and Colorado Plateau east into the western slope of the southern Rocky Mountains. Stands are found on plains, gentle hill slopes, knolls and bluffs, mesa tops, and plateau parks. Substrates are variable and include sand, cobbles, clay loams and silty clay. This association is characterized by a relatively sparse to moderate herbaceous layer (10-40% cover) strongly dominated by the cool-season bunchgrass

Hesperostipa comata. Low cover of other grasses, such as *Achnatherum hymenoides*, *Achnatherum lettermanii*, *Aristida purpurea*, *Elymus elymoides*, *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 species may be diverse and include species of *Artemisia*, *Balsamorhiza*, *Cirsium*, *Gilia*, *Hymenopappus*, *Lappula*, *Machaeranthera*, and *Vicia*. Scattered shrubs and dwarf-shrubs may be present with less than 5% total cover. The widespread introduced annual grass *Bromus tectorum* often contributes significant cover in disturbed stands. Some stands have high cover of cryptogams on the soil.

DISTRIBUTION

Capitol Reef National Park

This association was sampled on a high slope in Little Sand Flats in an area protected from heavy grazing. Other sites of this association occur primarily in the northern portion of the Waterpocket Fold within the park. They are found in similar locations of sandy basins within the Navajo sandstone or, in the southern end of the park, in pockets within the Entrada sandstone. A large area of this association occurs on Johnson Mesa just south of Fruita.

Globally

This grassland is found in the Colorado Plateau and Great Basin in Colorado and Utah and will probably occur in adjacent states.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This herbaceous association is found scattered throughout the Waterpocket Fold and in protected locations in the Halls Creek drainage. The one sample plot was observed on a high slope on the west side of Little Sand Flat. The site is gentle (2° slope), occurs at 1982 m elevation, and is oriented to a northeastern aspect. The unvegetated surface consists of sandy soils and litter cover. Parent materials are sandstones and shale that have been eroded and redistributed in alluvial and eolian deposits.

Globally

This grassland occurs on the Colorado Plateau and Great Basin. Elevation ranges from 1250-2320 m. Stands are found on point bars, stream terraces, in sand-filled potholes in slickrock washes and on plains, gentle hill slopes, knolls and bluffs, mesa tops, and plateau parks. Substrates are variable and include sand, cobbles, clay loams and silty clay derived from eolian or alluvial deposits. Fires may be important in maintaining these grasslands by reducing woody cover, but burning during the growing season could also damage the *Hesperostipa comata* plants.

VEGETATION DESCRIPTION

Capitol Reef National Park

This rare grassland is scattered throughout the park. The vegetation is characterized by the bunchgrass *Hesperostipa comata*. An associated stoloniferous grass present in low abundance is *Bouteloua gracilis*. Forbs are diverse but are sparse in cover. The shrub layer is relatively diverse and provides sparse to moderate cover. The succulent *Opuntia polyacantha* is present to common. Scattered *Juniperus osteosperma* and *Pinus edulis* may be present.

Globally

This association is characterized by a relatively sparse to moderate herbaceous layer (10-40% cover) strongly dominated by the cool-season bunchgrass *Hesperostipa comata*, but 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*, *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 species include *Artemisia campestris*, *Artemisia dracuncululus*, *Artemisia ludoviciana*, *Balsamorhiza sagittata*, *Cirsium arizonicum*, *Cryptantha crassisejala*, *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. *vaseyana*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Opuntia polyacantha*, *Gutierrezia sarothrae*, 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 like *Salsola kali*, *Bassia scoparia*, *Poa pratensis*, and *Sisymbrium altissimum* may be present to abundant. 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

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Shrub/sapling (tall & short)	<i>Opuntia polyacantha</i>
Herb (field)	<i>Bouteloua gracilis, Hesperostipa comata</i>

Globally

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Hesperostipa comata</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Salsola kali

Globally

Cirsium arizonicum

CONSERVATION STATUS RANK

Global Rank & Reasons: G2G4 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

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

Capitol Reef National Park Inventory Notes: Stand experienced heavy grazing.

Capitol Reef National Park Data: The description is based on 1986 field data (1 plot: CARE.9112).

Local Description Authors: J. Von Loh, mod. D. Clark

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, Thilenius et al. 1995, Western Ecology Working Group n.d.

***Sporobolus airoides* Southern Plains Herbaceous Vegetation**

Alkali Sacaton Southern Plains Herbaceous Vegetation

CODE	CEGL001685
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	<i>SPOROBOLUS AIROIDES</i> HERBACEOUS ALLIANCE (A.1267) Alkali Sacaton Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Chihuahuan-Sonoran Desert Bottomland and Swale Grassland (CES302.746)
Inter-Mountain Basins Greasewood Flat (CES304.780)
Western Great Plains Floodplain (CES303.678)
Western Great Plains Saline Depression Wetland (CES303.669)
Western Great Plains Shortgrass Prairie (CES303.672)
Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This alkali sacaton mesic grassland community is found in the southwestern Great Plains, on the Colorado Plateau, in the southwestern United States, and adjacent Mexico. Stands occur on slightly to moderately saline, nearly level bottomlands and terraces. Additional moisture from washes and sheet flow runoff are important for most stands. Substrates are shallow, moderately well to poorly drained, silty clay soils formed in alluvium. The community is dominated by medium-tall and short grasses. *Sporobolus airoides* is a dominant, often accompanied by *Distichlis spicata*, *Symphotrichum subulatum*, *Pascopyrum smithii*, *Buchloe dactyloides*, *Hordeum jubatum*, and *Bouteloua gracilis*. Scattered shrubs, such as *Atriplex* spp. or *Sarcobatus vermiculatus*, may be present. Forb cover is low.

DISTRIBUTION

Capitol Reef National Park

This herbaceous association is rare in the park and is represented by plots sampled in Middle Desert Wash, Jailhouse Rock, and Lower South Desert.

Globally

This alkali sacaton mesic grassland community is found in the southwestern Great Plains, Colorado Plateau and elsewhere in the southwestern United States and Mexico, ranging from Kansas and Colorado south to Texas, New Mexico and west to Arizona, Utah, and possibly California.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This herbaceous association occurs on deep, well-developed soils on canyon bottoms and floodplains. Sites are flat or slope gently between 1700 and 1900 m elevation. Bare soil covers most of the unvegetated surface, with lesser cover by gravel, litter and biological soil crusts, depending on the density of grasses. Soils are well-drained to rapidly drained fine sandy loams or clay loams derived from alluvium.

Globally

This grassland community occurs on alluvial toe slopes and flats, terraces, floodplain depressions, and sandy stream banks and washes in bottomlands throughout the southern Great Plains and Colorado Plateau. Additional moisture from washes and sheet flow runoff are important for most stands. Elevations range from below 1000 m (3050 ft.) to over 2000 m (6100 ft.). Sites are typically flat to gently sloping but may be as steep as 30% slope. Soils are shallow to moderately deep, moderately well to poorly drained, alkaline, and often saline with sandy, silty or clay soils (Francis 1986, Johnston 1987, Kittel et al. 1999a, Lauver et al. 1999, Von Loh et al. 2002). Other parent materials include lava flow, cinders, relict Pleistocene river cobbles, and sandstone.

VEGETATION DESCRIPTION

Capitol Reef National Park

This alkali sacaton grassland grows on canyon bottoms and floodplains within the park. Total vegetation cover ranges from 1 to 55% and is dominated by the bunchgrass *Sporobolus airoides*. Shrubs may be present but do not have enough cover to constitute a stratum (<5%). Common species include *Sarcobatus vermiculatus*, *Gutierrezia sarothrae*, and *Atriplex canescens*. Other herbaceous species present may include *Pleuraphis jamesii*, *Bouteloua gracilis*, *Achnatherum hymenoides*, and *Salsola tragus*.

Globally

This association is characterized by a sparse to moderately dense (15-75% cover), medium-tall graminoid layer dominated by *Sporobolus airoides*. Associated species include *Achnatherum hymenoides*, *Symphotrichum subulatum*, *Buchloe dactyloides*, *Distichlis spicata*, *Hordeum jubatum*, *Bouteloua gracilis*, *Panicum obtusum*, *Pleuraphis jamesii*, *Sphaeralcea* spp., *Sporobolus cryptandrus*, and *Pascopyrum smithii* (Francis 1986, Johnston 1987, Kittel et al. 1999a, Lauver et al. 1999, Von Loh et al. 2002). Scattered shrubs may be present, such as *Atriplex canescens*, *Atriplex confertifolia*, *Ephedra* spp., *Ericameria nauseosa*, *Gutierrezia sarothrae*, or *Sarcobatus vermiculatus*. Total shrub cover is low (<10%), and forb cover is minor.

MOST ABUNDANT SPECIES

Capitol Reef National Park

Stratum

Species

Short shrub/sapling *Gutierrezia sarothrae*
Herb (field) *Sporobolus airoides*

Globally

Stratum Species
Herb (field) *Sporobolus airoides*

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park
Halogeton glomeratus

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G3Q (9-Apr-1998). The number of occurrences is unknown. The community is reported from Arizona, Colorado (S3), Kansas, New Mexico (S2), Texas, Utah, and Mexico and may occur in California. The community is found on slightly to moderately saline, bottomland and terraces with alluvial silty clay soils.

CLASSIFICATION COMMENTS

Capitol Reef National Park
Data are not available.

Globally

Compare this association with *Sporobolus airoides* - *Bouteloua gracilis* Herbaceous Vegetation (CEGL001686) and *Pleuraphis jamesii* - *Sporobolus airoides* Herbaceous Vegetation (CEGL001778). Stands in Montana are placed with *Sporobolus airoides* Northern Plains Herbaceous Vegetation (CEGL002274), which occurs in the northwestern Great Plains, and this type is restricted to the southwestern Great Plains and southwestern United States. In the southeastern Plains see *Distichlis spicata* - (*Hordeum jubatum*, *Poa arida*, *Sporobolus airoides*) Herbaceous Vegetation (CEGL002042).

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Plots are on deep alluvium with only light erosion evident, although small hummocks have formed around the few shrubs present. Soils show cracking at the surface to about 2 cm. wide. Sites are fairly flat, broad floodplains covered consistently with *Sporobolus airoides* and dotted with a mixture of shrubs. Small rocks are scattered on the soil surface.

Capitol Reef National Park Data: The description is based on field data collected in 2005 during accuracy assessment (5 plots: CARE_AA.0548, CARE_AA.0551, CARE_AA.0669, CARE_AA.1008, CARE_AA.1086).

Local Description Authors: J. Coles

Global Description Authors: J. Drake, mod. K. Schulz and J. Coles

REFERENCES: Aldous and Shantz 1924, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Carsey et al. 2003a, Donnelly et al. 2006, Driscoll et al. 1984, Francis 1986, Hansen et al. 2004b, Johnston 1987, Kittel and Lederer 1993, Kittel et al. 1999b, Lauver et al. 1999, Lindauer 1970, Soil Conservation Service 1978, Steward 1982, Von Loh et al. 2002, Western Ecology Working Group n.d.

***Bouteloua eriopoda* - *Pleuraphis jamesii* Herbaceous Vegetation**

Black Grama - James' Galleta Herbaceous Vegetation

CODE	CEGL001751
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	Short sod temperate or subpolar grassland (V.A.5.N.e.)
ALLIANCE	<i>BOUTELOUA ERIOPODA</i> HERBACEOUS ALLIANCE (A.1284)

Black Grama Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Apacherian-Chihuahuan Semi-Desert Grassland and Steppe (CES302.735)
Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This Colorado Plateau desert grassland has been documented from the upper Rio Puerco watershed in northwestern New Mexico, in north-central Arizona and southeastern Utah, and extends south to central New Mexico at Sevilleta National Wildlife Refuge. Stands occur on flat to gently sloping plains, basin floors, mesa tops, and less often on steeply sloping mesa sides. Substrates are variable and include loam to clay-loam soils derived from basalt outcrop, shale, clay and sandstone, and coarser textured soils derived from black cinders and sandstone. *Bouteloua eriopoda* and *Pleuraphis jamesii* dominate the low to moderate herbaceous cover. Associates include low cover of *Aristida purpurea*, *Bouteloua gracilis*, *Hesperostipa neomexicana*, *Muhlenbergia porteri*, *Sporobolus airoides*, and *Sporobolus cryptandrus*. Shrubs are few and scattered and may include *Atriplex canescens*, *Ephedra torreyana*, *Ephedra viridis*, *Ericameria nauseosa*, and *Gutierrezia sarothrae*.

DISTRIBUTION

Capitol Reef National Park

This association is rare, occurring primarily on south-facing slopes in scattered locations throughout the park. The larger known sites are located on the south side of Johnson Mesa, south of Fruita, northwest of Notom on a south-facing slope in the Carmel Formation and the mesa northwest of Ackland Springs. A small site is located at the base of the Airstrip Route into Halls Creek in the southern end of the park.

Globally

This Colorado Plateau association is known from the upper Rio Puerco watershed in northwestern New Mexico, Wupatki National Monument and Petrified Forest National Park in north-central Arizona, and scattered small sites at Capitol Reef National Park in southeastern Utah. It extends south to the Sevilleta National Wildlife Refuge in central New Mexico in the transition zone with the northern Chihuahuan Desert.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This herbaceous association has been observed in only a few locations throughout the park. The one sampled site is moderately steep (26° slope), occurs at 1275 m elevation, and is oriented to a southern exposure. The unvegetated surface has high cover of litter and moderate cover of gravel, rocks and large boulders. Sparse exposure of bare soil is present. Parent materials are volcanic, deposited as landslide and alluvium. Soils are rapidly drained clay loams.

Globally

This Colorado Plateau desert grassland has been documented from the upper Rio Puerco watershed in northwestern New Mexico, in north-central Arizona, and from a single station in southeastern Utah. Elevations range from 1455-1830 m (4770-6000 ft.) at the southern end of the range and at 1275 m on a south-facing slope in Utah. Stands occur on flat to gently sloping plains, basin floors, or steeply sloping mesa sides. Substrates are variable and include weakly developed Entisols and Entisol-Mollisol complexes often with loam to clay-loam soils derived from basalt outcrop, shale, clay and sandstone, and coarser textured soils derived from black cinders and sandstone.

VEGETATION DESCRIPTION

Capitol Reef National Park

This association is extremely rare, known from only a few locations in the park. Total vegetation cover ranges from 102 to 130%. The vegetation is characterized by a closed perennial graminoid canopy of *Bouteloua eriopoda* and *Pleuraphis jamesii* that range in cover from 55 to 65% and 45 to 55%, respectively. Associated herbaceous species are sparse in terms of cover and low in diversity. The annual forb *Phacelia crenulata* provides sparse cover. The short- and dwarf-shrub layer, including succulents, is relatively diverse but provides only sparse cover, less than 10%. The most common shrub, providing less than 5% cover, is *Ephedra viridis*.

Globally

This association is characterized by *Bouteloua eriopoda* and *Pleuraphis jamesii* dominating an open to moderately

dense perennial graminoid layer. Associates include low cover of *Aristida purpurea*, *Bouteloua gracilis*, *Hesperostipa neomexicana*, *Muhlenbergia porteri*, *Sporobolus airoides*, *Sporobolus cryptandrus*, and *Sporobolus flexuosus*. Forb cover and diversity are low. Scattered shrubs may be present, including *Atriplex canescens*, *Ephedra torreyana*, *Ephedra viridis*, *Ericameria nauseosa*, and *Gutierrezia sarothrae* (Francis 1986). The presence of *Bouteloua eriopoda* and *Muhlenbergia porteri*, and its occurrence at Sevilleta National Wildlife Refuge, suggests that this grassland is transitional to Chihuahuan Desert grasslands that begin more than 100 miles to the south.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Ephedra viridis</i>
Herb (field)	<i>Phacelia crenulata</i>
Herb (field)	<i>Bouteloua eriopoda</i> , <i>Pleuraphis jamesii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Gutierrezia sarothrae</i>
Herb (field)	<i>Bouteloua eriopoda</i> , <i>Pleuraphis jamesii</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G3 (14-Nov-2005). This transitional Colorado Plateau-Chihuahuan Desert grassland has had its range significantly reduced by the impacts of livestock grazing over the last 150 years, particularly during years of extreme drought. Few examples remain that have not been significantly impacted by grazing and altered fire regimes. Overall, high-quality occurrences are not likely to exceed 50 in number. Inventory of potential occurrences in both the Chihuahuan Desert and Colorado Plateau ecoregions is needed. The range of this association is not likely to extend much further north than southern Utah, as *Bouteloua eriopoda* is known only from the Colorado River drainage (including the Virgin River) south of Moab.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Limited quantitative documentation exists for this type, outside of plots taken at Capitol Reef National Park, near the northern end of the association's range.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: This association is found only in a few locations in the park. The sampled plot was located on the south slope of Johnson Mesa in an area covered by black lava boulders from a landslide that occurred 60,000 to 100,000 years ago.

Capitol Reef National Park Data: The description is based on 2003 field data (1 plot: CARE.0553).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: E. Muldavin, mod. K.A. Schulz and J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Francis 1986, Hansen et al. 2004b, Muldavin et al. 1998d, Western Ecology Working Group n.d.

***Bouteloua gracilis* - *Hesperostipa comata* Herbaceous Vegetation [Provisional]**

Blue Grama - Needle-and-Thread Herbaceous Vegetation

CODE CEG002932
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 Short sod temperate or subpolar grassland (V.A.5.N.e.)
ALLIANCE *BOUTELOUA GRACILIS* HERBACEOUS ALLIANCE (A.1282)
Blue Grama Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Grassland (CES304.787)
Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This is a poorly documented grassland association currently known from Zion and Capitol Reef National Parks in Utah. It is found primarily on gently sloping to flat mesa tops or valley bottoms. Elevation range is not well established but ranges from 1715 m in Capitol Reef to 2260 m in Zion. Soils are coarse textured loamy sands. In valley bottoms the soils are derived from alluvium. The soil surface may have some plant litter; biological crusts are rarely present. Stands tend to be small, patchy, and patterned in a mosaic with scattered shrubs, or adjacent to pinyon-juniper woodlands. It is a grassland, with *Bouteloua gracilis* and *Hesperostipa comata* codominant, with cover as much as 20% combined. Other grasses that might occur include *Poa fendleriana*, *Muhlenbergia montana* and *Sporobolus cryptandrus*. Shrubs that are likely to occur, but with low cover, include *Tetradymia canescens*, *Ericameria nauseosa*, *Atriplex canescens*, *Arctostaphylos patula*, *Artemisia tridentata*, *Quercus gambelii*, and *Yucca utahensis*. Scattered *Pinus edulis* was present in two sampled sites, but with minimal cover.

DISTRIBUTION

Capitol Reef National Park

This rare association is represented by a single plot located on the floor of the Strike Valley near Bitter Creek Divide.

Globally

This association has currently only been described from Zion National Park in southwestern Utah, and from Capitol Reef NP in central Utah. It may occur more widely in the Colorado Plateau region.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This rare grassland association occurs on a valley floor at 1715 m elevation. The unvegetated surface is covered mostly by litter or exposed soil; biological soil crusts are absent. The soil is a coarse-textured alluvium.

Globally

This is a poorly documented grassland association. From known occurrences it appears to be found primarily on gently sloping, to flat mesa tops or valley bottoms. Elevation range is not well established but ranges from 1715 m in Capitol Reef to 2260 m in Zion. Soils are coarse textured, loamy sand. In valley bottoms the soils are derived from alluvium. The soil surface may have some plant litter, or be bare soil; biological crusts are rarely present.

VEGETATION DESCRIPTION

Capitol Reef National Park

This rare grassland type is limited to small patches on valley floors. Total vegetation cover is around 30%. The grass layer is dominated by patches of *Bouteloua gracilis* interspersed with clumps of *Hesperostipa comata*. Shrubs are present, creeping in from adjacent shrubland communities. The shrub component consists of scattered individuals of *Atriplex canescens* and *Artemisia tridentata* ssp. *wyomingensis*.

Globally

Stands of this association tend to be small, patchy, and patterned in a mosaic with scattered shrubs. It is a grassland, with *Bouteloua gracilis* and *Hesperostipa comata* codominant, with variable amounts of cover ranging from 5 to

20% combined. Other grasses that might occur include *Poa fendleriana*, *Muhlenbergia montana* and *Sporobolus cryptandrus*. Forbs occurring in Capitol Reef stands included *Cleome lutea* and *Helianthus petiolaris*. Shrubs are less consistent in composition among sites sampled and contribute less than 10% cover. Shrubs that are likely to occur include *Tetradymia canescens*, *Ericameria nauseosa*, *Atriplex canescens*, *Arctostaphylos patula*, *Artemisia tridentata*, *Quercus gambelii*, and *Yucca utahensis*. Scattered *Pinus edulis* was present in two sampled sites, but with minimal cover. Pinyon-Juniper woodlands are a part of the shrubland/grassland mosaic on a landscape scale.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Cleome lutea</i> , <i>Helianthus petiolaris</i>
Herb (field)	<i>Bouteloua gracilis</i> , <i>Hesperostipa comata</i>

Globally

Herb (field) *Bouteloua gracilis*, *Hesperostipa comata*, *Poa fendleriana*

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum

Globally

Data are not available.

CONSERVATION STATUS RANK

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

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This is a very tentative type, distinguished by only 3 plots from Zion National Park, and an additional plot from Capitol Reef National Park. It is also very similar to other grassland associations in the Colorado Plateau region, and may be considered for lumping with one of those.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: The plot is weedy. *Bouteloua gracilis* and *Hesperostipa comata* are patchy in their distribution and generally alternate dominance.

Capitol Reef National Park Data: The description is based on field data collected in 2005 during accuracy assessment (1 plot: CARE_AA.0242).

Local Description Authors: J. Coles

Global Description Authors: M. Reid

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

***Bouteloua gracilis* - *Pleuraphis jamesii* Herbaceous Vegetation**

Blue Grama - James' Galleta Herbaceous Vegetation

CODE	CEGL001759
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	Short sod temperate or subpolar grassland (V.A.5.N.e.)
ALLIANCE	<i>BOUPELOUA GRACILIS</i> HERBACEOUS ALLIANCE (A.1282) Blue Grama Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Grassland (CES304.787)
Western Great Plains Shortgrass Prairie (CES303.672)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

These grasslands occur on alluvial flats, mesas and plains in the semi-arid southwestern Great Plains and the Colorado Plateau in southeastern Colorado, New Mexico, northern Arizona and southern Utah. Elevation ranges from 1625-1890 m (5330-5654 ft.) on the Colorado Plateau and extends below 1525 m (5000 ft.) in the southwestern Great Plains. Sites are flat to undulating, with shallow to moderately deep, loam to silty clay loam-textured soil. Stands are codominated by the graminoids *Bouteloua gracilis* and *Pleuraphis jamesii*. These short and medium-tall perennial bunch grasses may form a sod-like ground cover with patches of bare ground, especially where grazing by livestock encourages a prostrate growth form. Canopy cover is relatively sparse to moderately dense (20-80% cover). Other grasses include *Buchloe dactyloides*, *Muhlenbergia torreyi*, *Sporobolus cryptandrus*, *Aristida* spp., *Achnatherum hymenoides*, *Pascopyrum smithii*, *Hesperostipa comata*, or *Hesperostipa neomexicana*. Forb cover is generally sparse but may be diverse. Characteristic species include *Sphaeralcea coccinea*, *Grindelia squarrosa*, *Cryptantha* spp., *Machaeranthera pinnatifida*, *Ratibida* spp., and *Zinnia grandiflora*. Scattered dwarf-shrubs, shrubs and cacti, such as *Gutierrezia sarothrae*, *Artemisia bigelovii*, *Artemisia frigida*, *Krascheninnikovia lanata*, *Prosopis glandulosa*, *Yucca glauca*, *Opuntia imbricata*, and *Opuntia polyacantha*, are not uncommon. Codominance of *Bouteloua gracilis* and *Pleuraphis jamesii* distinguishes this vegetation from several closely related grasslands.

DISTRIBUTION

Capitol Reef National Park

This rare association is represented by a single plot within the park on a slope at the base of Oyster Shell Reef near Bitter Creek Divide.

Globally

These grasslands are found in the southern shortgrass steppe of southeastern Colorado and eastern New Mexico, and alluvial flats and mesas of the Colorado Plateau in New Mexico and Utah, south to Sevilleta National Wildlife Refuge in central New Mexico.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This association was sampled on a gentle, east-facing gravelly toe slope at 1625 m elevation. Most of the unvegetated surface is covered by gravel, with some sand and litter. The soil is coarse-textured slope wash.

Globally

These grasslands occur on alluvial flats, mesas and plains in the semi-arid southwestern Great Plains and the Colorado Plateau in southeastern Colorado, New Mexico, northern Arizona and southern Utah. Elevation ranges from 1625-1890 m (5330-5654 ft.) on the Colorado Plateau and extends below 1525 m (5000 ft.) in the southwestern Great Plains. Sites are flat to undulating, with shallow to moderately deep, loam to silty clay loam-textured soil.

VEGETATION DESCRIPTION

Capitol Reef National Park

This rare association is known only from a gravelly slope wash deposit derived from Oyster Shell Reef. Total vegetation cover is approximately 30% and is dominated by patches of *Bouteloua gracilis* alternating with patches of *Pleuraphis jamesii*. *Bromus tectorum* is present in a corner of the community that receives disturbance from an adjacent road. Scattered shrubs are present but do not have enough cover to constitute a stratum. Common shrubs include *Atriplex canescens* and *Chrysothamnus viscidiflorus*. Scattered *Juniperus osteosperma* trees may be present with less than 10% cover. No forb species were reported from the plot or vicinity.

Globally

This association is characterized by a variable (20-80% cover) herbaceous layer codominated by the graminoids *Bouteloua gracilis* and *Pleuraphis jamesii*. These short and medium-tall perennial bunch grasses may form a sod-like ground cover with patches of bare ground, especially where grazing by livestock encourages a prostrate growth form. Other grasses include *Buchloe dactyloides*, *Muhlenbergia torreyi*, *Sporobolus cryptandrus*, *Aristida* spp., *Achnatherum hymenoides*, *Pascopyrum smithii*, *Hesperostipa comata*, or *Hesperostipa neomexicana*. Forb cover is

generally sparse but may be diverse. Characteristic species include *Sphaeralcea coccinea*, *Grindelia squarrosa*, *Cryptantha* spp., *Machaeranthera pinnatifida*, *Ratibida* spp., and *Zinnia grandiflora*. Scattered dwarf-shrubs, shrubs and cacti, such as *Gutierrezia sarothrae*, *Artemisia bigelovii*, *Artemisia frigida*, *Krascheninnikovia lanata*, *Prosopis glandulosa* (southern stands), *Yucca glauca*, *Opuntia imbricata*, and *Opuntia polyacantha*, are not uncommon. Codominance of *Bouteloua gracilis* and *Pleuraphis jamesii* distinguishes this vegetation from several closely related grasslands.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Tall shrub/sapling	<i>Atriplex canescens</i>
Herb (field)	<i>Bouteloua gracilis</i> , <i>Pleuraphis jamesii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Bouteloua gracilis</i> , <i>Pleuraphis jamesii</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G2G4 (15-Oct-1999). Historically, most sites supporting this association have been converted to dryland or irrigated cropland in the plains. Overgrazing by livestock has changed some of these grasslands to sparse desert grasslands or desert scrubland. In addition, the reduction of fire frequency, either by livestock grazing the fine fuels that carry fires or by active suppression, has allowed the invasion of trees and shrubs. Loss to urban development has been significant in recent decades. Transformation to pinyon/juniper woodlands or desert grassland/scrubland, and urban development continue the negative trend. More classification and survey work are needed to distinguish this type from closely related grasslands over its relatively broad geographic range, and to inventory its extent and condition.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

More classification and survey work is needed to distinguish this type from closely related grasslands over its relatively broad geographic range, and to inventory its extent and condition.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Plot lies at the base of a sandstone reef, and soils are composed of sand and pebbles eroded from above. The main road crosses the eastern edge of the plot. The area has been significantly altered by cattle grazing, although there are some bunch grasses to the north within the polygon. There are also many weedy annuals in the plot, especially *Bromus tectorum* near the road.

Capitol Reef National Park Data: The description is based on accuracy data collected in 2005 (1 plot: CARE_AA.1804).

Local Description Authors: J. Coles

Global Description Authors: K.A. Schulz

REFERENCES: Beavis et al. 1982, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Dick-Peddie 1993, Driscoll et al. 1984, Francis 1986, Johnston 1987, Muldavin et al. 1998d, Rogers 1953, Shaw et al. 1989, Soil Conservation Service 1978, Terwilliger et al. 1979a, Van Pelt 1978, Western Ecology Working Group n.d.

***Pleuraphis jamesii* - *Sporobolus airoides* Herbaceous Vegetation**
James' Galleta - Alkali Sacaton Herbaceous Vegetation

CODE	CEGL001778
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	Short sod temperate or subpolar grassland (V.A.5.N.e.)
ALLIANCE	<i>PLEURAPHIS JAMESII</i> HERBACEOUS ALLIANCE (A.1287) James' Galleta Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Apacherian-Chihuahuan Semi-Desert Grassland and Steppe (CES302.735)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This once-extensive grassland of the northern Chihuahuan Desert, Colorado Plateau and Great Basin has been described in New Mexico from White Sands Missile Range and the upper Rio Puerco watershed, as well as in north-central Arizona and southeastern Utah. It has, however, experienced significant declines throughout its range. It primarily occurs in swales within open valley bottoms and alluvial flats, although sand sheets and dunes also can support the association. Sites are on level to gentle slopes (<15%) at elevations between 1300-2075 m (4260-6800 ft.). Soils are generally deep, with surface textures ranging from loamy sands, fine loams to silty clay loams and clays, derived from substrates that include lava flows, cinders, eolian sands, alluvium and relict Pleistocene river cobbles. The vegetation is characterized by a sparse to moderately dense perennial herbaceous layer dominated by *Pleuraphis jamesii* with *Sporobolus airoides* as a subdominant. Total vegetation cover in grazed sites generally does not exceed 20% but may be as high as 50% in protected areas. Occasionally, *Sporobolus airoides* may be codominant or dominant. This association usually has a sparse but diverse shrub layer that may include scattered *Atriplex canescens*, *Atriplex confertifolia*, *Atriplex obovata*, *Coleogyne ramosissima*, *Ephedra torreyana*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Opuntia imbricata*, *Opuntia macrorhiza*, *Opuntia phaeacantha*, *Sarcobatus vermiculatus*, and *Yucca angustissima*. The key graminoid species dominate the herbaceous layer and account for more than 80% of the total plant cover. Associated herbaceous species, such as *Achnatherum hymenoides*, *Bouteloua gracilis*, *Muhlenbergia porteri*, *Muhlenbergia pungens*, *Muhlenbergia torreyi*, *Pascopyrum smithii*, *Scleropogon brevifolius*, *Sphaeralcea coccinea*, and *Sporobolus cryptandrus*, may be present with low cover. Biological soil crusts may be extensive in undisturbed examples of this association.

DISTRIBUTION

Capitol Reef National Park

This association was sampled along Deep Creek in the South Desert within the park. It typically occurs in patches on low benches all along Deep Creek through the South Desert.

Globally

This once-extensive grassland of the northern Chihuahuan Desert, Colorado Plateau and Great Basin is reported in New Mexico from White Sands Missile Range and the upper Rio Puerco watershed. More recently, it has been documented in north-central Arizona and southeastern Utah. It has experienced significant declines throughout its range.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This herbaceous association was observed on the basin floor near Deep Creek in the South Desert. The sampled site is gentle (2° slope), occurs at 1707 m elevation, and is oriented to a northeastern aspect. The unvegetated surface is bare soil, typically with an alkaline covering. Parent materials are variable and include sandstones and shale eroded and distributed as alluvium. Soils are unrecorded.

Globally

This grassland association is described in New Mexico from White Sands Missile Range and the upper Rio Puerco watershed, as well as in north-central Arizona and southeastern Utah. It primarily occurs in swales within open valley

bottoms and alluvial flats, although sand sheets and dunes also can support the association. Sites are on level to gentle slopes (<15%) at elevations between 1300-2075 m (4260-6800 ft.). Soils are generally deep, with surface textures ranging from loamy sands, fine loams to silty clay loams and clays, derived from substrates that include lava flows, cinders, eolian sands, alluvium and relict Pleistocene river cobbles.

VEGETATION DESCRIPTION

Capitol Reef National Park

This grassland association is uncommon within the park. The vegetation is characterized by a grass canopy of *Pleuraphis jamesii* and *Sporobolus airoides*. The remaining herbaceous layer is low in species diversity and provides sparse cover. The short- and dwarf-shrub layers are relatively diverse and provide low to moderate cover. The most common shrubs present include *Atriplex confertifolia*, *Ericameria nauseosa*, and *Gutierrezia sarothrae*.

Globally

This association is characterized by a sparse to moderately dense perennial herbaceous layer codominated by *Pleuraphis jamesii* and *Sporobolus airoides*. Total vegetation cover generally does not exceed 20% in grazed sites but may be as high as 75% in protected areas. Occasionally, *Sporobolus airoides* may be codominant or dominant over *Pleuraphis jamesii*. This association usually has a sparse but diverse shrub layer that may include scattered *Atriplex canescens*, *Atriplex confertifolia*, *Atriplex obovata*, *Coleogyne ramosissima*, *Ephedra torreyana*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Opuntia imbricata*, *Opuntia macrorhiza*, *Opuntia phaeacantha*, *Opuntia polyacantha*, *Sarcobatus vermiculatus*, and *Yucca angustissima*. The key graminoid species dominate the herbaceous layer and typically account for more than 80% of the total plant cover. Associated herbaceous species, such as *Achnatherum hymenoides*, *Chaenactis stevioides*, *Cryptantha* sp., *Cymopterus newberryi*, *Bouteloua gracilis*, *Ipomopsis gunnisonii*, *Lappula occidentalis*, *Muhlenbergia porteri*, *Muhlenbergia pungens*, *Muhlenbergia torreyi*, *Pascopyrum smithii*, *Plantago patagonica*, *Scleropogon brevifolius*, *Sphaeralcea coccinea*, and *Sporobolus cryptandrus*, may be present with low cover (Francis 1986, Muldavin et al. 2000b). Biological soil crusts may be extensive in undisturbed examples of this association.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex confertifolia</i>
Herb (field)	<i>Gutierrezia sarothrae</i>
Herb (field)	<i>Pleuraphis jamesii</i> , <i>Sporobolus airoides</i>

Globally

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Pleuraphis jamesii</i> , <i>Sporobolus airoides</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Salsola kali

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G2G3 (14-Nov-2005). This once-extensive grassland of the Great Basin and Chihuahuan Desert ecoregions has been described in New Mexico from the Upper Rio Puerco watershed and White Sands Missile Range, as well as isolated areas in north-central Arizona and southeastern Utah. It has experienced significant declines throughout its range. Remaining examples that have not been negatively impacted by grazing and/or invaded by shrubs are rare. However, this grassland is probably more widespread than is documented and hence the rank of G2G3.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

In the classification of the plant communities of the upper Rio Puerco watershed, Francis (1986) described two plant communities codominated by *Pleuraphis jamesii* - *Sporobolus airoides* that were separated by the relative dominance of the key species. Both plant communities were combined into this association. *Sporobolus airoides* is larger and often more abundant than *Pleuraphis jamesii* which suggests that this association should be moved to the *Sporobolus airoides* Herbaceous Alliance (A.1267).

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: There is moderate grazing.

Capitol Reef National Park Data: The description is based on 1986 field data (1 plot: CARE.9114).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: Y. Chauvin, mod. K.A. Schulz and J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Francis 1986, Hansen et al. 2004b, Muldavin et al. 1998b, Muldavin et al. 2000b, West et al. 1972

***Pleuraphis jamesii* Herbaceous Vegetation
James' Galleta Herbaceous Vegetation**

CODE	CEGL001777
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	Short sod temperate or subpolar grassland (V.A.5.N.e.)
ALLIANCE	<i>PLEURAPHIS JAMESII</i> HERBACEOUS ALLIANCE (A.1287) James' Galleta Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This widespread grassland association is found on alluvial flats, plateau parks, mesas and plains in the Colorado Plateau and elsewhere in the southwestern U.S. Landforms vary from mesa tops and slopes to basin floors. Stands may be small woodland parks or more extensive grasslands on the plains. Soils in bottomland stands tend to be fine-textured; however, stands also occur on a variety of substrates. Vegetation is characterized by a relatively sparse to moderately dense (10-60% cover) perennial herbaceous layer strongly dominated by the warm-season bunchgrass *Pleuraphis jamesii*. Low cover of other grasses, such as *Achnatherum hymenoides*, *Bouteloua eriopoda*, *Bouteloua gracilis*, *Hesperostipa comata*, *Muhlenbergia porteri*, *Sporobolus airoides*, or *Sporobolus cryptandrus*, may be present. Forb cover is usually sparse and includes species of *Plantago*, *Gilia*, *Lappula*, and prickly pear cacti (*Opuntia* spp.). Many species of shrubs and dwarf-shrubs may be present; however, they are not dense enough to form a shrub layer. Some stands have high cover of cryptogams on the soil surface.

DISTRIBUTION

Capitol Reef National Park

This association was sampled near Cottonwood Tanks in the vicinity of Halls Creek. It occurs sporadically along Halls Creek south of The Post. This area was grazed for decades so many of these grasslands have shrubs and/or non-native grasses and forbs invading.

Globally

This widespread grassland association is found on alluvial flats, plateau parks and plains in the Colorado Plateau and elsewhere in the southwestern U.S.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This association was observed on a valley floor. The sampled site is level (1° slope), occurs at 1448 m elevation, and

is oriented to an eastern aspect. The unvegetated surface has high exposure of bare soil and low to moderate cover of litter. Parent materials are Entrada sandstone deposited as alluvium. Soils are well-drained silt loams.

Globally

This widespread grassland association is found on a variety of sites, including alluvial flats, toe slopes, valley floors, benches, hillsides, washes, colluvial slopes, plateau parks, mesas and plains in the Colorado Plateau and elsewhere in the southwestern U.S. Elevation ranges from 1220-1930 m, with a few sites on the western edge of the southern Rocky Mountains extending to 2400 m. Landforms vary from mesa tops and slopes to basin floors. Sites are flat to moderately steep (to 53% slope). Stands may be small woodland parks or more extensive on the plains. Soils are variable. In bottomland stands, soils tend to be fine-textured; however, stands also occur on sandy loams derived from sandstone, remnant lava flow, basaltic cobbles, black or red cinders, or alluvium derived from relict Pleistocene river cobbles, sandstone, sand, or clay soils.

VEGETATION DESCRIPTION

Capitol Reef National Park

This grassland association is uncommon, distributed at lower elevations, primarily in the southern end of the park. The total vegetation cover ranges from 16 to 50% in this sparsely to moderately vegetated stand. This herbaceous association is characterized by the perennial bunchgrass *Pleuraphis jamesii* that ranges in cover from 5 to 15%. Another bunchgrass provided low cover in the stand, e.g., *Achnatherum hymenoides*. Forbs are diverse but provide sparse cover. The shrub layer provides low cover and is low in diversity. The short-shrub layer provides low to moderate cover and includes *Atriplex canescens* and *Sarcobatus vermiculatus*. Canopy *Juniperus osteosperma* trees are present outside the plot but within the stand, providing sparse cover. Cryptogam cover is sparse.

Globally

This association is characterized by a sparse to moderately dense perennial herbaceous layer (5-60% cover) strongly dominated by the warm-season bunchgrass *Pleuraphis jamesii*. Low cover of other grasses, such as *Aristida* spp., *Achnatherum hymenoides*, *Bouteloua eriopoda*, *Bouteloua gracilis*, *Hesperostipa comata*, *Muhlenbergia porteri*, *Sporobolus airoides*, or *Sporobolus cryptandrus*, may be present. Forb cover is usually sparse and includes *Cymopterus newberryi*, *Phacelia crenulata*, *Plantago patagonica*, *Sphaeralcea parvifolia*, and *Townsendia annua* along with species of *Gilia*, *Lappula*, *Zinnia*, and prickly-pear cacti (*Opuntia* spp.). Many species of shrubs and dwarf-shrubs may be present, but they are not abundant enough to form a shrub layer. Woody species may include *Artemisia filifolia*, *Atriplex canescens*, *Atriplex confertifolia*, *Brickellia oblongifolia*, *Ephedra torreyana*, *Ephedra viridis*, *Ericameria nauseosa*, *Fallugia paradoxa*, *Gutierrezia* spp., *Krascheninnikovia lanata*, *Tetradymia* spp., and occasional *Juniperus* spp. trees. The widespread introduced annual grass *Bromus tectorum* and several other exotic species, such as *Salsola kali*, *Bassia scoparia*, and *Sisymbrium altissimum*, may be present to abundant, especially on disturbed sites. Some stands have high cover of cryptogams on the soil, including *Collema tenax*, *Tortula ruralis*, *Buellia papillata*, and *Fulgensia bracteata*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex canescens</i> , <i>Sarcobatus vermiculatus</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Pleuraphis jamesii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Pleuraphis jamesii</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Salsola kali*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G2G4 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This association is defined by the dominance of *Pleuraphis jamesii* in the graminoid layer without codominance of other grass species or the presence of a shrub layer.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Grassland stands are subject to erosion by wind and water and invasion by shrubs.

Capitol Reef National Park Data: The description is based on 2003 field data (1 plot: CARE.0521).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: K.A. Schulz, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Cannon 1960, Cogan et al. 2004, Collins 1984, Driscoll et al. 1984, Francis 1986, Francis and Aldon 1983, Hansen et al. 2004b, Helm 1981, Kleiner 1968, Kleiner 1983, Kleiner and Harper 1972, Kleiner and Harper 1977, Marr et al. 1973a, NVNHP 2003, Nichol 1937, Stewart et al. 1940, USFS 1937, Utah Environmental and Agricultural Consultants 1973, Von Loh et al. 2002, Weaver and Albertson 1956, West et al. 1972, Western Ecology Working Group n.d.

Eleocharis palustris Herbaceous Vegetation

Marsh Spikerush Herbaceous Vegetation

CODE	CEGL001833
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	<i>ELEOCHARIS (PALUSTRIS, MACROSTACHYA)</i> SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1422) (Marsh Spikerush, Page Spikerush) Seasonally Flooded Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Boreal Wet Meadow (CES103.873)
Inter-Mountain Basins Greasewood Flat (CES304.780)
Northwestern Great Plains Mixedgrass Prairie (CES303.674)
Western Great Plains Open Freshwater Depression Wetland (CES303.675)
Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)
Western Great Plains Closed Depression Wetland (CES303.666)
Temperate Pacific Subalpine-Montane Wet Meadow (CES200.998)
Willamette Valley Wet Prairie (CES204.874)
North American Arid West Emergent Marsh (CES300.729)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This spikerush wet meadow community is found in the central Great Plains of the United States and Canada and in the western United States. Elevations range from near sea level to 3050 m (0-10,000 ft.). Stands occur in small depressions in intermittent streambeds or depression ponds that flood early in the season and may dry out by summer. Soils are generally fine-textured. Stands are composed of submersed and emergent rooted vegetation less than 1 m tall dominated by *Eleocharis palustris*, often in nearly pure stands. Vegetative cover can be sparse to dense (10-90%), but *Eleocharis palustris* is the dominant species, and the only species with 100% constancy. Other species, when present, can contribute as much as 40% cover, but never exceed that of the *Eleocharis palustris* cover.

DISTRIBUTION

Capitol Reef National Park

This association is narrowly distributed on saturated soils or in the shallow standing water in the oxbow and just downstream from the waterfall along the Fremont River. It is also found in Halls Creek Narrows.

Globally

This spikerush wet meadow community is found in the central Great Plains of the United States and Canada and throughout the western United States including the desert Southwest.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This wetland association was observed on channel beds and basin floors. Sampled sites are nearly flat (1 to 2° slopes), occur at 1555 m elevation, and include all aspects. The unvegetated surface cover is not recorded. Parent materials are variable and include sandstones and shale deposited as alluvium. Soils are seasonally flooded, saturated, or inundated.

Globally

This wetland occurs across the central and northwestern Great Plains and western United States. Elevations range from near sea level to 3050 m (0-10,000 ft.). In the western mountains, it occurs in valleys and canyon bottoms on the banks and in the overflow channels of low-gradient streams, as well as along the margins of ponds and lakes. On the Great Plains, this community occurs in small depressions in intermittent streambeds, depression ponds that flood early in the season and dry out by summer, and small prairie potholes. It can also occur in the bottom of ephemeral ponds or playas on floodplain terraces of large rivers. In wet years, stands may remain ponded throughout the growing season. Soils range from organic to silty clay to fine loam formed from weathered siltstone and shale or eolian loess. Soils are reported as slightly alkaline.

VEGETATION DESCRIPTION

Capitol Reef National Park

This wetland association is rare in the park and is distributed along principal drainages. The vegetation is characterized by a closed canopy of *Eleocharis palustris*. The remaining herbaceous layer is diverse and provides moderate to high cover. Commonly associated graminoids and fern allies include *Eleocharis acicularis*, *Equisetum laevigatum*, *Juncus balticus*, *Juncus ensifolius*, *Muhlenbergia asperifolia*, and *Schoenoplectus tabernaemontani*. Forbs are diverse, largely exotic, and provide generally sparse cover by individual species. The most abundant is *Trifolium repens*. The short shrub *Shepherdia rotundifolia* provides low cover in one stand.

Globally

This wetland association is dominated by submersed and emergent rooted vegetation under 1 m tall. The species composition can be quite variable, but this community is easy to recognize by the bright green, nearly pure stands of *Eleocharis palustris*. Vegetation cover can be sparse to dense (10-90%), but *Eleocharis palustris* is the dominant species, and the only species with 100% constancy. Other species, when present, can contribute as much as 40% cover, but never exceed that of the *Eleocharis palustris* cover. Some of this variation is described from Colorado (Baker and Kennedy 1985, Kittel et al. 1999b). Co-occurring species in low-elevation stands on the western slope can include *Phalaris arundinacea*, *Juncus balticus*, *Hordeum jubatum*, *Equisetum* spp., *Pascopyrum smithii*, *Schoenoplectus americanus*, *Sparganium angustifolium*, species of *Lemna* and *Potamogeton*, as well as the introduced *Melilotus officinalis* and *Bromus inermis*. On the eastern plains of Colorado co-occurring species can include *Leersia oryzoides*, *Schoenoplectus pungens*, *Panicum virgatum*, *Carex pellita*, and *Spartina pectinata*. At montane elevations, other graminoids, such as *Carex aquatilis*, *Carex utriculata*, and *Deschampsia caespitosa*, are present. Forb cover is typically low but can be occasionally abundant (30%) in some stands. Forb species include *Pedicularis groenlandica*, *Rhodiola integrifolia*, and *Caltha leptosepala*.

In stands from eastern Washington, associates include *Carex utriculata*, *Cicuta douglasii*, and species of *Glyceria* and *Potamogeton*. In northwestern Nebraska, *Eleocharis acicularis* and *Eleocharis palustris* commonly cover the bottoms of the pools and emerge above the water as the pools dry up. Ephemeral submersed aquatics, such as *Callitriche palustris*, *Potamogeton diversifolius*, and *Marsilea vestita*, may be present. As the pools dry out in mid-summer, ephemeral annual forbs, such as *Limosella aquatica* and *Plagiobothrys scouleri*, may appear. By late summer *Amaranthus californicus* and *Gnaphalium palustre* may dominate in the lowest parts of the depression (Steinauer and Rolfsmeier 2000). In southwestern South Dakota, vegetation is composed of nearly homogeneous stands of *Eleocharis palustris*. Other emergents, such as *Polygonum amphibium*, *Marsilea vestita*, and *Eleocharis*

ovata, are occasionally found. Herbaceous cover is greater than 75% except in areas of deeper open water where floating and submerged aquatic plants occur, including *Bacopa rotundifolia* and *Heteranthera limosa* (H. Marriott pers. comm. 1999). In lower elevation Utah stands, *Glaux maritima*, *Distichlis spicata*, and *Juncus balticus* are important associates (Brotherson and Barnes 1984).

Few stand data are available for Colorado examples. Generally, it appears that this community is dominated by *Eleocharis palustris*, forming a scattered to dense overstory, often with few associated species. Commonly associated graminoids include *Hordeum jubatum* and *Pascopyrum smithii*. Forbs present may include *Atriplex argentea*, *Polygonum aviculare*, and *Rorippa sinuata* (Baker and Kennedy 1985). The higher elevation stands may include a slightly different suite of species, but no stand data are available. Ramaley (1942) described a *Distichlis spicata*-dominated salt meadow on a lakeshore in the San Luis Valley ringed by *Eleocharis palustris*. Stands in Utah include *Eleocharis acicularis* and *Alopecurus aequalis* as likely associates (Padgett et al. 1989).

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Eleocharis palustris</i> , <i>Muhlenbergia asperifolia</i>

Globally

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Eleocharis palustris</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Dactylis glomerata, *Elaeagnus angustifolia*, *Lactuca serriola*, *Medicago sativa*, *Melilotus officinalis*, *Sonchus asper*, *Tamarix chinensis*, *Trifolium pratense*, *Trifolium repens*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (1-Feb-1996).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: The oxbow is a wetland area remaining after the river was diverted during Highway 24 construction. Some shallow standing water remains at one site that includes both riverbanks. The Fremont River received occasional grazing below the Behunin Cabin until 1990.

Capitol Reef National Park Data: The description is based on 1988 field data (2 plots: CARE.9095, CARE.9107).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: D. Faber-Langendoen, mod. K. Schulz, M.S. Reid, G. Kittel, J. Coles

REFERENCES: Baker 1983c, Baker and Kennedy 1985, Billings 1945, Boggs 2000, Bork 1978, Boss 1983, Bourgeron and Engelking 1994, Brotherson and Barnes 1984, Bunin 1985, CONHP unpubl. data 2003, Carsey et al. 2003a, Christy 2004, Cooper 1993, Cooper and Severn 1992, Crow 1968, Crow 1977, Crowe and Clausnitzer 1997, Crowe et al. 2004, Driscoll et al. 1984, Durkin et al. 1995a, Easterday and Mamone 1980, Ellis et al. 1979, Evans 1989b, Evenden 1990, Flowers 1962, Hall and Hansen 1997, Hansen et al. 1988a, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, Harris 1954, Henderson and McAllister 1983, Heusser 1960, IDCDC 2005, Jankovsky-Jones et al. 1999, Jankovsky-Jones et al. 2001, Johnston 1987, Kagan et al. 2000, Kettler and McMullen 1996, Kierstead and Pogson 1976, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1997a, Kittel et al. 1999a, Kittel et al. 1999b, Kovalchik 1987, Kovalchik 1993, Kovalchik 2001, Kunze 1994, MTNHP 2002b, Manning and

Padgett 1991, Manning and Padgett 1995, Marriott 1985, Marriott pers. comm., Moseley 1998, Murray 2000, Mutel 1973, Mutel and Marr 1973, NVNHP 2003, Padgett 1981, Padgett et al. 1988b, Padgett et al. 1989, Penfound 1953, Ramaley 1919a, Ramaley 1942, Seyer 1981, Shephard 1995, Stearns-Roger, Inc. 1978, Steinauer and Rolfmeier 2000, Stewart 1940, Titus and Christy 1996a, Titus and Christy 1999, Von Loh 2000, WNHP unpubl. data, Youngblood et al. 1985a

***Juncus balticus* Herbaceous Vegetation**

Baltic Rush Herbaceous Vegetation

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	<i>JUNCUS BALTICUS</i> SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1374) Baltic Rush Seasonally Flooded Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Boreal Wet Meadow (CES103.873)
Inter-Mountain Basins Interdunal Swale Wetland (CES304.059)
North American Arid West Emergent Marsh (CES300.729)
Northern Prairie Pothole Wetland Complex (CECX005705)
Northern Columbia Plateau Basalt Pothole Ponds (CES304.058)
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)
Temperate Pacific Subalpine-Montane Wet Meadow (CES200.998)
Western Great Plains Open Freshwater Depression Wetland (CES303.675)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This Baltic rush community is found widely throughout the western United States and into western Canada. This wet meadow vegetation 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 a dense sward 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

Capitol Reef National Park

This association is narrowly distributed on saturated soils or in the shallow standing water in Halls Creek.

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

Capitol Reef National Park

This wetland association was observed on channel beds and basin floors. Sampled sites are nearly flat and occur at

1296 m elevation. The unvegetated surface cover is not recorded. Parent materials are variable and include sandstone deposited as alluvium. Soils are seasonally flooded, saturated, or inundated.

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 ft.). Far northern stands in the Boreal Plains are at about 800 m (2625 ft.). 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 and 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

Capitol Reef National Park

This rare wetland association is restricted in the park to drainages where the groundwater table is at the surface throughout the growing season. The vegetation is dominated by *Juncus balticus* in a near-monoculture. The margins of the community may support riparian shrubs such as *Salix exigua* or other graminoids such as *Distichlis spicata*.

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 tiogatum*), *Dodecatheon pulchellum*, *Glaux maritima*, *Iris missouriensis*, *Maianthemum stellatum*, *Rumex aquaticus*, *Polygonum bistortoides*, *Potentilla plattensis*, and *Solidago canadensis*. 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*, and *Xanthium strumarium*, may occur in disturbed stands. This association is considered by some to be a grazing-induced community because *Juncus balticus* is tolerant of grazing (low palatability when mature) and increases with grazing disturbance (Padgett et al. 1989, Hansen et al. 1995). Nearly pure stands of *Juncus balticus* may indicate that the site was heavily grazed in the past (Hansen et al. 1995). However, this association also occurs as a stable, late-seral community in areas with low disturbance (Kittel and Lederer 1993).

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Juncus balticus</i> , <i>Distichlis spicata</i>

Globally

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Juncus balticus</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Trifolium pratense

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (1-Feb-1996).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

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

Capitol Reef National Park Inventory Notes: Point is in a section of Halls Creek where water comes to the surface, open water just upstream from point

Capitol Reef National Park Data: The description is based on 2003 field data (1 observation point: CARE.9652).

Local Description Authors: J. Coles

Global Description Authors: J. Drake, mod. D. Faber-Langendoen, K.A. Schulz, L. Allen, G. Kittel

REFERENCES: ANHIC 2005, Baker 1984a, 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 1995, Muldavin et al. 2000a, Murray 2000, Mutel 1973, Mutz and Graham 1982, Olson and Gerhart 1982, Padgett 1981, Padgett et al. 1989, Richard et al. 1996, Rector 1979, Shupe et al. 1986, Stewart 1940, Taylor 1980, Taylor and Teare 1979a, Thompson and Hansen 2002, Titus and Christy 1996a, Tuhy and Jensen 1982, Volland 1976, Wasser and Hess 1982, Western Ecology Working Group n.d., WNHP unpubl. data, Youngblood et al. 1985a

***Phragmites australis* Western North America Temperate Semi-natural Herbaceous Vegetation**

Common Reed Western North America Temperate Semi-natural Herbaceous Vegetation

CODE	CEGL001475
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	Semipermanently flooded temperate or subpolar grassland (V.A.5.N.1.)
ALLIANCE	<i>PHRAGMITES AUSTRALIS</i> SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1431) Common Reed Semipermanently Flooded Herbaceous Alliance

ECOLOGICAL SYSTEM(S): North American Arid West Emergent Marsh (CES300.729)
Northern Columbia Plateau Basalt Pothole Ponds (CES304.058)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This reed marsh type is found across the west-temperate regions of the United States and Canada. Stands occur in semi-permanently flooded marshes, ditches, impoundments, etc. that have often been disturbed by human activity.

The vegetation is often variable, as *Phragmites australis* will often invade into existing natural or semi-natural communities present on the site. Once firmly established, this community is usually strongly dominated by *Phragmites australis*, with few or no other vascular plants present. In Colorado, this reed marsh often occurs in small wet patches in seeps and backwater areas of large floodplains, around the fringes of irrigation ponds, ditches, and along railroad embankments that have poor drainage. Stands have a dense, 1 to 1.5-m tall herbaceous layer dominated by the perennial graminoid *Phragmites australis*. Minor cover of associates such as *Agrostis stolonifera*, *Carex* spp., *Conyza canadensis*, *Glycyrrhiza lepidota*, *Iva axillaris*, *Mentha arvensis*, *Schoenoplectus acutus*, and *Typha latifolia* may be present.

DISTRIBUTION

Capitol Reef National Park

This association occurs in Middle Desert Wash in Cathedral Valley, Fremont River Valley, Halls Creek, Lower Deep Creek through the South Desert, near Ackland Springs and along Pleasant Creek. Tamarisk has invaded this association in many locations.

Globally

This reed marsh type is found across the temperate regions of the western United States and Canada, ranging from western North Dakota and Saskatchewan to Oregon, south to California and Texas. Its distribution is somewhat incomplete as not all states have listed semi-natural types in their state.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This tall-grass association was observed on the banks and channels of washes and canyon bottom drainages. Sites are nearly flat to relatively steep (1 to 38° slopes), occur between 1640 and 1890 m elevation, and have various orientation. The unvegetated surface has high exposure of bare soil. Parent materials are variable and include sandstones and shale that have eroded to old alluvial deposits. The soils are moderately well-drained loamy sands, saturated and intermittently flooded.

Globally

This association is widespread in the western U.S. and Canada. Elevations range from 640-1980 m. Stands occur in temporarily to semi-permanently flooded marshes, ditches, impoundments, pond and lake margins, swales, and wet meadows that often have been disturbed by human activity. Sites are usually saturated or flooded during the growing season, but the soil surface may dry out in late summer. Soils are often fine-textured silts and clays. In Colorado and Utah, this reed marsh often occurs in small wet patches in seeps and backwater areas of large floodplains in springs emerging from canyon walls, around the fringes of irrigation ponds, ditches, and along railroad embankments that have poor drainage.

VEGETATION DESCRIPTION

Capitol Reef National Park

This wetland association is uncommon in mesic drainage bottoms within the park. The total vegetation cover ranges from 6 to 20% on one stand and over 100% in another in these sparsely to densely vegetated stands. This tall-grass association is characterized by an open canopy, typically 1-2 m tall, of *Phragmites australis* that ranges in cover from 5 to 15%. The associated herbaceous layer can be diverse and provides sparse to low cover. Associated graminoids are diverse, provide low to moderate cover, and include *Agrostis gigantea*, *Elymus canadensis*, *Equisetum arvense*, *Equisetum hyemale*, *Hordeum jubatum*, *Juncus balticus*, *Muhlenbergia asperifolia*, and *Sporobolus contractus*. Forbs are diverse and provide low cover; those commonly present include *Ambrosia acanthicarpa*, *Artemisia ludoviciana*, *Eurybia glauca*, *Castilleja linariifolia*, *Cirsium calcareum*, *Conyza canadensis*, *Hymenopappus filifolius*, *Machaeranthera canescens*, *Mirabilis linearis*, *Oenothera pallida*, *Iva acerosa*, and *Taraxacum officinale*. The shrub layer is low in diversity and provides sparse to low cover, including *Amelanchier utahensis*, *Ericameria nauseosa*, *Pinus edulis*, and *Tamarix chinensis*. This association tends to form a mosaic with other wetland and riparian associations.

Globally

The vegetation is often variable as *Phragmites australis* will often invade into existing natural or semi-natural communities present on the site. Once firmly established, this community is usually strongly dominated by *Phragmites australis* with few or no other vascular plants present. Stands have a dense, 1 to 3-m tall herbaceous layer dominated by the perennial graminoid *Phragmites australis* usually with at least 50% absolute cover.

Associated graminoids include *Agrostis stolonifera*, *Carex* spp., *Typha latifolia*, *Juncus balticus*, *Agrostis gigantea*, *Elymus canadensis*, *Equisetum* spp., *Hordeum jubatum*, *Muhlenbergia asperifolia*, *Schoenoplectus acutus*, and *Sporobolus contractus*. Forbs are diverse and provide low cover; those commonly present include *Ambrosia acanthicarpa*, *Conyza canadensis*, *Glycyrrhiza lepidota*, *Eurybia glauca*, *Iva acerosa*, *Iva axillaris*, *Mentha arvensis*, *Solidago canadensis*, and *Taraxacum officinale*. Introduced species such as *Lepidium latifolium* and *Cirsium arvense* may be present and compete well against *Phragmites australis* in disturbed sites.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Ericameria nauseosa</i>
Herb (field)	<i>Muhlenbergia asperifolia</i> , <i>Phragmites australis</i>
Herb (field)	<i>Equisetum hyemale</i>

Globally

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Phragmites australis</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Tamarix chinensis

Globally

Cirsium arvense

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (20-Sep-2000).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This vegetation has variable hydrology and is often treated as part of other marshes and meadows. The geographic distribution of the type is arbitrarily limited to Bailey's Dry and Humid Temperate Domain in western North America (Bailey 1997, 1998). Compare with *Phragmites australis* Eastern North America Temperate Semi-natural Herbaceous Vegetation (CEGL004141). The two types need to be better distinguished, both in concept and in name.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Light grazing occurs in this association at some locations. The association occurs at seeps along the bank of washes and in canyon channels.

Capitol Reef National Park Data: The description is based on 1988 and 2003 field data (2 plots: CARE.9362, CARE.0432).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: D. Faber-Langendoen, mod. K. Schulz and J. Coles

REFERENCES: Bailey 1997, Bailey 1998, Baker 1982a, Baker 1984a, Bourgeron and Engelking 1994, Butler et al. 2002, CONHP unpubl. data 2003, Carsey et al. 2003a, Driscoll et al. 1984, Greenall 1996, Hall and Hansen 1997, Hansen et al. 1991, Hansen et al. 1995, Hoagland 1998c, Hoagland 2000, IDCDC 2005, Johnston 1987, Kagan et al. 2000, Kittel et al. 1995, Kittel et al. 1999b, MTNHP 2002b, NDNHI n.d., NVNHP 2003, Von Loh 2000,

***Schoenoplectus pungens* Herbaceous Vegetation Common Threesquare Herbaceous Vegetation**

CODE	CEGL001587
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 Semipermanently flooded temperate or subpolar grassland (V.A.5.N.1.)
ALLIANCE *SCHOENOPLECTUS PUNGENS* SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1433)
Common Threesquare Semipermanently Flooded Herbaceous Alliance

ECOLOGICAL SYSTEM(S): North American Arid West Emergent Marsh (CES300.729)
Inter-Mountain Basins Interdunal Swale Wetland (CES304.059)
Western Great Plains Saline Depression Wetland (CES303.669)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This bulrush wet meadow community is found in the western United States in the intermountain basins, as far north as southern British Columbia, as well as in western parts of the Great Plains north into Alberta, Canada. Stands are found along low-gradient, meandering, usually perennial streams and springs and around the margins of ponds and marshes. Substrates are generally dark, organic, fine-textured soils derived from alluvium. *Schoenoplectus pungens* dominates the dense, 0.3 to 0.6-m tall herbaceous vegetation layer. Other species that often are present include *Schoenoplectus maritimus*, *Spartina gracilis*, *Hordeum jubatum*, *Pascopyrum smithii*, *Juncus balticus*, *Eleocharis palustris*, *Lemna minor*, *Sagittaria latifolia*, and *Typha* spp. Stands of this association contain no tree or shrub layer, but a few scattered trees and shrubs may be present, most commonly *Populus deltoides*, *Populus fremontii*, *Salix amygdaloides*, *Salix exigua*, *Salix gooddingii*, *Symphoricarpos occidentalis*, or *Sarcobatus vermiculatus*.

DISTRIBUTION

Capitol Reef National Park

This association is rare within the park, occupying areas of inundation and/or soil saturation, and was sampled along the road at Ackland Springs.

Globally

This community occurs in intermountain basins of the western United States in the, as well as western parts of the Great Plains, from east-central Alberta and Montana south to Colorado, and west into Nevada, Utah, and Wyoming.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This wetland association was observed in a narrow depression, only 2 m wide, adjacent to a roadbed and extending several hundred meters. The sampled site is gentle (3° slope), occurs at 1823 m elevation, and is oriented to a southeastern aspect. The unvegetated surface has high cover of live vegetation basal area and moderate exposure of bare soil. Litter and open water are present in sparse amounts. Parent materials are variable and include sandstones and shale that have deposited as old alluvial deposits. Soils are somewhat poorly drained to saturated sandy loams.

Globally

Stands of this widespread association are found throughout much of the western U.S., north into British Columbia and east to Alberta, Canada, in appropriate wetland habitats. Elevations range from 1000-2400 m. Stands occur along low-gradient, meandering, usually perennial streams, along springs, around the margins of ponds and marshes, in low-lying swales, adjacent to perennial pools in intermittent washes, and abandoned or overflow channels where the soils remain saturated (Hansen et al. 1995, Jones and Walford 1995, Walford 1996, Kittel et al. 1999a). It also occurs on silt and sand bars within the active channel. Soils are generally derived from alluvium and are fine-textured or sandy, and often are black, alkaline, organic anoxic with gleying. Soils range from normal to saline with pH ranging from 7.4-9.1. Typical pH reported for Alberta stands is 8.5 (Thompson and Hansen 2002).

VEGETATION DESCRIPTION

Capitol Reef National Park

This wetland association is rare within the park. The total vegetation cover ranges from 46 to 60% in this moderately to densely vegetated stand. This herbaceous association is characterized by a moderately closed canopy of the graminoid *Schoenoplectus pungens* that ranges in cover from 45 to 55%. Associated graminoids provide sparse cover and include *Distichlis spicata* and *Juncus balticus*. *Iva acerosa* provides sparse cover.

Globally

This widespread association is characterized by a dense, 0.3 to 0.6-m tall herbaceous vegetation layer dominated by *Schoenoplectus pungens*. Associated species include *Schoenoplectus maritimus*, *Equisetum* spp., *Spartina gracilis*, *Distichlis spicata*, *Hordeum jubatum*, *Muhlenbergia asperifolia*, *Pascopyrum smithii*, *Juncus balticus*, *Eleocharis palustris*, *Lemna minor*, *Sagittaria latifolia*, and *Typha* spp. Stands of this association contain no tree or shrub layer, but a few scattered trees and shrubs may be present, most commonly *Populus deltoides*, *Populus fremontii*, *Salix amygdaloides*, *Salix exigua*, *Salix gooddingii*, *Symphoricarpos occidentalis*, or *Sarcobatus vermiculatus*. Northern stands have >50% cover by *Schoenoplectus pungens* with no other constant or significant species.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Juncus balticus</i> , <i>Schoenoplectus pungens</i>

Globally

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Schoenoplectus pungens</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Agrostis stolonifera, *Melilotus officinalis*

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G4 (9-Apr-1998).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Muldavin et al. (2000a) described five *Schoenoplectus pungens* community types from New Mexico. Most are codominated with an associated species listed in the vegetation description, e.g., *Eleocharis palustris*, *Distichlis spicata*, *Paspalum distichum*, and *Equisetum laevigatum*, with one being a *Schoenoplectus pungens* Monotype Community Type reported from the Gila River basin. Muldavin et al.'s (2000a) concept of this community type states that it can be dominated by *Schoenoplectus pungens* or *Schoenoplectus americanus*. Hansen et al. (1995) also include *Schoenoplectus americanus* in their *Scirpus pungens* Habitat Type. The range of *Schoenoplectus americanus*, however, does not extend into Alberta, so this may be less of an issue moving north. This association needs further review to clarify whether to include stands where *Schoenoplectus pungens* is not the dominant species.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: This is a spring/seep community. Tadpoles are present in standing water. Cattle are grazing in the site, causing disturbance. The surrounding communities are typical mixed shrublands.

Capitol Reef National Park Data: The description is based on 2003 field data (1 plot: CARE.0452).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: G.P. Jones, mod. K. Schulz, J. Coles, L. Allen

REFERENCES: Bourgeron and Engelking 1994, Brotherson and Barnes 1984, Bundy et al. 1996, Butler et al. 2002, CONHP unpubl. data 2003, Carsey et al. 2003a, Driscoll et al. 1984, Gleason and Cronquist 1991, Great Plains Flora Association 1986, Hansen et al. 1991, Hansen et al. 1995, IDCDC 2005, Jones 1992b, Jones and Walford 1995, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1999b, Larson 1993, Lauver et al. 1999, MTNHP 1988, MTNHP 2002b, MacKenzie and Moran 2004, Muldavin et al. 2000a, NDNHI n.d., NVNHP 2003, Thompson and Hansen 2002, Walford 1996, Western Ecology Working Group n.d.

***Typha (latifolia, angustifolia)* Western Herbaceous Vegetation
(Broadleaf Cattail, Narrowleaf Cattail) Western Herbaceous Vegetation**

CODE	CEGL002010
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	Semipermanently flooded temperate or subpolar grassland (V.A.5.N.1.)
ALLIANCE	<i>TYPHA (ANGUSTIFOLIA, LATIFOLIA)</i> - (<i>SCHOENOPLECTUS</i> SPP.) SEMI-PERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1436) (Narrowleaf Cattail, Broadleaf Cattail) - (Clubbrush species) Semipermanently Flooded Herbaceous Alliance

ECOLOGICAL SYSTEM(S): North American Arid West Emergent Marsh (CES300.729)
Inter-Mountain Basins Interdunal Swale Wetland (CES304.059)
Northern Columbia Plateau Basalt Pothole Ponds (CES304.058)
Western Great Plains Open Freshwater Depression Wetland (CES303.675)
Temperate Pacific Freshwater Emergent Marsh (CES200.877)
Western Great Plains Floodplain (CES303.678)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This association is widespread across the western United States and western Great Plains occurring near streams, rivers, and ponds. The soil is flooded or saturated for at least part of the growing season. The alluvial soils have variable textures ranging from sand to clay and usually with a high organic content. The dominant species, *Typha latifolia* or *Typha angustifolia*, often form dense, almost monotypic stands. Other species typical of wetlands may be found in lesser amounts in this community; among these are shallower water emergents such as *Carex* spp., *Eleocharis macrostachya*, *Eleocharis palustris*, *Glyceria* spp., *Juncus balticus*, *Juncus torreyi*, *Mentha arvensis*, *Schoenoplectus acutus*, and *Veronica* spp. In deeper water, *Lemna minor*, *Potamogeton* spp., *Sagittaria* spp., *Azolla filiculoides*, and other aquatics may be present in trace amounts.

DISTRIBUTION

Capitol Reef National Park

This uncommon association was sampled in Upper Deep Creek. It also occurs in Water Canyon, along the Fremont River, and in Pleasant Creek where it typically forms a mosaic with other riparian and wetland communities. These areas tend to be small and limited to the saturated soils around springs and seeps or along major drainages.

Globally

This association is widely distributed, occurring across the western United States and western Great Plains.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This herbaceous association was observed on stream margins. The sampled site is gentle (2° slope), lies at 2043 m elevation, and is oriented to an east-facing aspect. The unvegetated surface is not described. Parent materials include sandstones and shale that have eroded and deposited as Quaternary alluvium. Soils are saturated to inundated.

Globally

This widespread community is found along streams, rivers, canals, and the banks of ponds and lakes. Elevations range from near sea level to 2000 m. Sites are nearly level. The soil is saturated or flooded for much of the year from freshwater sources such as springs or streams. The alluvial soils have variable textures ranging from sand to clay and usually with a high organic content.

VEGETATION DESCRIPTION

Capitol Reef National Park

This wetland association is uncommon, occurring on saturated and inundated soils in the park. The vegetation is characterized by moderate cover of the perennial graminoid *Typha latifolia*. The sampled site also contains the

annual exotic grass *Bromus tectorum*. The common forbs present provide low to moderate cover and include *Descurainia pinnata*, *Penstemon pachyphyllus*, and *Veronica anagallis-aquatica*. The canopy trees *Populus angustifolia* and *Populus fremontii* provide low cover.

Globally

This community is dominated by hydrophytic macrophytes, especially *Typha latifolia* or *Typha angustifolia*, which grow from approximately 2-3 m tall. *Typha latifolia* and *Typha angustifolia* often form dense, near-monotypic stands (70-98% cover), almost to the exclusion of other species. In some stands the two *Typha* species are codominant. Other species typical of wetlands may be found in lesser amounts in this community; among these are shallower water emergents such as *Carex* spp., *Eleocharis macrostachya*, *Eleocharis palustris*, *Glyceria* spp., *Juncus balticus*, *Juncus torreyi*, *Mentha arvensis*, *Schoenoplectus acutus*, and *Veronica* spp. In deeper water, *Lemna minor*, *Potamogeton* spp., *Sagittaria* spp., *Azolla filiculoides*, and other aquatics may be present in trace amounts. Trace amounts of grasses like *Agrostis stolonifera*, *Beckmannia syzigachne*, *Hordeum jubatum*, *Muhlenbergia asperifolia*, and *Phalaris arundinacea* may also be present.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Bromus tectorum</i> , <i>Typha latifolia</i>

Globally

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Typha angustifolia</i> , <i>Typha latifolia</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This community is a common element found in many wetland systems, but has received little attention. Consequently, the diagnostic features and species of this community are not well known. Many ecologists (Hansen et al. 1995, Kittel et al. 1999b) have included *Typha angustifolia* as a codominant in this association. More classification work is needed to clarify the concept of this association.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: The sampled site is lightly grazed.

Capitol Reef National Park Data: The description is based on 1988 field data (1 plot: CARE.9329).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Drake, mod. K. Schulz, mod. M.S. Reid

REFERENCES: Baker 1984a, Boss 1983, Bourgeron and Engelking 1994, Bundy et al. 1996, Bunin 1985, CONHP unpubl. data 2003, Carsey et al. 2003a, Christy 1973, Christy 2004, Crowe and Clausnitzer 1997, Crowe et al. 2004, Dethier 1990, Driscoll et al. 1984, Hansen et al. 1991, Hansen et al. 1995, Holland 1986b, IDCDC 2005, Jankovsky-Jones et al. 2001, Johnston 1987, Jones 1992b, Jones and Walford 1995, Kagan et al. 2000, Kittel et al. 1996, Kittel et al. 1999a, Kittel et al. 1999b, Kovalchik 1993, Kovalchik 2001, Kunze 1994, Lindauer 1978, Lindauer and Christy 1972, MTNHP 2002b, Marriott and Faber-Langendoen 2000, Masek 1979, McEachern 1979, Muldavin et al. 1993b, Muldavin et al. 2000a, Murray 2000, NVNHP 2003, Padgett et al. 1989, Ramaley 1939b, Sanville et al.

1986, Titus et al. 1996, Tolstead 1942, Von Loh 2000, WNHP unpubl. data, Youngblood et al. 1985a

***Gutierrezia sarothrae* / *Sporobolus airoides* - *Pleuraphis jamesii* Shrub Herbaceous Vegetation**

Snakeweed / Alkali Sacaton - James' Galleta Shrub Herbaceous Vegetation

CODE	CEGL001776
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 layer (V.A.7.N.e.)
ALLIANCE	<i>SPOROBOLUS AIROIDES</i> - (<i>PLEURAPHIS JAMESII</i>) SHRUB HERBACEOUS ALLIANCE (A.1532) Alkali Sacaton - (James' Galleta) Shrub Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This Colorado Plateau desert grassland has been documented from the upper Rio Puerco watershed in New Mexico and the Painted Desert of northern Arizona on alluvial flats and mesas. Sites are level to gently sloping, and substrates are variable. Stands typically have been disturbed by improper grazing of livestock, frequent sheet flow, or wind. The vegetation is characterized by an open (10-25% cover) woody layer dominated by *Gutierrezia sarothrae* with a moderately dense perennial graminoid layer typically codominated by *Pleuraphis jamesii* and *Sporobolus airoides*, although either may dominate or *Sporobolus airoides* may be absent. The herbaceous layer has greater cover than the shrub layer that may include other scattered shrubs and dwarf-shrubs such as *Artemisia tridentata*, *Atriplex canescens*, *Ephedra viridis*, *Eriogonum corymbosum*, *Ericameria nauseosa*, *Fallugia paradoxa*, *Isocoma drummondii*, *Opuntia* spp., or *Juniperus monosperma*. Associated herbaceous species such as *Achnatherum hymenoides*, *Aristida purpurea*, *Bouteloua* spp., *Hesperostipa comata*, *Muhlenbergia porteri*, *Sphaeralcea coccinea*, and *Sporobolus cryptandrus* may be present with low cover. Diagnostic of this shrub steppe association is the dominance of *Gutierrezia sarothrae* in the open short shrub layer (10-25% cover).

DISTRIBUTION

Capitol Reef National Park

This rare association is represented by a single plot within the park along a drainage in Middle Desert Wash.

Globally

This shrub steppe association occurs in the Colorado Plateau from the upper Rio Puerco watershed in northwestern New Mexico to north-central Arizona.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This association was sampled once in the park on gently sloping valley bottom sediments at 1925 m elevation. Most of the unvegetated surface is exposed soil, with low cover by litter, gravel, dead wood and biological soil crusts. Soils are derived from alluvium.

Globally

This Colorado Plateau desert grassland has been documented from the upper Rio Puerco watershed in northwestern New Mexico and the Painted Desert of northern Arizona on mesas and alluvial flats. Elevation ranges from 1310-1655 m. Sites are level to gently sloping. Substrates are variable and include soils derived from relatively deep, fine-textured alluvium, shallow, coarse or fine loams, and pure cinder (or mixed cinder and clay) and limestone soils as well as pure sand (Francis 1986). Sites typically have been disturbed by improper grazing of livestock, frequent sheet flow, or wind.

VEGETATION DESCRIPTION

Capitol Reef National Park

This type occurs in valley bottoms with a history of disturbance, either from grazing or natural erosion. Total vegetation cover is approximately 35%. The association consists of an open shrubland of *Gutierrezia sarothrae* (18% cover), *Atriplex canescens* (4% cover), and *Ericameria nauseosa* (2% cover) with a grassy understory of *Bouteloua gracilis* (4% cover) and *Sporobolus airoides* (3% cover). Biological soil crusts have minimal cover and no forbs were recorded.

Globally

This association is characterized by an open (10-25% cover) woody layer dominated by *Gutierrezia sarothrae* with a moderately dense perennial graminoid layer typically codominated by *Pleuraphis jamesii* and *Sporobolus airoides*, although either may dominate or *Sporobolus airoides* may be absent. The herbaceous layer has greater cover than the shrub layer that may include other scattered shrubs and dwarf-shrubs such as scattered *Artemisia tridentata*, *Atriplex canescens*, *Ephedra viridis*, *Eriogonum corymbosum*, *Ericameria nauseosa*, *Fallugia paradoxa*, *Isocoma drummondii*, *Opuntia* spp., or *Juniperus monosperma*. Associated herbaceous species such as *Achnatherum hymenoides*, *Aristida purpurea*, *Bouteloua curtipendula*, *Bouteloua eriopoda*, *Bouteloua gracilis*, *Hesperostipa comata*, *Muhlenbergia porteri*, *Sphaeralcea coccinea*, and *Sporobolus cryptandrus* may be present with low cover (Francis 1986).

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex canescens</i>
Herb (field)	<i>Gutierrezia sarothrae</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Bouteloua gracilis</i> , <i>Sporobolus airoides</i>

Globally

<u>Stratum</u>	<u>Species</u>
Shrub/sapling (tall & short)	<i>Gutierrezia sarothrae</i>
Herb (field)	<i>Pleuraphis jamesii</i> , <i>Sporobolus airoides</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

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

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Stands dominated by *Sporobolus airoides* are included in this association and alliance. There is no *Sporobolus airoides* Shrub Herbaceous Alliance in the USNVC.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: The plot is on alluvium with moderate hummocking adjacent to a wash but not on its terrace. The wash bottom is about 5 m wide and is unvegetated. There are two associations present here. One is *Ericameria nauseosa* Desert Wash Shrubland (CEGL002261) that occupies a wash about 15 m wide. *Gutierrezia sarothrae* dominates the upland adjacent to the wash.

Capitol Reef National Park Data: The description is based on field data collected in 2005 during accuracy assessment (1 plot: CARE_AA.0498).

Local Description Authors: J. Coles

Global Description Authors: K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Francis 1986, Hansen et al. 2004b,

***Ericameria nauseosa* / *Bouteloua gracilis* Shrub Herbaceous Vegetation Rubber Rabbitbrush / Blue Grama Shrub Herbaceous Vegetation**

CODE	CEGL003495
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	Short temperate or subpolar grassland with a sparse microphyllous evergreen shrub layer (V.A.7.N.j.)
ALLIANCE	<i>ERICAMERIA NAUSEOSA</i> SHRUB SHORT HERBACEOUS ALLIANCE (A.1546) Rubber Rabbitbrush Shrub Short Herbaceous Alliance
ECOLOGICAL SYSTEM(S):	Inter-Mountain Basins Semi-Desert Grassland (CES304.787) Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association occurs on valley floors, swales and alluvial flats in the southern and central part of the Colorado Plateau. Its presence generally indicates disturbance, and it may represent degraded forms of other grassland, shrubland or woodland communities. Stands occupy gentle to moderate slopes (2-13%) between 1635 and 2010 m (5360-6600 ft.) elevation. Aspect does not affect the distribution of this association. Litter and bare soil cover most of the unvegetated surface. Parent materials include sandstones and shale that have eroded and been re-deposited as alluvium or windblown sediments (loess). Soils are well-drained and fine-sandy or silty in texture. Total vegetation cover ranges from 10 to 65%, roughly equally divided between the shrub and herbaceous layers. The vegetation is characterized by an open short-shrub canopy of *Ericameria nauseosa* that ranges in cover from 5 to 25% and an understory dominated by *Bouteloua gracilis* that ranges in cover from 5 to 35%. Other shrubs may be present with very low cover, including *Tetradymia canescens*, *Atriplex* spp., *Gutierrezia sarothrae*, and *Opuntia polyacantha*. Associated graminoids present include the bunch grasses *Achnatherum hymenoides*, *Aristida purpurea*, *Pascopyrum smithii*, *Pleuraphis jamesii*, *Sporobolus airoides*, *Sporobolus cryptandrus*, and *Muhlenbergia pungens*. Only scattered forbs are present.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon along the northern park boundary in the vicinity of Cathedral Junction and was sampled on Rock Springs Bench and in Rock Springs Wash. It is more widespread on BLM-managed lands outside the park.

Globally

This association has been documented from widely scattered sites in southern Utah, northern Arizona, from the upper Rio Puerco watershed in northern New Mexico (Francis 1986), Petrified Forest National Park in northeastern Arizona, and is likely to occur across the central part of the Colorado Plateau.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This shrub herbaceous association was observed on valley floors on alluvial flats. Sites are gentle (1 to 2° slopes), occur at 1860 m elevation, and are oriented to southeastern aspects. The unvegetated surface has sparse to low cover of litter and high exposure of sand and bare soil. There is moderate to high cover by live vegetation basal area. Parent materials are variable and include sandstones and shale that have eroded and become deposited as alluvium. Soils are well-drained sands and loamy sands.

Globally

This shrub herbaceous association occurs on valley floors, swales and alluvial flats in the central part of the Colorado Plateau. Stands occupy gentle to moderate slopes (2-13%) between 1635 and 2010 m (5360-6600 ft.) elevation. Aspect does not control the distribution of this association. Litter and bare soil cover most of the unvegetated surface. Parent materials are variable and include sandstones and shale that have eroded and been re-deposited as alluvium or windblown sediments. Soils are well-drained and fine-sandy or silty in texture.

VEGETATION DESCRIPTION

Capitol Reef National Park

This association is rare in the park and uncommon adjacent to the park on BLM-managed lands. The total vegetation cover ranges from 8 to 40% in these sparsely to moderately vegetated stands. This shrub herbaceous association is characterized by a sparse short-shrub canopy of *Ericameria nauseosa* that ranges in cover from 1 to 5% and the shortgrass *Bouteloua gracilis* that ranges in cover from 5 to 35%. The dwarf-shrub layer is sparse in terms of species composition and provides sparse cover by *Gutierrezia sarothrae* and *Opuntia polyacantha*. Associated graminoids commonly present include the bunch grasses *Achnatherum hymenoides* and *Muhlenbergia pungens*. Only scattered forbs are present.

Globally

The total vegetation cover ranges from 10 to 65%, roughly equally divided between the shrub and herbaceous layers. The vegetation is characterized by a short-shrub canopy of *Ericameria nauseosa* that ranges in cover from 5 to 25% and an understory dominated by *Bouteloua gracilis* that ranges in cover from 5 to 35%. Other shrubs may be present with very low cover, including *Tetradymia canescens*, *Atriplex canescens*, *Atriplex confertifolia*, *Gutierrezia sarothrae*, and *Opuntia polyacantha*. Associated graminoids present include the bunch grasses *Achnatherum hymenoides*, *Aristida purpurea*, *Pascopyrum smithii*, *Sporobolus airoides*, *Sporobolus cryptandrus*, and *Muhlenbergia pungens*. Only scattered forbs are present, such as *Chaetopappa ericoides*, *Ipomopsis longiflora*, and *Senecio spartioides*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Ericameria nauseosa</i>
Herb (field)	<i>Gutierrezia sarothrae</i>
Herb (field)	<i>Achnatherum hymenoides</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Ericameria nauseosa</i>
Herb (field)	<i>Bouteloua gracilis</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (14-Apr-2003).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Former CEG001738 and CEG001739 were lumped into this new association; separation of these two types by ssp. of *Ericameria nauseosa* was not supported by the data in Francis (1986).

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: The sites are grazed by livestock. Soil erosion is evident in terms of pedestalled shrubs, swales, and sheet flows across sites.

Capitol Reef National Park Data: The description is based on 2003 field data (2 plots: CARE.0439, CARE.0441).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles and K.A. Schulz

REFERENCES: Francis 1986, Hansen et al. 2004a, Western Ecology Working Group n.d.

***Muhlenbergia pungens* Herbaceous Vegetation** **Sandhills Muhly Herbaceous Vegetation**

CODE	CEGL002363
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	Short temperate or subpolar grassland with a sparse microphyllous evergreen shrub layer (V.A.7.N.j.)
ALLIANCE	<i>MUHLENBERGIA PUNGENS</i> HERBACEOUS ALLIANCE (A.2652) Sandhills Muhly Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)
Inter-Mountain Basins Semi-Desert Grassland (CES304.787)
Inter-Mountain Basins Active and Stabilized Dune (CES304.775)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This somewhat rare association occurs locally on sandy flats and dunes in southern Utah and northwestern Colorado. It is dependent on a certain degree of disturbance to maintain the mid-seral species *Muhlenbergia pungens*. Elevations range from 1646 to 2256 m (5400-7400 ft.), and slopes are flat to gentle. Soils are sands derived from local sandstone, eolian sands or alluvium. In areas protected from grazing, the unvegetated ground surface supports cryptobiotic crusts; in disturbed areas, bare ground cover is high. Total vegetation cover is somewhat sparse, rarely exceeding 50% and usually closer to 25%. *Muhlenbergia pungens* is the dominant or codominant grass, although other grasses may be important in terms of cover, including *Bouteloua gracilis*, *Achnatherum hymenoides*, *Sporobolus cryptandrus*, and *Aristida purpurea*. At Zion National Park, the community is codominated by montane grasses such as *Muhlenbergia montana* and *Poa fendleriana*. Forbs are diverse but contribute little total cover and vary widely among sites. *Machaeranthera canescens*, *Senecio spartioides*, and *Heterotheca villosa* are among the more common species. Scattered shrubs, such as *Atriplex confertifolia*, *Gutierrezia sarothrae*, and *Opuntia* spp., are often present but do not total more than 10% cover.

DISTRIBUTION

Capitol Reef National Park

This association is rare within the park. It was sampled east of Fruita and in Paradise Flats. Since the plot data were collected, the area around the Paradise Flats plot has converted to more of a rabbitbrush / blue grama herbaceous shrubland than a sandhills muhly herbaceous association. *Muhlenbergia pungens* is still present at the site but is no longer dominant. No other sites of this association are known in the park. *Muhlenbergia pungens* tends to be most abundant on unstable sites, e.g., shifting dunes and "blowout" pockets. It occupies sandy substrates of bottomlands, hills, washes, and canyon bottoms from desert shrub to pinyon-juniper woodlands of Hickman Bridge, Fremont River Valley, Capitol Gorge, Paradise Flats, Muley Twist Canyon, Cohab Canyon, Grand Wash, and Halls Creek.

Globally

This association has been documented from southern Utah and northwestern Colorado.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This herbaceous association was observed on steps-in-slope and low slopes with eolian sand or sandy alluvium. Sampled sites are nearly flat (1 to 3° slopes), occur between 1646 and 2256 m elevation, and occupy northern to eastern aspects. The unvegetated surface is unrecorded. Parent materials are variable and include sandstones and shale eroded and distributed as eolian deposits and alluvium. Soils are well-drained sands.

Globally

This association occurs locally on sandy flats and dunes in southern Utah and northwestern Colorado. Elevations range from 1646 to 2256 m (5400-7400 ft.), and slopes are flat to gentle. Soils are sands derived from local sandstone, eolian sands or alluvium. In areas protected from grazing, the unvegetated ground surface supports cryptobiotic crusts; in disturbed areas, bare ground cover is high.

VEGETATION DESCRIPTION

Capitol Reef National Park

This sparse grassland association is rare in the park, occurring on sand dunes and deep sandy flats. The vegetation is characterized by *Muhlenbergia pungens*. Associated graminoids are low in diversity, provide sparse to low cover, and include *Achnatherum hymenoides* and *Bouteloua gracilis*. Forbs are low in diversity, provide sparse cover, and include *Artemisia campestris*, *Eriogonum leptocladon*, and *Senecio spartioides*. Short and dwarf-shrubs are varied and can provide sparse to low cover, usually 10% or less. *Atriplex confertifolia* and the succulent *Opuntia fragilis* provide sparse to low cover.

Globally

This association is somewhat rare and local in the Colorado Plateau of Colorado and Utah. Total vegetation cover is somewhat sparse, rarely exceeding 50% and usually closer to 25%. *Muhlenbergia pungens* is the dominant or codominant grass, although other grasses may be important in terms of cover, including *Bouteloua gracilis*, *Achnatherum hymenoides*, *Sporobolus cryptandrus*, and *Aristida purpurea*. At Zion National Park, the community includes montane grasses such as *Muhlenbergia montana* and *Poa fendleriana*. Forbs are diverse but contribute little total cover and vary widely among sites. *Machaeranthera canescens*, *Senecio spartioides*, and *Heterotheca villosa* are among the more common species. Scattered shrubs, such as *Atriplex confertifolia*, *Gutierrezia sarothrae*, and *Opuntia* spp., are often present, but do not total more than 10% cover.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Muhlenbergia pungens</i>

Globally

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Muhlenbergia pungens</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Yucca elata var. *utahensis*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (22-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This association is poorly documented from the Colorado Plateau. The sites used in this description are varied in composition and structure. Once more information becomes available, it may be necessary to split this association.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Stands have been heavily grazed by cattle in the past, leaving observable trails.

Capitol Reef National Park Data: This description is based on 1988 field data (2 plots: CARE.9098, CARE.9414).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

Aquilegia micrantha - *Mimulus eastwoodiae* Herbaceous Vegetation Mancos Columbine - Eastwood's Monkeyflower Herbaceous Vegetation

CODE	CEGL002729
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	Saturated temperate perennial forb vegetation (V.B.2.N.f.)
ALLIANCE	<i>AQUILEGIA MICRANTHA</i> SATURATED HANGING GARDEN HERBACEOUS ALLIANCE (A.2506) Mancos Columbine Saturated Hanging Garden Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Hanging Garden (CES304.764)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This hanging garden type is scattered throughout the canyons of the Colorado Plateau in Utah, northern Arizona and western Colorado, where groundwater emerges from cracks, crevices, alcoves and ledges in cliffs to create moist seeps. Hanging gardens form exclusively in sedimentary rocks; the best developed examples occur in massive bedded sandstones of eolian origin, such as Navajo, Wingate, Cedar Mesa and Entrada formations. Water chemistry is variable, ranging from potable to calcareous to saline. The structure of these communities ranges from a crack in a vertical cliff face supporting a narrow line of herbaceous vegetation to deep, shaded alcoves supporting different plant assemblages on the back wall and on the wet colluvial floor of the alcove. Elevations range from 1250 to 1890 m (4100-6200 ft.), and aspect is not important in determining stand distribution. Soils are typically poorly developed sandy loams and generally are saturated throughout the growing season. The dominant species are generally forbs, ferns and graminoids; however, shrubs and trees sometimes form a margin sheltering the gardens. The forb component includes a number of rare and endemic species. Characteristic forbs include *Adiantum capillus-veneris*, *Aquilegia micrantha*, *Mimulus eastwoodiae*, *Cirsium* spp., *Epipactis gigantea*, *Zigadenus vaginatus*, *Maianthemum stellatum*, *Solidago velutina*, and *Dodecatheon pulchellum*. Graminoids tend to be variable from stand to stand; common species include *Juncus ensifolius*, *Calamagrostis scopulorum*, *Agrostis gigantea*, *Schizachyrium scoparium*, *Carex aurea*, and *Carex curatorum*. The woody species that occur on the margins of these wetlands are also variable and may include *Populus* spp., *Pinus edulis*, *Juniperus scopulorum*, *Rhus trilobata*, *Toxicodendron rydbergii*, *Clematis ligusticifolia*, *Cercocarpus intricatus*, *Ericameria nauseosa*, and *Cercocarpus montanus*.

DISTRIBUTION

Capitol Reef National Park

This association was sampled in and adjacent to Halls Creek. *Aquilegia micrantha* is known from hanging gardens in Lower Halls Creek; *Mimulus eastwoodiae* is known from hanging gardens in Halls Creek Narrows. The association is known from Sheets Gulch and is likely to be found in similar sites elsewhere in the park.

Globally

This association is restricted to massive sandstone cliffs and slopes in canyons of the Colorado Plateau in western Colorado and southeastern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This herbaceous association occurs in hanging gardens and seeps throughout the Waterpocket Fold in the park. Sites

are found in alcoves and crevices between 1250 and 1890 m elevation, with variable aspect orientation. The alcoves and seeps supporting hanging gardens are eroded into Navajo and Wingate sandstone cliffs. Parent materials are Navajo and Wingate sandstone with bedrock cracks and eroded fine-grained soils. Soils are saturated to poorly drained sands. Just outside the park boundary this association is known to occur at the base of the Mesa Verde Group. Sites have also been found adjacent to the park in alcoves and crevices of the Curtis Formation.

Globally

These wetland communities are scattered throughout the canyons of the Colorado Plateau in Utah, northern Arizona and western Colorado. Occurrences are defined by cracks, crevices, alcoves and ledges in cliffs where groundwater emerges to create permanently moist seeps. Hanging gardens form exclusively in sedimentary rocks; the best developed examples occur in massive bedded sandstones of eolian origin, such as Navajo, Wingate, Cedar Mesa, Moab Tongue and Entrada sandstones. Water chemistry is variable, ranging from potable to calcareous to saline. The structure of these communities ranges from a simple crack in a vertical cliff face supporting a narrow line of herbaceous vegetation to deep, shaded alcoves supporting different plant assemblages on the back wall and on the wet colluvial floor of the alcove. Elevations range from 1250 to 1890 m (4100-6200 ft.), and aspect is not important in determining stand distribution. Soils are typically poorly developed sandy loams and generally are saturated throughout the growing season and may have an alkaline crust.

VEGETATION DESCRIPTION

Capitol Reef National Park

Hanging gardens containing the Eastwood monkey-flower herbaceous association occur rarely on ledges and in alcoves and can be difficult to access in the park. The vegetation is characterized by the forb *Mimulus eastwoodiae*. Additional forbs common to these wetlands and providing moderate to dense cover include *Adiantum capillus-veneris*, *Cirsium calcareum*, and *Maianthemum stellatum*. The graminoid layer is low in diversity but can have moderate to dense cover by *Agrostis gigantea* and *Panicum* sp. The shrub layer below the gardens is low in diversity and provides sparse to moderate cover, including *Baccharis emoryi* and *Toxicodendron radicans*.

Globally

The dominant species within the seep are generally forbs, ferns and graminoids; however, mesophytic shrubs and trees sometimes form a margin sheltering the gardens. Vegetative components of hanging gardens are diverse and include a number of rare and endemic species. *Aquilegia micrantha* and *Mimulus eastwoodiae* are present to codominant. Other characteristic forbs present in many hanging gardens include *Adiantum capillus-veneris*, *Cirsium rydbergii*, *Dodecatheon pulchellum*, *Epipactis gigantea*, *Euphorbia brachycera*, *Heterotheca villosa*, *Zigadenus vaginatus*, *Maianthemum stellatum*, and *Solidago velutina*. Graminoids tend to be more variable from stand to stand; common species include *Juncus ensifolius*, *Calamagrostis scopulorum*, *Dichanthelium acuminatum*, *Agrostis gigantea*, *Schizachyrium scoparium*, *Carex aurea*, and *Carex curatorum*. The woody species that occur on the margins of these wetlands are also variable and may include *Populus* spp., *Pinus edulis*, *Juniperus scopulorum*, *Rhus trilobata*, *Toxicodendron radicans*, *Toxicodendron rydbergii*, *Clematis ligusticifolia*, *Cercocarpus intricatus*, *Ericameria nauseosa*, and *Cercocarpus montanus*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tall shrub/sapling	<i>Baccharis emoryi</i>
Short shrub/sapling	<i>Toxicodendron radicans</i>
Herb (field)	<i>Mimulus eastwoodiae</i>
Herb (field)	<i>Agrostis gigantea</i>
Herb (field)	<i>Adiantum capillus-veneris</i>

Globally

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Aquilegia micrantha</i> , <i>Mimulus eastwoodiae</i>
Herb (field)	<i>Adiantum capillus-veneris</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Lactuca serriola, *Melilotus officinalis*, *Tamarix chinensis*

Globally

Erigeron kachinensis, Mimulus eastwoodiae, Tamarix chinensis, Toxicodendron radicans

CONSERVATION STATUS RANK

Global Rank & Reasons: G2G3 (14-Nov-2005). This association tends to be under-sampled because many stands are located on inaccessible vertical cliffs.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This association is part of a complex of herbaceous communities collectively known as "hanging gardens." Few systematic studies of these communities have been completed (e.g., Welsh and Toft 1981, Welsh 1989, Fowler 1995), and even fewer quantitative data are available, partly because stands can be difficult or dangerous to access. The National Park Service is undertaking systematic surveys of vegetation, particularly spring and seep communities, throughout the Colorado Plateau (A. Evenden pers. comm. 2005). As more data become available, the various hanging garden associations should be revisited. John Spence, botanist at Glen Canyon National Recreation Area, is reported to be in the process of publishing a comprehensive study and classification of hanging gardens in the Colorado Plateau (J. Spence pers. comm. 2005).

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Sampled seeps and hanging gardens do not contain the diagnostic species *Aquilegia micrantha* and at one site does not contain either *Aquilegia micrantha* or *Mimulus eastwoodiae*. However, other hanging gardens known throughout the park do contain the above-mentioned species. This association has not been thoroughly sampled within the park due to access difficulties. One further consideration for future sampling of this and other sparsely distributed communities is the method to collect plot data. Since traditional plots are not practical in vertical environments, alternative methods need to be developed and guidelines distributed. *Capitol Reef National Park Data:* The description is based on 1986 and 1988 field data (3 plots: CARE.9052, CARE.9138, CARE.9424 and local knowledge by park staff).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Spence, mod. J. Coles and K.A. Schulz

REFERENCES: CONHP unpubl. data 2003, Carsey et al. 2003a, Evenden pers. comm., Fowler 1995, Malanson 1980, Malanson 1982, Malanson and Kay 1980, Romme et al. 1993, Spence pers. comm., Welsh 1989, Welsh and Toft 1981, Western Ecology Working Group n.d.

***Bromus tectorum* Semi-natural Herbaceous Vegetation**
Cheatgrass Semi-natural Herbaceous Vegetation

CODE	CEGL003019
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Annual graminoid or forb vegetation (V.D.)
PHYSIOGNOMIC GROUP	Temperate or subpolar annual grasslands or forb vegetation (V.D.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar annual grasslands or forb vegetation (V.D.2.N.)
FORMATION	Short temperate annual grassland (V.D.2.N.d.)
ALLIANCE	<i>BROMUS TECTORUM</i> SEMI-NATURAL HERBACEOUS ALLIANCE (A.1814) Cheatgrass Semi-natural Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This herbaceous vegetation type is found throughout much of western North America from the western Great Plains to the Intermountain West. It occurs most often after disturbance of a natural shrub- or grass-dominated community that results in the replacement of the natural vegetation by non-native, annual grass species of *Bromus*. *Bromus tectorum* typically dominates the community with over 80-90% of the total vegetation cover, making it difficult to determine what natural community was formerly present. This vegetation also includes grasslands dominated or codominated by other Eurasian introduced annual *Bromus* species such as *Bromus hordeaceus*, *Bromus madritensis*, *Bromus japonicus*, *Bromus rigidus*, or *Bromus rubens*. It is distinct from the annual *Bromus* communities found along the Pacific Coast typical of the Mediterranean or maritime climates.

DISTRIBUTION

Capitol Reef National Park

Data are not available.

Globally

This alliance-level herbaceous vegetation type is found throughout much of western North America from the western Great Plains to intermountain and southwestern U.S.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

Data are not available.

Globally

This herbaceous vegetation type is found throughout much of western North America from the western Great Plains to the Intermountain and southwestern U.S. Elevation ranges from sea level to 2200 m. Stands occur after disturbance of a natural shrub- or grass-dominated community, resulting in the replacement of the natural vegetation by non-native, annual grass species of *Bromus*, although invasion of undisturbed sites has also been reported (e.g., Evans et al. 2001). At Wind Cave National Park in South Dakota, weedy non-native graminoid vegetation occurs on recently disturbed areas, most commonly along roads. Small stands also occur in prairie dog towns (H. Marriott pers. comm. 1999). In the Great Basin, *Bromus tectorum* grasslands have invaded large areas of burned-over sagebrush steppe. *Bromus tectorum* increases the fire frequency of steppe communities, which eventually eliminates sagebrush (FEIS 2001).

VEGETATION DESCRIPTION

Capitol Reef National Park

Data are not available.

Globally

This vegetation type is characterized by a sparse to dense, short, annual graminoid layer typically dominated by *Bromus tectorum* with over 80-90% of the total vegetation cover. Other introduced annual species of *Bromus* that may dominate or codominate are *B. carinatus*, *B. hordeaceus*, *B. madritensis*, *B. japonicus*, *B. rigidus*, or *B. rubens*. Although there may be remnant species of the former native vegetation, the high cover of annual bromes makes it difficult to determine what natural community was formerly present. Weedy and exotic annual forbs may also have significant cover in some stands. At Wind Cave National Park in South Dakota, this weedy non-native graminoid vegetation is usually dominated by several perennial and annual brome grasses, including *Bromus inermis*, *Bromus japonicus*, and *Bromus tectorum*. Cover is variable (H. Marriott pers. comm. 1999), and in drought years, *Bromus tectorum* may be sparse or absent.

MOST ABUNDANT SPECIES

Capitol Reef National Park

Data are not available.

Globally

Stratum

Herb (field)

Species

Bromus hordeaceus, *Bromus japonicus*, *Bromus madritensis*, *Bromus rigidus*, *Bromus rubens*, *Bromus tectorum*

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (invasive) (1-Dec-1997).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This alliance also includes grasslands dominated or codominated by other Eurasian introduced annual *Bromus* species. It is distinct from the annual *Bromus* communities found along the Pacific Coast with Mediterranean or maritime climates because it does not have the introduced annual oatgrass (*Avena barbata* and *Avena fatua*), or other species typical of the California annual grassland (Sawyer and Keeler-Wolf 1995).

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Data are not available.

Capitol Reef National Park Data: The description is based on 2004 field data (1 plot: CARE.8705)

Local Description Authors:

Global Description Authors: D. Faber-Langendoen, mod. K. Schulz and J. Coles

REFERENCES: Beatley 1976, Cogan et al. 2004, Daubenmire 1975, Englund 2004, Evans et al. 2001, FEIS 2001, Karl et al. 1999, Marriott pers. comm., Naumann pers. comm., Redente et al. 1992, Sawyer and Keeler-Wolf 1995, Western Ecology Working Group n.d., Young and Evans 1973, Young and Evans 1978

***Pinus ponderosa* Slickrock Sparse Vegetation**
Ponderosa Pine Slickrock Sparse Vegetation

CODE	CEGL002972
PHYSIOGNOMIC CLASS	Sparse Vegetation (VII)
PHYSIOGNOMIC SUBCLASS	Consolidated rock sparse vegetation (VII.A.)
PHYSIOGNOMIC GROUP	Sparsely vegetated cliffs (VII.A.1.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural sparsely vegetated cliffs (VII.A.1.N.)
FORMATION	Cliffs with sparse vascular vegetation (VII.A.1.N.a.)
ALLIANCE	WOODED BEDROCK SPARSELY VEGETATED ALLIANCE (A.2546) Wooded Bedrock Sparsely Vegetated Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Cliff and Canyon (CES304.779)
Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This sparse wooded association is restricted to exposures of massive Navajo sandstone in the canyons and plateaus of southern Utah. The vegetation is rooted in joints in the sandstone. Because Navajo sandstone is a massive formation and is relatively undeformed in the Colorado Plateau, joints and fractures are relatively rare; thus the vegetation is sparse. Sites are on gentle to vertical slopes, occur between 1800 and 2430 m elevation, and are oriented to any aspect. The unvegetated surface has high exposure of bedrock and sparse to low cover of litter, large rocks, and sand. Soils are rapidly drained, shallow loamy sands and form only in cracks and potholes in the bedrock. This ponderosa pine slickrock sparse vegetation association is characterized by *Pinus ponderosa* trees, often stunted to less than 10 m tall that range in cover from 1% to less than 20%. The shrub element is depauperate also and provides sparse to low cover. Common shrubs include *Amelanchier utahensis*, *Cercocarpus intricatus*, and *Arctostaphylos patula*. The herbaceous layer is diverse in terms of species composition but is sparse, less than 5% total cover. The forb

Helianthella microcephala is relatively common.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon and was sampled north of North Coleman Canyon and in upper Deep Creek. It occurs throughout the Waterpocket Fold in sheltered pockets among the domes and cliffs of Navajo Sandstone.

Globally

This association is currently only known from southern Utah. It is relatively common on Navajo sandstone outcrops at Zion National Park and, although less common, occurs on similar substrates in Capitol Reef National Park.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This uncommon sparse vegetation type occurs on exposed Navajo sandstone on escarpments, canyons and in alcoves within the park. Slopes are moderate to steep (15-45°), occur between 1900 and 2430 m elevation, and may be oriented to any aspect. The unvegetated surface has high exposure of bedrock and sparse to low cover of litter, large rocks, and sand. Parent materials are Navajo sandstone. Soils are rapidly drained loamy sands.

Globally

This sparse vegetation association was observed on exposures of massive Navajo sandstone in the canyons and plateaus of southern Utah. Sites are on gentle to vertical slopes, occur between 1800 and 2430 m elevation, and are oriented to any aspect. The unvegetated surface has high exposure of bedrock and sparse to low cover of litter, large rocks, and sand. Soils are rapidly drained, shallow loamy sands and form only in cracks and potholes in the bedrock.

VEGETATION DESCRIPTION

Capitol Reef National Park

This slickrock-dominated community is uncommon in the park but occurs throughout the Waterpocket Fold. Total vegetation cover ranges from 4 to 35%. The association is characterized by an open canopy, typically somewhat dwarfed but occasionally to 15 m tall, of *Pinus ponderosa* trees with 1 to 5% cover. Scattered *Pinus edulis* and *Juniperus osteosperma* or *Juniperus scopulorum* trees may form a scattered subcanopy, occasionally with slightly higher cover than *Pinus ponderosa*. The shrub layer is sparse and may include *Amelanchier utahensis*, *Cercocarpus intricatus*, and *Arctostaphylos patula*. The herbaceous layer is diverse in terms of species composition but provides less than 5% total cover. Forbs tend to have higher cover than grasses; reported herbaceous species include *Helianthella microcephala*, *Hesperostipa comata*, *Leymus salinus*, and *Achnatherum hymenoides*.

Globally

This ponderosa pine slickrock sparse vegetation association is characterized by *Pinus ponderosa* trees, often stunted to less than 10 m tall that range in cover from 1% to less than 20%. The shrub element is depauperate also and provides sparse to low cover. Common shrubs include *Amelanchier utahensis*, *Cercocarpus intricatus*, and *Arctostaphylos patula*. The herbaceous layer is diverse in terms of species composition but is sparse, less than 5% total cover. The forb *Helianthella microcephala* is relatively common.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pinus ponderosa</i>
Tall shrub/sapling	<i>Amelanchier utahensis</i>
Tall shrub/sapling	<i>Cercocarpus intricatus</i>
Short shrub/sapling	<i>Arctostaphylos patula</i>
Herb (field)	<i>Helianthella microcephala</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Pinus ponderosa</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (22-Jan-2002)

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This type is poorly sampled because many occurrences are on inaccessible near-vertical sandstone cliffs that are hundreds of feet high. When viewed with binoculars, the community appears to be relatively homogenous.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Sites are most common on slickrock slopes in the Waterpocket Fold. Soils are very shallow and are deposited in small ledges between bedrock folds. No disturbance was noted. Other plots are associated with dry washes with significant bedrock exposures.

Capitol Reef National Park Data: The description is based on 2004 field data and data collected in 2005 during accuracy assessment (4 plots: CARE.0700, CARE_AA.0416, CARE_AA.1109, CARE_AA.1331).

Local Description Authors: J. Von Loh, mod. D. Clark and J. Coles

Global Description Authors: J. Coles

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

***Cercocarpus intricatus* Slickrock Sparse Vegetation
Littleleaf Mountain-mahogany Slickrock Sparse Vegetation**

CODE	CEGL002977
PHYSIOGNOMIC CLASS	Sparse Vegetation (VII)
PHYSIOGNOMIC SUBCLASS	Consolidated rock sparse vegetation (VII.A.)
PHYSIOGNOMIC GROUP	Sparsely vegetated pavement (VII.A.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural sparsely vegetated pavement (VII.A.2.N.)
FORMATION	Pavement with sparse vascular vegetation (VII.A.2.N.a.)
ALLIANCE	<i>CERCOCARPUS INTRICATUS</i> SPARSELY VEGETATED ALLIANCE (A.2543) Littleleaf Mountain-mahogany Sparsely Vegetated Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Cliff and Canyon (CES304.779)
Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This sparse shrubland association is restricted to exposures of massive sandstones such as on the Colorado Plateau. Elevations range between 1412 and 2348 m (4630-7700 ft.), while slopes and aspects vary widely. The density of the vegetation is limited by the availability of crevices and shallow depressions where sandy soil collects and plants can root. Most of the surface is sandstone, sometimes nearly covered by lichens. Total vegetation cover is less than 15% and often less than 5%. *Cercocarpus intricatus* is dominant or codominant, with lesser cover by other shrubs such as *Amelanchier utahensis*, *Arctostaphylos patula*, *Artemisia bigelovii*, *Cercocarpus montanus*, *Glossopetalon spinescens* var. *meionandrum*, or *Ephedra viridis*. The herbaceous layer is diverse, variable and low in cover. Occasional dwarfed individuals (often only 1-1.5 m tall) of *Pinus edulis* or *Juniperus osteosperma* may occur.

DISTRIBUTION

Capitol Reef National Park

This association is widely distributed along the Waterpocket Fold in the park. It was sampled on exposures of Navajo and Kayenta formation sandstone in the vicinity of Brimhall Canyon, Upper Muley Twist, between North and South

Coleman canyons, near Oak Creek, north of Sheets Gulch and in Deep Creek.

Globally

This association has been described from National Park Service units in southern and eastern Utah and western Colorado with extensive exposures of massive sandstones.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This sparse shrubland association was observed on exposed bedrock of Navajo and Kayenta formation sandstones. Sites are gentle (0 to 5° slopes), occur between 1463 and 2348 m elevation, and are oriented to all aspects. The unvegetated surface is unrecorded but is typically 50 to 90% bedrock exposure. Parent materials are sandstone, mostly Navajo Formation but with some Kayenta Formation present. Soils are rapidly drained fine sands.

Globally

This sparse shrubland association is restricted to exposures of massive sandstones such as the Navajo, Weber, Cedar Mesa, White Rim, Kayenta and Wingate formations on the Colorado Plateau. Elevations range between 1412 and 2348 m (4630-7700 ft.), slopes range from level to vertical, and all aspects are possible. The vegetation roots in crevices where sandy soil collects. As much as 99% of the surface is exposed bedrock or rock and gravel from fractured bedrock, sometimes nearly covered by lichens.

VEGETATION DESCRIPTION

Capitol Reef National Park

This association is common in the park and is distributed with sandstone exposures. The vegetation is characterized by the shrub *Cercocarpus intricatus*. The canopy trees *Juniperus osteosperma* and *Pinus edulis* are occasionally present and provide sparse cover. The associated shrub layer has moderate diversity in terms of species composition and provides sparse to low cover. Common tall shrubs include *Amelanchier utahensis* and *Fraxinus anomala*. Short and dwarf-shrubs typically present include *Artemisia bigelovii*, *Gutierrezia sarothrae*, and *Opuntia polyacantha*. The herbaceous layer is nearly absent from some stands and is moderately diverse in others, providing sparse cover. Graminoids are sometimes present, including *Achnatherum hymenoides* and *Bouteloua gracilis*. Forbs occasionally observed include *Helianthella microcephala*, *Phlox hoodii*, and *Stephanomeria minor*.

Globally

This *Cercocarpus intricatus* sparse shrub association is restricted to exposures of sandstone. Germination sites for vascular plant species are limited to cracks and small depressions in the bedrock where soil collects. Total vegetation cover is less than 20% and often is 5% or less. *Cercocarpus intricatus* is dominant or codominant, with between 1 and 20% cover. Most stands contain other shrubs as well, including *Amelanchier utahensis*, *Arctostaphylos patula*, *Artemisia bigelovii*, *Cercocarpus montanus*, *Glossopetalon spinescens* var. *meionandrum*, or *Ephedra viridis*. The herbaceous layer is diverse, variable and low in cover. Occasional dwarfed individuals (often only 1-1.5 m tall) of *Pinus edulis* or *Juniperus osteosperma* may occur. Colorful lichens may cover much of the surface of the exposed bedrock.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Tall shrub/sapling	<i>Amelanchier utahensis</i> , <i>Fraxinus anomala</i>
Short shrub/sapling	<i>Ericameria nauseosa</i> , <i>Rhus trilobata</i>
Short shrub/sapling	<i>Cercocarpus intricatus</i> , <i>Ephedra viridis</i>
Herb (field)	<i>Artemisia bigelovii</i> , <i>Gutierrezia microcephala</i> , <i>Gutierrezia sarothrae</i>
Herb (field)	<i>Helianthella microcephala</i> , <i>Stephanomeria minor</i>
Herb (field)	<i>Achnatherum nelsonii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Short shrub/sapling	<i>Cercocarpus intricatus</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park
Bromus tectorum

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (22-Jan-2002).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Three individual stands are located on almost pure bedrock, near a vertical sandstone wall, and on white slickrock, respectively.

Capitol Reef National Park Data: The description is based on 1986 and 1988 field data (9 plots: CARE. 9034, CARE.9097, CARE.9111, CARE.9115, CARE.9116, CARE.9169, CARE.9180, CARE.9203, CARE.9420).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

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

***Ephedra torreyana* - (*Atriplex* spp.) / Nonvascular Gypsum Sparse Vegetation
Torrey's Joint-fir - (Saltbush species) / Nonvascular Gypsum Sparse Vegetation**

CODE	CEGL002349
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	<i>EPHEDRA TORREYANA</i> SPARSELY VEGETATED ALLIANCE (A.2571) Torrey's Joint-fir Sparsely Vegetated Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Blackbrush-Mormon-tea Shrubland (CES304.763)
Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)
Inter-Mountain Basins Shale Badland (CES304.789)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This sparse shrubland is restricted to the barren slopes of badlands, ridges, hills and gullies with gypsum soils in the northern Colorado Plateau of eastern Utah and western Colorado. Sites are flat to moderately steep (0 to 36° slopes), occur between 1280 and 1845 m (4200-6050 ft.) elevation, and are oriented to all aspects. The unvegetated surface has as much as 95% cover of ground lichens or bare soil. Litter and rocks are scarce, but surface erosion may expose a layer of gravel. Parent materials are gypsiferous shales of the Paradox, Moenkopi or Carmel formations. Soils are rapidly drained and range in texture from sandy loam to silty clay, although the sand often consists entirely of unweathered gypsum crystals. The vegetation is characterized by the moderate to near-total cover by gypsophilous ground lichens. The total vascular vegetation cover ranges from 1 to 10% and rarely as high as 30%. It consists of a scattering of *Ephedra torreyana* shrubs that ranges in cover from 1 to 15%. Other shrubs may be present, including *Atriplex canescens*, *Atriplex confertifolia*, *Ericameria nauseosa*, and *Opuntia polyacantha*. The herbaceous layer is

absent to extremely sparse in terms of cover, but some plots may contain occasional plants of *Achnatherum hymenoides*, *Poa fendleriana*, *Pleuraphis jamesii*, and the forbs *Eriogonum inflatum*, *Lepidium montanum*, *Lappula occidentalis*, and *Sphaeralcea parvifolia*.

DISTRIBUTION

Capitol Reef National Park

This association is widespread in the northern portions of the park, in the Carmel Formation along the Waterpocket Fold. It was sampled near the confluence of Deep Creek and the Fremont River, near Upper Deep Creek in the South Desert, and along the Halls Creek drainage within the park.

Globally

This association is known from gypsum outcrops and soils in eastern Utah and western Colorado.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This sparse association was observed on badlands slopes, upper slopes of ridges, and on interfluves. Sites are gentle to moderately steep (2 to 20° slopes), occur between 1458 and 1845 m elevation, and are oriented to eastern aspects. The unvegetated surface has up to 93% cover of vascular cryptogams or bare soil. There is sparse to low cover of litter. Parent materials are of the Carmel Formation. Soils are rapidly drained sands and sandy loams.

Globally

This sparse shrubland is restricted to barren badlands, ridges, hills and gullies with gypsum soils in eastern Utah and western Colorado. Sites are flat to moderately steep (0 to 36° slopes), occur between 1280 and 1845 m (4200 - 6050 ft.) elevation, and are oriented to all aspects. The unvegetated surface has up to 95% cover of ground lichens or bare soil. Litter and rocks are scarce, but surface erosion may expose a layer of gravel. Parent materials are gypsiferous shales of the Paradox, Moenkopi or Carmel formations. Soils are rapidly drained and range in texture from sandy loam to silty clay, although the sand often consists entirely of unweathered gypsum crystals.

VEGETATION DESCRIPTION

Capitol Reef National Park

This sparse vegetation association is widespread in the northern portion of the park and occasional along Halls Creek drainage in the southern portion of the park. The total vegetation cover ranges from 3 to 30% cover. This sparse shrub association is characterized by a sparse canopy of *Ephedra torreyana* short shrubs that range in cover from 1 to 15%. The associated short- and dwarf-shrub layers are moderately diverse in terms of species composition, provide sparse to low cover, and commonly include *Atriplex confertifolia* and *Ericameria nauseosa*. The herbaceous layer is low in species composition, provides sparse cover, and includes the bunchgrass *Achnatherum hymenoides* and the forb *Lepidium montanum*. Cryptogam cover is high for these stands, ranging from 88 to 93% cover.

Globally

This unusual sparse shrubland is limited by soils within the Colorado Plateau. This association is characterized by the moderate to near-total cover by gypsophilous ground lichens. The total vascular vegetation cover ranges from 1 to 10% and rarely as high as 30%. It consists of a scattering of *Ephedra torreyana* shrubs that ranges in cover from 1 to 15%. Other shrubs may be present, including *Atriplex canescens*, *Atriplex confertifolia*, *Ericameria nauseosa*, and *Opuntia polyacantha*. The herbaceous layer is absent to extremely sparse in terms of cover, but some plots may contain occasional plants of *Achnatherum hymenoides*, *Poa fendleriana*, *Pleuraphis jamesii*, and the forbs *Eriogonum inflatum*, *Lepidium montanum*, *Lappula occidentalis*, and *Sphaeralcea parvifolia*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex canescens</i> , <i>Atriplex confertifolia</i> , <i>Ericameria nauseosa</i>
Short shrub/sapling	<i>Ephedra torreyana</i> , <i>Fallugia paradoxa</i>
Herb (field)	<i>Atriplex gardneri</i> , <i>Krascheninnikovia lanata</i>
Herb (field)	<i>Achnatherum hymenoides</i>

Globally

<u>Stratum</u>	<u>Species</u>
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Short shrub/sapling *Ephedra torreyana*

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Bromus tectorum, Descurainia pinnata, Salsola tragus

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (21-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Many sites have high cover of cryptobiotic crust. Some sites are subject to erosion from runoff resulting in shrubs growing from pedestals of soil. Two plots have received light grazing by cattle.

Capitol Reef National Park Data: The description is based on 1986, 2003, and 2005 (AA) field data (9 plots: CARE.0421, CARE.0477, CARE.0523, CARE.9032, CARE.9132, CARE.9309, CARE_AA.0450, CARE_AA.1058, CARE_AA.1278).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Ephedra torreyana* - *Artemisia bigelovii* Sparse Vegetation
Torrey's Joint-fir - Bigelow Sagebrush Sparse Vegetation**

CODE	CEGL002350
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	<i>EPHEDRA TORREYANA</i> SPARSELY VEGETATED ALLIANCE (A.2571) Torrey's Joint-fir Sparsely Vegetated Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)
Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This Colorado Plateau association has been described from Petrified Forest National Park in northern Arizona and Capitol Reef National Park in southeastern Utah, where it is widespread. Stands occur on plateaus, mesas, ridges, hills, cliffs, rocky colluvial slopes, benches, terraces, and near drainage channels that are gently sloping to steep (3-50%) between 1402 and 1915 m elevation on all aspects. The unvegetated surface has moderate to high cover of gravel and low to moderate cover of large rocks and litter. Cryptogams are typically absent, but one stand has 75% cover. Parent materials include sandstones and shale. Soils are rapidly drained and variable in texture, including loams, sands, and clays, but are unified by a coating of fine to coarse gravels composed of sandstone, shale, basalt, or petrified wood. The vegetation is typically sparse (<10% total cover) and is characterized by an open, mixed shrub

canopy dominated or codominated by *Ephedra torreyana* and *Artemisia bigelovii*. Locally, shrub cover may range up to about 20% cover, but in general, shrub cover is <10% with scattered grasses and forbs (<5% cover). Additionally, total cover may temporarily exceed 10% following rain events due to blooms of annuals. Associated shrubs are diverse but characteristically include all or some of *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Ericameria nauseosa*, *Eriogonum corymbosum*, and *Gutierrezia sarothrae*. Occasional *Juniperus osteosperma* may be present as saplings. The herbaceous layer is characteristically depauperate and sparse. Species recorded from plots include *Achnatherum hymenoides*, *Aristida purpurea*, *Bouteloua gracilis*, *Hesperostipa comata*, and *Pleuraphis jamesii*. Forbs present include *Phacelia crenulata* and *Tetaneuris acaulis*. The exotic annual grass *Bromus tectorum* is common in many of the sampled stands.

DISTRIBUTION

Capitol Reef National Park

This association is abundant and was sampled east of Brimhall Canyon, near the Brimhall trailhead, on Notom Bench, near Notom Ranch, in the Hartnet Draw, at Polk Creek, on Rock Springs Bench, near Chimney Rock, on the Red Slide, in the vicinity of Wagon Box Mesa and near Fruita.

Globally

This association occurs in Petrified Forest National Park in northern Arizona and Capitol Reef National Park in southeastern Utah. It is likely to occur on suitable habitat throughout the central Colorado Plateau.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This sparse vegetation association was observed on slopes, steps-in-slope, interfluves, ridges, hills, and colluvial slopes. Sites are gentle to steep (2 to 28° slopes), occur between 1402 and 1915 m elevation, and are oriented to all aspects. The unvegetated surface has moderate to high cover of gravel and low to moderate cover of large rocks. There is low to moderate cover of litter. Cryptogams are typically absent, but one stand had 75% cover. Parent materials include sandstones and shale of the Summerville, Entrada, Curtis, Chinle, Carmel, Salt Wash Member of the Morrison Formation, and Emery formations. Soils are rapidly drained and variable in texture.

Globally

This Colorado Plateau association has been described from Petrified Forest National Park in northern Arizona and Capitol Reef National Park in southeastern Utah, where it is widespread. Stands occur on plateaus, mesas, ridges, hills, cliffs, rocky colluvial slopes, benches, terraces, and near drainage channels that are gently sloping to steep (3-50%) between 1402 and 1915 m elevation. Aspect is not an important factor in determining the distribution of this association. The unvegetated surface has moderate to high cover of gravel and low to moderate cover of large rocks and litter. Cryptogams are typically absent, but one stand has 75% cover. Parent materials include sandstones and shale of the Summerville, Entrada, Curtis, Chinle, Carmel, Salt Wash Member and Emery formations. Soils are rapidly drained and variable in texture, including loams, sands, and clays, but are unified by a coating of fine to coarse gravels composed of sandstone, shale, basalt, or petrified wood.

VEGETATION DESCRIPTION

Capitol Reef National Park

This sparse vegetation association is abundant in the northern portion of the park and common elsewhere. The total vegetation cover ranges from 1 to 70% cover. This sparse shrub association is characterized by an open canopy of *Ephedra torreyana* and *Artemisia bigelovii* short shrubs that range in cover from 0 to 5% and 0 to 15%, respectively. The canopy tree *Juniperus osteosperma* is occasionally present as saplings and provides sparse to low cover. The associated short- and dwarf-shrub layers are somewhat diverse in terms of species composition, provide sparse to low cover, and include *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Ericameria nauseosa*, *Eriogonum corymbosum*, and *Gutierrezia sarothrae*. The herbaceous layer is low in species composition and generally provides sparse cover. Common graminoids include *Achnatherum hymenoides*, *Aristida purpurea*, *Bouteloua gracilis*, *Hesperostipa comata*, and *Pleuraphis jamesii*. Forbs commonly present include *Phacelia crenulata* and *Tetaneuris acaulis*. Cryptogams are typically absent, but one stand had 75% cover.

Globally

This shrubland association is typically sparse (<10% total cover) and is characterized by an open, mixed canopy dominated or codominated by *Ephedra torreyana* and *Artemisia bigelovii*. Shrub cover may range up to about 20% cover, but in general, shrub cover is <10% with scattered grasses and forbs (<5% cover). Additionally, total cover

may temporarily exceed 10% following rain events due to blooms of annuals. Associated shrubs are diverse but characteristically include all or some of *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Ericameria nauseosa*, *Eriogonum corymbosum*, and *Gutierrezia sarothrae*. Occasional *Juniperus osteosperma* may be present as saplings. Other shrubs species that may be present with low cover are *Artemisia tridentata*, *Atriplex canescens*, *Atriplex gardneri*, *Coleogyne ramosissima*, *Krascheninnikovia lanata*, *Opuntia polyacantha*, *Purshia stansburiana*, *Rhus trilobata*, *Shepherdia rotundifolia*, *Tetradymia glabrata*, and *Tetradymia spinosa*. The herbaceous layer is characteristically depauperate and sparse. Species recorded from plots include *Achnatherum hymenoides*, *Achnatherum speciosum*, *Aristida purpurea*, *Bouteloua gracilis*, *Bouteloua eriopoda*, *Hesperostipa comata*, *Hesperostipa neomexicana*, *Pleuraphis jamesii*, *Sporobolus airoides*, and *Vulpia octoflora*. Forbs present may include *Astragalus amphioxys*, *Chaetopappa ericoides*, *Chamaesyce fendleri*, *Cryptantha crassisepala*, *Lepidium montanum*, *Parryella filifolia*, *Phacelia crenulata*, *Plantago patagonica*, *Senecio spartioides*, and *Tetranneuris acaulis*. The exotic annual grass *Bromus tectorum* is common in many of the sampled stands.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Short shrub/sapling	<i>Atriplex canescens</i> , <i>Atriplex confertifolia</i> , <i>Chrysothamnus viscidiflorus</i> , <i>Coleogyne ramosissima</i> , <i>Ericameria nauseosa</i> , <i>Rhus trilobata</i> , <i>Shepherdia rotundifolia</i> , <i>Tetradymia glabrata</i> , <i>Tetradymia spinosa</i>
Short shrub/sapling	<i>Artemisia bigelovii</i> , <i>Artemisia tridentata</i> , <i>Ephedra torreyana</i> , <i>Ephedra viridis</i> , <i>Purshia stansburiana</i>
Herb (field)	<i>Atriplex gardneri</i> , <i>Eriogonum corymbosum</i> , <i>Eriogonum leptocladon</i> , <i>Gutierrezia sarothrae</i> , <i>Xylorhiza venusta</i>
Herb (field)	<i>Lepidium montanum</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Achnatherum speciosum</i> , <i>Bouteloua eriopoda</i> , <i>Bouteloua gracilis</i> , <i>Bromus tectorum</i> , <i>Hesperostipa comata</i> , <i>Pleuraphis jamesii</i> , <i>Vulpia octoflora</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex confertifolia</i> , <i>Chrysothamnus viscidiflorus</i> , <i>Ericameria nauseosa</i>
Short shrub/sapling	<i>Artemisia bigelovii</i> , <i>Atriplex canescens</i> , <i>Ephedra torreyana</i> , <i>Ephedra viridis</i>
Herb (field)	<i>Eriogonum corymbosum</i> , <i>Eriogonum leptocladon</i> , <i>Gutierrezia sarothrae</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Bouteloua gracilis</i> , <i>Hesperostipa comata</i> , <i>Pleuraphis jamesii</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus rubens, *Bromus tectorum*, *Descurainia pinnata*

Globally

Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (21-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Dense cryptobiotic crust is present on some stands. There is some drought effect with many dead shrubs. There is some grazing of stands.

Capitol Reef National Park Data: The description is based on 1986, 1988, 2003, and 2005 (AA) field data (17 plots:

CARE.0401, CARE.0404, CARE.0418, CARE.0443, CARE.0451, CARE.0459, CARE.0543, CARE.0554, CARE.0560, CARE.9012, CARE.9024, CARE.9040, CARE.9096, CARE.9223, CARE.9412, CARE.9435, CARE_AA.0390).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Western Ecology Working Group n.d.

***Ephedra torreyana* Sparse Vegetation Torrey's Joint-fir Sparse Vegetation**

CODE	CEGL002353
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	<i>EPHEDRA TORREYANA</i> SPARSELY VEGETATED ALLIANCE (A.2571) Torrey's Joint-fir Sparsely Vegetated Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This very sparse shrub association is locally common in eastern Utah, occurring on alluvial fans, pediments, terraces, benches, mesas, rocky canyon slopes and stabilized dunes. This community occupies sites that are often actively eroding steep slopes, with pedestalled shrubs and gullies. A few stands are on level to gently sloping sand sheets that are subject to blowouts. Sampled stands are located between 1220 and 1780 m (4000-5840 ft.) elevation. Bare ground, rocks and gravel cover most of the unvegetated surface, although biological soil crusts may cover as much as 50% of the surface in sandier sites. Soils tend to be rapidly drained, shallow, alkaline sandy loams, clay loams and loamy sands derived from shaley sandstones (or sandy shales) such as the Morrison, Moenkopi, Cutler and Summerville formations. Total vegetation cover ranges from 1 to 15% but is generally less than 10%. The vegetation is dominated or codominated by a sparse canopy of *Ephedra torreyana* with between 1 and 10% cover. Associated shrubs may include *Atriplex confertifolia*, *Eriogonum leptocladon*, *Eriogonum corymbosum*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, *Xylorhiza* spp., *Opuntia* spp., and *Coleogyne ramosissima*. The herbaceous layer may have as much cover as the shrubs but will rarely exceed a few percent and may often be nearly absent. Common herbaceous species include *Pleuraphis jamesii*, *Eriogonum inflatum*, and *Sphaeralcea* spp. *Achnatherum hymenoides* is absent or has only trace cover. *Bromus tectorum* may be abundant in disturbed sites.

DISTRIBUTION

Capitol Reef National Park

This association is fairly common and was sampled in Cathedral Valley and along Middle Desert Wash within the park and along Notom Road adjacent to the park.

Globally

This association has been documented from southeastern Utah. It is likely to be fairly restricted in both its range and in the size of occurrences.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This association occupies pediments, terraces, and interfluves. Sites are flat to moderately steep (0 to 20° slopes), occur between 1567 and 1689 m elevation, and are oriented to northeastern and southeastern aspects. The unvegetated surface has high exposure of bare soil or cover by small rocks and gravel. Parent materials are Entrada sandstone or Summerville formations and old alluvial deposits. Soils are rapidly drained loams, sandy loams, and loamy sands.

Globally

This very sparse shrub association occurs in patches scattered throughout the northern Colorado Plateau on a broad range of landforms, including alluvial fans, pediments, terraces, benches, mesas, rocky canyon slopes and stabilized dunes. Stands are located on level to moderately steep slopes (to 50%) between 1220 and 1780 m (4000-5840 ft.) elevation. Most sampled plots are on cooler north or east aspects, with few plots on south or west aspects. Bare ground, rocks and gravel cover most of the unvegetated surface, although biological soil crusts may cover as much as 50% of the surface in sandier sites. There is little litter. Parent materials are Tidwell Member of the Morrison Formation shale eroded to form old alluvial deposits. Soils tend to be rapidly drained, shallow, alkaline sandy loams, clay loams and loamy sands derived from shaley sandstones (or sandy shales) such as the Morrison Moenkopi, Cutler and Summerville formations.

VEGETATION DESCRIPTION

Capitol Reef National Park

This sparse vegetation association is locally common in Cathedral Valley, Middle Desert Wash and south of the Fremont River on the east side of the Waterpocket Fold. Total vegetation cover ranges from 3 to 25% in these sparsely vegetated stands. This association is characterized by a sparse canopy of *Ephedra torreyana* short shrubs that range in cover from 1 to 5%. The associated short- and dwarf-shrub layers include *Atriplex confertifolia*, *Ericameria nauseosa*, *Eriogonum leptocladon*, and *Gutierrezia sarothrae*, which provide sparse to low cover. The herbaceous layer is low in species composition and provides sparse cover. The common short bunchgrass that provides sparse cover is *Pleuraphis jamesii*. Common forbs provide sparse cover and include *Sphaeralcea parvifolia* and *Thelesperma subnudum*.

Globally

This sparse shrub association is locally common in eastern Utah. Total vegetation cover ranges from 1 to 15% but is generally less than 10%. The vegetation is dominated or codominated by a sparse canopy of *Ephedra torreyana* with between 1 and 10% cover. Associated shrubs may include *Atriplex confertifolia*, *Eriogonum leptocladon*, *Eriogonum corymbosum*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, *Xylorhiza* spp., *Opuntia* spp., and *Coleogyne ramosissima*. The herbaceous layer may have as much cover as the shrubs but will rarely exceed a few percent and may often be nearly absent. Diversity is moderate considering the sparse nature of the community and often includes *Pleuraphis jamesii*, *Eriogonum inflatum*, *Phacelia crenulata*, and *Sphaeralcea* spp. *Achnatherum hymenoides* is absent or has only trace cover. *Bromus tectorum* may be abundant in disturbed sites.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex confertifolia</i> , <i>Ericameria nauseosa</i>
Short shrub/sapling	<i>Ephedra torreyana</i>
Herb (field)	<i>Eriogonum leptocladon</i> , <i>Gutierrezia sarothrae</i>
Herb (field)	<i>Pleuraphis jamesii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex confertifolia</i>
Short shrub/sapling	<i>Ephedra torreyana</i>
Herb (field)	<i>Eriogonum leptocladon</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Bromus tectorum, *Salsola tragus*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (21-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

All *Ephedra torreyana* shrubland types are relatively sparse, and many have some degree of graminoid understory. This association is distinguished from others by having only *Pleuraphis jamesii* in the understory and lacking any significant cover by *Bouteloua gracilis* or *Achnatherum hymenoides*. However, there is relatively little quantitative data and no literature to support these associations; as additional data become available, it may be necessary to revisit and revise association concepts.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Sites are subject to erosion from runoff and flash floods. One plot had sparse grazing by cattle.

Capitol Reef National Park Data: The description is based on 2003 and 2005 (AA) field data (3 plots: CARE.0419, CARE.0434, CARE.0436, CARE_AA.0333).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Leymus salinus* Shale Sparse Vegetation**
Salinas Lyme Grass Shale Sparse Vegetation

CODE	CEGL002745
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	<i>LEYMUS SALINUS</i> SPARSELY VEGETATED ALLIANCE (A.1258) Salinas Lyme Grass Sparsely Vegetated Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Cliff and Canyon (CES304.779)
Inter-Mountain Basins Shale Badland (CES304.789)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This generally sparse association typically occurs on cool, sparsely vegetated badland slopes of Mancos, Morrison, or other shale formations in the Colorado Plateau of southeastern Utah and western Colorado. Elevations range between 1341 and 1971 m (4400-6465 ft.), and slopes tend to be north to east-facing and moderately steep to steep (38-71% slope). The physical appearance of the community is characterized by a moderate cover of colluvial rocks and blocks fallen from sandstone ledges above the stand. Total vegetation cover is characteristically sparse (<10%) but ranges widely, from 3 to 55% depending on aspect and slope. The tall bunchgrass *Leymus salinus* is visually dominant, with between 2 and 10% cover. Freeze-thaw, shrink-swell action, frequent rolling rocks and sheet erosion of the clay soils tend to create bare soils between the scattered bunches of *Leymus salinus* and dwarf-shrubs such as *Chrysothamnus viscidiflorus* var. *stenophyllus*, *Gutierrezia sarothrae*, and *Atriplex confertifolia*, which total between 1 and 5% cover.

DISTRIBUTION

Capitol Reef National Park

This association is rare within the park and was sampled in the shale badlands of Bitter Springs Canyon and northwest of the Temple of the Sun.

Globally

This association typically occurs on cool, sparsely vegetated badland slopes of Mancos, Morrison, or other shale formations in the Colorado Plateau of southeastern Utah and western Colorado.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This herbaceous vegetation association was observed on north-facing colluvial slopes of the Mancos shale and Morrison formations. Sampled sites are moderately steep to steep (16 to 20° slopes), occur between 1733 and 1960 m elevation, and occupy northern to northwestern aspects. The unvegetated surface has moderate to high cover of gravel and large rocks and low to moderate cover of litter. There is typically low exposure of bare soil. Parent materials are Mancos shale and Morrison clays. Soils are rapidly drained clay loams to sandy loams.

Globally

This association typically occurs on sparsely vegetated shale slopes in the Colorado Plateau of southeastern Utah and western Colorado between 1341 and 1971 m (4400-6465 ft.). Slopes tend to be moderately steep to steep (38-71%) and are generally north to east-facing. The soil surface usually has moderate cover of colluvial rocks and blocks from sandstone ledges above the stand. Soil textures range from clays to clay loams, and the effects of shrink-swell action and sheet erosion in these soils is evident in the high percentage of bare ground. Parent materials include Chinle Formation shale and Morrison Formation shale, including the Brushy Basin, Tidwell, and Salt Wash members.

VEGETATION DESCRIPTION

Capitol Reef National Park

This sparse grassland is rare in the park, restricted to shale badlands exposures. Total vegetation cover ranges from 17 to 65%. This tall bunchgrass association is characterized by *Leymus salinus* that ranges in cover from 5 to 25%. Associated graminoids are low in diversity, provide sparse to low cover, and include *Achnatherum hymenoides*, *Bromus tectorum*, and *Hesperostipa comata*. Forbs are low in diversity and provide sparse cover. Short and dwarf-shrubs are varied and can provide sparse to low cover, usually 10% or less. *Atriplex confertifolia* and *Chrysothamnus viscidiflorus* are typically present. Sparse cryptobiotic cover is present, typically less than 1% cover.

Globally

This generally sparse herbaceous association occurs throughout the northern Colorado Plateau in its characteristic habitat of steep, northerly shale slopes. Total vegetation cover is characteristically sparse (<10%) but ranges widely, from 3 to 55% locally depending on aspect and slope, with cooler north-facing slopes tending to support denser vegetation. The tall bunchgrass *Leymus salinus* is visually dominant, with between 2 and 10% cover. Other grasses and forbs may be present, usually with less than 1% cover except in wet years. Short and dwarf-shrubs may have nearly equal cover to the grass and include species such as *Chrysothamnus viscidiflorus* var. *stenophyllus*, *Atriplex confertifolia*, *Ephedra* spp., and *Gutierrezia sarothrae*. In some stands, scattered individuals of *Juniperus osteosperma* may be present.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex confertifolia</i> , <i>Chrysothamnus viscidiflorus</i>
Herb (field)	<i>Hesperostipa comata</i> , <i>Leymus salinus</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex confertifolia</i>
Herb (field)	<i>Leymus salinus</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus rubens, *Bromus tectorum*, *Descurainia pinnata*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (26-Jun-2001).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Stands are lightly grazed by cattle and/or deer and elk. North-facing slopes support grassland association.

Capitol Reef National Park Data: This description is based on 2003 field data (3 plots: CARE.0503, CARE.0531, CARE.0581).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Comer pers. comm., Western Ecology Working Group n.d.

***Eriogonum corymbosum* Badlands Sparse Vegetation**
Crispleaf Wild 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) 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 gentle to moderately steep, occur between 1219 and 1945 m (4000-6380 ft.) 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 or Chinle shales 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 cover from 5 to 20%. Associated shrubs include *Atriplex confertifolia*, *Ephedra torreyana*, *Ericameria nauseosa*, *Psoralea fremontii*, *Salvia dorrii*, *Gutierrezia sarothrae*, 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; *Pleuraphis jamesii* and *Elymus elymoides* are among the few herbaceous species recorded in this association.

DISTRIBUTION

Capitol Reef National Park

This association is uncommon. It was sampled at Twin Rocks and on Danish Hill (Scenic Drive) within the park.

Globally

This association has been described from southern and eastern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This short-shrub association was observed on shale badlands and alluvial flats. Sites are flat to gentle (0 to 4° slopes), occur between 1720 and 1945 m 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 Formation shale that eroded to badlands

deposits. Soils are rapidly drained sandy clays and sandy loams.

Globally

This unusual sparse short-shrub association occurs on barren shale badlands. Sites are flat to gentle to moderately steep, occur between 1219 and 1945 m (4000-6380 ft.) 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 rock. Litter is sparse. Parent materials are Moenkopi, Morrison, Mancos or Chinle shales that erode to badlands. Vegetation has difficulty growing in these sites. Soils are rapidly drained sandy clays or silty clays.

VEGETATION DESCRIPTION

Capitol Reef National Park

This uncommon association occupies badlands in the vicinity of Fruita within the park. The total vegetation cover ranges from 5 to 25% cover. This sparse shrub association is characterized by an open canopy of *Eriogonum corymbosum* short shrubs that range in cover from 5 to 25%. The associated short- and dwarf-shrub layer is low in terms of species composition, provides sparse to low cover, and includes *Atriplex confertifolia* and *Ephedra torreyana*. The herbaceous layer is low in species diversity and provides sparse cover. No species of graminoid or forb provides more than 1% cover.

Globally

Total vascular vegetation cover for this association rarely exceeds 20% and is often closer to 10%. The vegetation is characterized by scattered *Eriogonum corymbosum* that ranges in cover from 5 to 20%. Associated shrubs include *Amsonia tomentosa*, *Atriplex confertifolia*, *Ephedra torreyana*, *Ericameria nauseosa*, *Psoralea fremontii*, *Salvia dorrii*, *Gutierrezia sarothrae*, 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; *Pleuraphis jamesii*, *Elymus elymoides*, and *Xylorhiza glabriuscula* are among the few herbaceous species recorded in this association.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Atriplex confertifolia</i> , <i>Chrysothamnus viscidiflorus</i> , <i>Eriogonum corymbosum</i>
Short shrub/sapling	<i>Ephedra torreyana</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Eriogonum corymbosum</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Halogeton glomeratus

Globally

Bromus tectorum, *Halogeton glomeratus*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (22-Jan-2002).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Some sites are very flat and have eroded with runoff, resulting in plants on pedestals.

Capitol Reef National Park Data: The description is based on 1986, 1987, 2003, and 2004 field data (6 plots:

CARE.0422, CARE.0620, CARE.9078, CARE.9319, CARE.9343, CARE.9704).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: J. Coles

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

***Eriogonum leptocladon* Sparse Vegetation** **Sand Wild Buckwheat Sparse Vegetation**

CODE	CEGL002822
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) Painted Desert Sparsely Vegetated Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Active and Stabilized Dune (CES304.775)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This sparse shrubland association is characteristic of sheets of loose or partially stabilized sand in southeastern Utah between 1220 and 1573 m (4000-5160 ft.) elevation. Stands occur on level to gently sloping sites with a tendency toward warmer western aspects. Soils are loamy sands and sandy loams derived from local eroding sandstone or eolian sands. Most of the unvegetated surface is bare soil, although biological soil crusts (consisting mostly of dark cyanobacteria) may cover as much as 20% of the ground in stable sites. Stands of this association tend to be small and occur in a mosaic with other sandy communities. Total vegetation cover by vascular species rarely exceeds 15%. The open shrub canopy is consistently dominated by *Eriogonum leptocladon* with between 2 and 10% cover. Other shrubs present may include *Eriogonum corymbosum*, *Atriplex canescens*, and *Gutierrezia sarothrae*. If *Artemisia filifolia* or *Coleogyne ramosissima* are present, it is with <1%. The herbaceous layer is generally sparse (5% or less total cover) and consists of species adapted to somewhat disturbed, sandy conditions. Common species include *Achnatherum hymenoides*, *Abronia fragrans*, *Oenothera pallida*, *Sporobolus* spp., and *Salsola tragus*.

DISTRIBUTION

Capitol Reef National Park

This community occurs approximately 1 mile southwest of the junction of the Notom Road with the main park road on the Fremont River.

Globally

This association has only been described from southeastern Utah.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This rare association occurs on sandy gentle slopes in the central part of the park. Soils are sandy loams derived from Entrada sandstone. The elevation of the sampled site is 1573 m.

Globally

This association is characteristic of sheets of loose or partially stabilized sand in southeastern Utah. Elevations range between 1220 and 1573 m (4000-5160 ft.). Stands occur on level to gently sloping sites with a tendency toward warmer western aspects. Soils are loamy sands and sandy loams derived from eroding sandstone or eolian sands. Most of the unvegetated surface is bare soil, although incipient biological soil crusts (consisting mostly of dark cyanobacteria) may cover up to 20% of the ground in more stable sites.

VEGETATION DESCRIPTION

Capitol Reef National Park

Total vegetation cover rarely exceeds 15% in this association. The shrub layer has approximately 10% cover and

consists primarily of *Eriogonum leptocladon* shrubs, most of which are less than 0.5 m tall. Other shrubs may be present in small amounts, including *Eriogonum corymbosum* and *Gutierrezia sarothrae*. The forb layer is sparse, rarely exceeding 5% total cover. The most conspicuous graminoid is *Pleuraphis jamesii*; forbs are varied and sparse, but common species include *Cryptantha* spp. and *Thelesperma subnudum*.

Globally

Stands of this sparse shrubland association tend to be small and occur in a mosaic of other sandy communities. Total vegetation cover by vascular species rarely exceeds 15%. The open canopy is consistently dominated by *Eriogonum leptocladon* with between 2 and 10% cover. Other shrubs present may include *Eriogonum corymbosum*, *Atriplex canescens*, and *Gutierrezia sarothrae*. If *Artemisia filifolia* or *Coleogyne ramosissima* are present, it is with 1% or less cover. The herbaceous layer is also generally sparse (5% or less cover) and consists of species adapted to somewhat disturbed, sandy conditions. Common species include *Achnatherum hymenoides*, *Abronia fragrans*, *Oenothera pallida*, *Sporobolus* spp., and *Salsola tragus*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Eriogonum leptocladon</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Eriogonum leptocladon</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Data are not available.

Globally

Salsola tragus

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (25-Aug-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Data are not available.

Capitol Reef National Park Data: The description is based on 2003 field data (1 plot: CARE.0420).

Local Description Authors: J. Coles

Global Description Authors: J. Coles

REFERENCES: 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)
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 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 1341-1890 m (4397-6200 ft.). The soil is a rapidly drained clay loam derived from shales such as the Salt Wash Member of the Morrison Formation or Chinle, Moenkopi 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 *Platyschukhria integrifolia* and *Xylorhiza venusta*.

DISTRIBUTION

Capitol Reef National Park

This association was sampled near Rock Springs Bench (about 200 m from the park boundary), along Deep Creek in the South Desert, upper Red Slide, head of Brimhall Canyon, at Jailhouse Rock, and north of Divide Canyon. It is locally common on heavy clays of the Chinle and Moenkopi formations near Fruita and on the Curtis Formation in the South and Middle deserts in the park.

Globally

This association is known from Arches, Capitol Reef and Petrified Forest national parks but likely is widespread in the painted desert and canyonlands regions of the Colorado Plateau in eastern Utah and northern Arizona.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This dwarf-shrub association was observed on low slopes of interfluves, midslopes of alluvial fans, and steps-in-slope of pediments. Sites are moderately steep (12 to 26° slopes), occur between 1756 and 1890 m elevation, and are oriented to southeastern and northwestern aspects. The unvegetated surface has high exposure of bare soil and low cover by litter. One site has moderate cover by gravel. Parent materials are Chinle, Moenkopi, and Curtis formation shale that erode to heavy clays. Soils are rapidly drained silt loams and sandy loams.

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 1341-1890 m (4397-6200 ft.). The soil is a rapidly drained clay loam derived from shales. Parent materials include the Salt Wash Member of the Morrison Formation, or Chinle, Moenkopi 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.

VEGETATION DESCRIPTION

Capitol Reef National Park

This dwarf-shrub association is rare to locally common in the park. The total vegetation cover ranges from 2 to 35% using cover estimates. This dwarf-shrubland is characterized by an open canopy of *Zuckia brandegeei* that ranges in cover from 1 to 25%. Canopy trees are rarely present, provide sparse cover, and include *Pinus edulis* and *Juniperus osteosperma*. The shrub layer is relatively diverse in terms of species composition and provides sparse to low cover. Short and dwarf-shrubs commonly present include *Artemisia bigelovii*, *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Ephedra torreyana*, *Ericameria nauseosa*, *Eriogonum corymbosum*, and *Eriogonum leptocladon*. The herbaceous layer is low in species diversity and typically provides sparse to low cover. Graminoids provide up to 5% cover, and include *Achnatherum hymenoides*, *Bromus tectorum*, and *Pleuraphis jamesii*. Forbs providing greater than 1% cover include only *Cryptantha pterocarya*.

Globally

This association's sparse canopy consists of *Zuckia brandegeei* with scattered *Artemisia bigelovii*, *Atriplex confertifolia*, *Atriplex obovata*, *Chrysothamnus viscidiflorus*, *Coleogyne ramosissima*, *Ericameria nauseosa*, *Eriogonum corymbosum*, *Eriogonum leptocladon*, *Ephedra torreyana*, *Ephedra viridis*, *Xylorhiza glabriuscula*, *Gutierrezia microcephala*, and *Gutierrezia sarothrae*. The herbaceous layer is low in diversity and provides sparse cover. The bunch grasses *Achnatherum hymenoides*, *Leymus salinus*, and *Pleuraphis jamesii* are present. Forbs include *Arabis holboellii*, *Cryptantha* sp., *Cymopterus acaulis*, *Eriogonum inflatum*, *Galium coloradoense*, *Penstemon barbatus*, *Platyschkuhria integrifolia*, and *Xylorhiza venusta*. *Bromus tectorum* may be present.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Eriogonum leptocladon</i>
Herb (field)	<i>Atriplex confertifolia</i> , <i>Chrysothamnus viscidiflorus</i> , <i>Ericameria nauseosa</i> , <i>Zuckia brandegeei</i>
Herb (field)	<i>Cryptantha pterocarya</i>
Herb (field)	<i>Pleuraphis jamesii</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Zuckia brandegeei</i>
Herb (field)	<i>Pleuraphis jamesii</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park
Bromus tectorum, *Halogeton glomeratus*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (29-Mar-2005).

CLASSIFICATION COMMENTS

Capitol Reef National Park
Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE:

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: There is some minor grazing. Southeast-facing slope across drainage has similar vegetation composition but is sparser. Steep slopes have rocky surface and active erosion that forms drainages. On one stand the vegetation is growing in and creating small pockets of soil among rocks. Shale badlands are present down slope from one stand and support pinyon pine - Utah juniper with a shrub understory.

Capitol Reef National Park Data: The description is based on 1986, 1988, and 2003 field data (7 plots: CARE.0440, CARE.0479, CARE.0566, CARE.9019, CARE.9197, CARE.9210, CARE.9411).

Local Description Authors: J. Von Loh, mod. D. Clark

Global Description Authors: K.A. Schulz

REFERENCES: Western Ecology Working Group n.d.

***Achnatherum hymenoides* Shrub Herbaceous Alliance**
Indian Ricegrass Shrub Herbaceous Alliance

CODE	A.1543
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 xeromorphic (often thorny) shrub layer (V.A.7.N.h.)
ALLIANCE	<i>ACHNATHERUM HYMENOIDES</i> SHRUB HERBACEOUS ALLIANCE (A.1543) Indian Ricegrass Shrub Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

Stands of this alliance occur on mesas, hill slopes, sand dunes, and along drainage channels on the Colorado Plateau and Great Basin. Elevation ranges from 1530-1920 m. Climate is semi-arid. Slopes vary from 0-30% depending on landform. All aspects are possible. The soil ranges from sand to sandy loam derived from eolian deposits. Vegetation included in this alliance is characterized by a moderately dense graminoid layer (25-40% cover) dominated by the medium-tall bunchgrass *Achnatherum hymenoides*, with a sparse (10-25% cover) xeromorphic short-shrub layer typically dominated by *Ephedra viridis* or *Ephedra torreyana* mixed with occasional *Artemisia bigelovii*, *Atriplex canescens*, *Ericameria nauseosa*, *Eriogonum corymbosum*, *Gutierrezia sarothrae*, *Parryella filifolia*, or *Purshia tridentata*. *Bouteloua gracilis*, *Hesperostipa comata*, *Muhlenbergia porteri*, *Pleuraphis jamesii*, *Sporobolus airoides*, or *Sporobolus cryptandrus* may be present to codominant. Forbs have sparse cover.

DISTRIBUTION

Capitol Reef National Park

This rare association was sampled on a mesa north of the Oak Creek Canyon access road within the Park.

Globally

Vegetation in this grassland alliance was described from Utah and northern Arizona, but may occur on sandy sites throughout much of the Colorado Plateau and Great Basin.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This shrub herbaceous alliance was observed on a mesa top. The site is gentle (2° slope), occurs at 1860 m, and is oriented to the southwest. The unvegetated surface has high exposure of bare soil and low cover of litter. Parent materials are variable and include sandstones and shale that are distributed as pediment deposits. Soils are rapidly drained sandy loams.

Globally

This alliance occurs on mesas, hill slopes, sand dunes, and along drainage channels on the Colorado Plateau and Great Basin. Stands were described from a woodland park at 1920 m elevation on Rone Bailey Mesa in southern Utah (Van Pelt 1978) and at 1530-1600 m at Petrified Forest National Park in northern Arizona. Climate is semi-arid. Annual precipitation is highly variable with a mean of 30 cm. Slopes vary from 0-30% depending on landform. Slopes are moderate (less than 15%); all aspects are possible. The soil ranges from sand to sandy loam derived from eolian deposits overlaying sandstone. Some stands are surrounded by a *Juniperus* woodlands or *Artemisia tridentata* - *Ephedra viridis*-dominated shrublands.

VEGETATION DESCRIPTION

Capitol Reef National Park

This alliance is rare within the Park. The total vegetation cover ranges from 6% to 30% in this sparsely vegetated stand. This shrub herbaceous association is characterized by the tall bunchgrass *Achnatherum hymenoides* that ranges in cover from 1% to 5%. The shrub layer is low in terms of species diversity and provides sparse cover. Associated short and dwarf-shrubs include *Artemisia frigida*, *Ephedra viridis*, and *Gutierrezia sarothrae*. The herbaceous layer is low in terms of species diversity and provides sparse cover. Associated graminoids include *Aristida purpurea*, *Hesperostipa comata*, and *Vulpia octoflora*. Forbs present include *Cryptantha flava*, *Cymopterus* sp., and

Hymenopappus filifolius.

Globally

This alliance is found in the Colorado Plateau and Great Basin and is characterized by a moderately dense graminoid layer dominated by the medium-tall bunchgrass *Achnatherum hymenoides*, with a sparse xeromorphic short-shrub layer dominated by *Ephedra viridis* or *Ephedra torreyana* mixed with occasional *Artemisia bigelovii*, *Atriplex canescens*, *Ericameria nauseosa*, *Eriogonum corymbosum*, *Gutierrezia sarothrae*, *Parryella filifolia*, or *Purshia tridentata*. *Bouteloua gracilis*, *Hesperostipa comata*, *Muhlenbergia porteri*, *Pleuraphis jamesii*, *Sporobolus airoides*, or *Sporobolus cryptandrus* may be present to codominant. Forbs have sparse cover. The medium-tall bunchgrass *Sporobolus cryptandrus* and patches of the sod-forming shortgrass *Bouteloua gracilis* are commonly present in varying abundance. Van Pelt (1978) described a stand with a canopy cover of 12% *Ephedra viridis*, 12% *Achnatherum hymenoides*, 4% *Sporobolus cryptandrus*, and 17% *Bouteloua gracilis*. Forbs cover is generally sparse and includes species of *Machaeranthera*.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Ephedra viridis</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Hesperostipa comata</i> , <i>Vulpia octoflora</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Ephedra viridis</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Bouteloua gracilis</i> , <i>Sporobolus cryptandrus</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Artemisia frigida, *Gutierrezia sarothrae*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: Not applicable.

CLASSIFICATION COMMENTS

Capitol Reef National Park

This association is influenced by exposure on a mesa top and is severely drought- and wind-affected.

Globally

This alliance has two associations that are based on the Van Pelt (1978) description of communities dominated by *Ephedra cutleri* and *Achnatherum hymenoides* on Rone Bailey Mesa, Utah. Additional information came from four plots at Petrified Forest National Park in Arizona. Information on other occurrences is needed to describe the full range of this alliance.

CLASSIFICATION CONFIDENCE: Not applicable

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Mesa top location results in exposure to wind and run-off erosion.

Several dead Utah juniper trees are present.

Capitol Reef National Park Data: The description is based on 2003 field data (1 plot: CARE.0416).

Local Description Authors: J. Von Loh, mod. by D. Clark

Global Description Authors: K.A. Schulz

REFERENCES: Thomas et al. 2003b, Van Pelt 1978, Western Ecology Working Group n.d.

***Salix gooddingii* Temporarily Flooded Woodland Alliance**

Goodding's Willow Temporarily Flooded Woodland Alliance

CODE	A.640
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	<i>SALIX GOODDINGII</i> TEMPORARILY FLOODED WOODLAND ALLIANCE (A.640) Goodding's Willow Temporarily Flooded Woodland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

Woodlands in this alliance are dominated by *Salix gooddingii*, often with *Fraxinus velutina*, and occur in mesic canyons and along floodplains in the Trans-Pecos of western Texas, southern New Mexico, southern Arizona and into Mexico. It extends into the Colorado Plateau in Utah. Composition varies with soil moisture and flooding regime. *Populus fremontii* is generally uncommon or absent. Among the canopy species that may be present are *Sapindus saponaria* var. *drummondii*, *Juglans microcarpa*, *Celtis laevigata* var. *reticulata*, *Ungnadia speciosa*, *Prosopis glandulosa*, and *Quercus pungens*. Woodlands in this alliance occur as isolated pockets in mesic desert canyons and along rocky floodplains of small, intermittent streams and is often associated with seeps and springs.

DISTRIBUTION

Capitol Reef National Park

This rare was sampled at Lower Willow Tank and at Willow Tank at the southern Park boundary.

Globally

This alliance is found in the Trans-Pecos of western Texas, southern New Mexico, southern Arizona, and Utah. It is also found in the Mexican states of Chihuahua and Coahuila and possibly Sonora.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was observed around bedrock tanks or potholes in slickrock canyons. Sites are gentle (2° slope), occur between 1463 m – 1494 m, and are oriented to eastern aspects. The unvegetated surface is unrecorded. Parent materials are Navajo Sandstone. Soils are intermittently moist to saturated and occasionally inundated.

This association has established around tanks or potholes in the Navajo Sandstone Formation. It could be influenced by heavy grazing and drought that each help to introduce invasive plants. However, grazing was removed from the southern portion of the Park in 1988. Fire is not a key to this community's ecology.

Globally

This deciduous riparian woodland occurs from Trans-Pecos Texas and southern New Mexico to southwestern Arizona and adjacent Mexican states. Elevations in New Mexico range from 990 to 1110 m (3250-3650 ft.). Stand are known from the floodplains of larger rivers, but woodlands in this alliance occur as isolated pockets in mesic desert canyons and along rocky floodplains of small, intermittent streams and are often associated with seeps and springs.

VEGETATION DESCRIPTION

Capitol Reef National Park

This woodland alliance is rare, occurring near the south Park boundary. The vegetation is characterized by a moderately open to closed canopy of *Salix gooddingii* trees. The shrub layer is variable in cover and composition. Tall shrubs provide moderate cover and include *Salix exigua* and the exotic *Tamarix chinensis*, which is present in one stand. The short shrub *Euthamia occidentalis* provides low to moderate cover. The herbaceous layer typically provides low to moderate cover and is diverse. Common graminoids include *Achnatherum hymenoides*, *Bromus tectorum*, *Dichanthelium oligosanthes*, *Elymus canadensis*, and *Juncus balticus*. Forbs provide low cover and those

commonly observed include *Artemisia ludoviciana*, *Castilleja linariifolia*, *Heterotheca villosa*, and *Oenothera elata*.

Globally

This alliance is characterized by an open to moderate tree canopy dominated by *Salix gooddingii*. Composition varies with soil moisture and flooding regime. *Populus fremontii* is uncommon or absent (Muldavin et al. 2000a, Szaro 1989). Canopy species that may be present include *Sapindus saponaria* var. *drummondii*, *Juglans microcarpa*, *Celtis laevigata* var. *reticulata*, *Ungnadia speciosa*, *Prosopis glandulosa*, and *Quercus pungens*. A shrub layer, if present, may include *Baccharis emoryi*, *Baccharis salicifolia*, or other riparian shrubs.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Salix gooddingii</i>
Short shrub/sapling	<i>Euthamia occidentalis</i>
Herb (field)	<i>Dichanthelium oligosanthes</i> , <i>Juncus balticus</i>
Herb (field)	<i>Artemisia ludoviciana</i> , <i>Heterotheca villosa</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Salix gooddingii</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Elymus canadensis*, *Oenothera elata*, *Salix exigua*, *Tamarix chinensis*, *Tragopogon dubius*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: Not applicable.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

This alliance has a limited distribution. Remaining examples have had many large trees removed, contain exotic species, and have been impacted by overgrazing. Disruption of the natural flooding regime, through damming, water diversions, and stream channelization, is also a major threat to these woodlands.

CLASSIFICATION CONFIDENCE: Not applicable

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: One stand showed heavy grazing effects in 1987, however grazing was removed from the southern portion of the Park in 1988.

Capitol Reef National Park Data: The description is based on 1987 field data (2 plots: CARE.9371, CARE.9372).

Local Description Authors: J. Von Loh, mod. by D. Clark

Global Description Authors: K.D. Patterson, mod. K.A. Schulz

REFERENCES: Diamond 1993, Muldavin, et al. 2000a, Szaro 1989.

***Sporobolus flexuosus* Herbaceous Alliance**
Mesa Dropseed Herbaceous Alliance

CODE	A.1268
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 SPOROBOLUS FLEXUOSUS HERBACEOUS ALLIANCE (A.1268)
Mesa Dropseed Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This alliance contains grasslands dominated by *Sporobolus flexuosus* in sandy basins, broad benches and terraces and piedmonts in southern New Mexico and extends north into the Colorado Plateau in Utah. Associated species can include *Dasyochloa pulchella*, *Paspalum setaceum*, *Psorothamnus scoparius*, and *Sporobolus contractus*.

DISTRIBUTION

Capitol Reef National Park

This association is distributed on broad benches and terraces above Halls Creek in the southern portion of the Park.

Globally

This grassland occurs near playas in the Chihuahuan Desert in southern New Mexico and extends north into Utah. It potentially could be found in southeastern Arizona, west Texas, and Chihuahua and Sonora.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This herbaceous alliance was observed on steps-in-slopes, benches, and terraces above the active floodplain of Halls Creek south of the narrows. Sites are gentle (1 to 2° slopes), occur between 1199 m – 1463 m, and are oriented to northern exposures. The unvegetated surface has high exposure of bare soil and low cover of litter. Cryptogams are common, providing up to 20% cover. Parent materials are variable and include sandstones and shale that have eroded and deposited as terrace gravel and alluvium. Soils are rapidly drained sandy loams.

This alliance has become established on high terraces and benches that rarely flood. A large flood event with sufficient volume of water could remove this community or subject it to deposition of sediments or debris. Creek meandering could remove established stands over time, but in the process would create new habitats. Grazing has resulted in an abundance of Russian-thistle that has altered the make-up of this alliance.

Globally

Grasslands in this Chihuahuan Desert alliance are found in sandy basins and lower piedmonts in southern New Mexico. The climate is semi-arid with most of the annual precipitation of about 35 cm occurs during the summer months as the result of convectional thunderstorms and during winter as occasional rains. Late spring and early summer are typically dry. Summers are hot, and winters can have periods of cold weather and occasional snows. Elevations range from 1200-1580 m. Stands have been found on the edge of a sandy playas bottom where there is a slight slope. *Sporobolus flexuosus* stands generally occur in loose, and/or blowing sands. The soil is derived from sandy alluvium and is classified as a Psamment with little pedogenic development. The edge of the playa is probably inundated less often than the center of the playa, consequently salinity on the edge could be high. This plant association is presently known from extreme southwestern New Mexico on the Gray Ranch, Hidalgo County. Other possible locations include Texas.

VEGETATION DESCRIPTION

Capitol Reef National Park

This alliance is rare in the southern portion of the Park. The total vegetation cover ranges from 15% to 55% cover. This herbaceous association is characterized by an open stand of the perennial bunchgrass *Sporobolus flexuosus* that ranges in cover from 5% to 15%. The associated herbaceous layer is low to moderate in terms of species composition and provides low to moderate cover. Other graminoids commonly present include *Achnatherum hymenoides* and *Sporobolus contractus*. Common forbs that provide sparse to low cover include *Eriogonum inflatum*, *Malacothrix glabrata*, *Salsola tragus*, *Sphaeralcea parvifolia*, and *Stephanomeria exigua*. The shrub layer is typically sparse to low in cover and low in species composition, and includes the short and dwarf-shrubs *Ephedra viridis* and *Opuntia polyacantha*. The short shrub *Atriplex canescens* is often present in stands, providing sparse cover. Cryptogam cover

can be as high as 20%.

Globally

Vegetation in this Chihuahuan alliance is found in sandy basins and piedmonts. Stands have a herbaceous layer that averages between 20-40% cover. It is dominated by the perennial bunchgrass *Sporobolus flexuosus*. Codominates are typically the grasses *Dasyochloa pulchella*, *Paspalum setaceum*, and *Sporobolus contractus*. Other graminoids may include *Aristida divaricata*, *Bouteloua eriopoda*, *Bouteloua gracilis*, *Bouteloua parryi*, *Cyperus esculentus*, and *Digitaria cognata*. Forbs are moderately sparse, averaging less than 15% total cover. A common perennial forb is *Chamaesyce albomarginata* with up to 10% cover in one stand. Other species may include *Eriogonum wrightii*, *Hymenopappus flavescens*, *Sida neomexicana*, and *Solanum* spp. Annuals may be seasonally abundant during wet years. Sparsely scattered *Yucca elata* shrubs may be present on some stands (Muldavin et al. 1998a).

Sporobolus flexuosus has replaced *Bouteloua eriopoda* in areas on the Jornada Experimental Range (Hennessy 1983). *Sporobolus flexuosus* is more drought- and grazing-tolerant than *Bouteloua eriopoda* (Muldavin et al. 1998a).

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Ephedra viridis</i> , <i>Opuntia polyacantha</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Sporobolus contractus</i> , <i>Sporobolus flexuosus</i>
Herb (field)	<i>Stephanomeria exigua</i>

Globally

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Dasyochloa pulchella</i> , <i>Paspalum setaceum</i> , <i>Sporobolus contractus</i> , <i>Sporobolus flexuosus</i>

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, *Descurainia pinnata* *Opuntia polyacantha*, *Salsola tragus*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: Not applicable.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Globally

The similar *Bouteloua gracilis* Herbaceous Alliance (A.1282) has one association with *Sporobolus flexuosus* listed as a codominant. This may create classification confusion when *Bouteloua gracilis* is present but not codominant.

CLASSIFICATION CONFIDENCE: Not applicable

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Stand is located on broad flats and benches above Halls Creek in the southern end of the Park, up to 10 m above riparian habitat. The stand experienced moderate grazing until 1988.

Capitol Reef National Park Data: The description is based on 1986 and 2004 field data (2 plots: CARE. 0630, CARE.9199).

Local Description Authors: J. Von Loh, mod. by D. Clark

Global Description Authors: K.A. Schulz

REFERENCES: Bourgeron et al. 1993b, Bourgeron et al. 1995, Hennessy et al. 1983, Muldavin and Mehlhop 1992, Muldavin et al. 1998c, Reid et al. 1994, Western Ecology Working Group n.d.

Slickrock Fin Pocket [Park Special]

CODE Park Special
USNVC HIERARCHY Not applicable

ECOLOGICAL SYSTEM(S): Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

Data are not available.

DISTRIBUTION

Capitol Reef National Park

This community is rare and is described as a Park special mapping unit. It was sampled in the fins north of the Onion Beds, in upper Deep Creek and north of Rim Overlook Trail within the Park and occurs sporadically from upper Deep Creek south to the Burr Trail.

Globally

Data are not available.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

This woodland association was first observed in slots among fins in the area northeast of the Onion Beds. Sites are gentle (2 to 3° slopes), occur between 1768 m and 2317 m, and are oriented to all aspects. The unvegetated surface has high exposure of bare soil, moderate cover of litter, and low cover of live stem basal area for one stand. Parent materials are primarily Wingate sandstone, but occasionally Navajo Formation, that occur as exposed bedrock and are eroded to eolian and alluvial deposits. Soils are rapidly drained sands and loamy sands.

Globally

Data are not available.

VEGETATION DESCRIPTION

Capitol Reef National Park

This rare mixed woodland community occurs in the Navajo and Wingate Formation along the western edge of the Waterpocket Fold within the Park. The total vegetation cover ranges from 63% to 115% cover. This woodland community is characterized by emergent and canopy trees that provide low to moderate cover. The emergent layer includes an open canopy, typically 35-50 m tall, of *Pinus ponderosa* and/or *Pseudotsuga menziesii* trees that range in cover from 25% to 35% (*Pinus ponderosa* only on one site). The canopy layer includes an open canopy, typically 10-15 m tall, of *Pinus edulis* and *Juniperus osteosperma* trees that range in cover from 15% to 25% (*Pinus edulis* only on one site). The shrub layer is diverse in terms of species composition and provides low to moderate cover. Tall shrubs commonly present include *Acer glabrum*, *Amelanchier utahensis*, and *Fraxinus anomala*. The short shrub layer includes *Cercocarpus intricatus*, *Ericameria nauseosa*, *Mahonia fremontii*, *Rhus trilobata*, and *Shepherdia rotundifolia*. Dwarf-shrubs are uncommon and provide sparse cover. The herbaceous layer is moderate to high in species composition and provides low cover. Graminoids commonly present include *Achnatherum hymenoides* and *Poa fendleriana*. Common forbs include *Arabis selbyi*, *Heterotheca villosa*, and *Taraxacum officinale*. The liana *Clematis ligusticifolia* sometimes provides sparse cover.

Globally

Data are not available.

MOST ABUNDANT SPECIES

Capitol Reef National Park

Stratum

Tree canopy

Tall shrub/sapling

Short shrub/sapling

Species

Pinus ponderosa, *Pseudotsuga menziesii*, *Juniperus osteosperma*, *Pinus edulis*

Acer glabrum, *Amelanchier utahensis*, *Fraxinus anomala*, *Mahonia fremontii*

Cercocarpus intricatus, *Ericameria nauseosa*, *Shepherdia rotundifolia*

Herb (field) *Poa fendleriana Helianthella microcephala*
Herb (field) *Heterotheca villosa*

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Bromus tectorum, Descurainia pinnata

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: Not applicable.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: Not applicable

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: The community at one site is attributed to a slot canyon draining rapidly to a wider area below, resulting in an abundance of shrubs and trees.

Capitol Reef National Park Data: The description is based on 1986 and 2003 field data (4 plots: CARE.0528, CARE.9103, CARE.9326, CARE.9327).

Local Description Authors: J. Von Loh, mod. D. Clark and J. Coles

REFERENCES:

Waterpocket Community [Park Special]

CODE Park Special
USNVC HIERARCHY Not applicable

ECOLOGICAL SYSTEM(S): Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

Data are not available.

DISTRIBUTION

Capitol Reef National Park

This association is rare and was sampled just north of the Hickman Bridge Trail in the Fold. It occurs sporadically throughout the Waterpocket Fold in the Navajo Formation.

Globally

Data are not available.

ENVIRONMENTAL DESCRIPTION

Capitol Reef National Park

The waterpocket community was observed on slickrock where a chain of small ponds developed in drainages within the Park. The site is gentle (3° slope), occurs at 1829 m, and is oriented to the east. The unvegetated surface is unrecorded. Parent materials are Navajo Sandstone. Soils are poorly drained fine sands.

Globally

Data are not available.

VEGETATION DESCRIPTION

Capitol Reef National Park

This waterpocket community is rare within the park, occupying small depressions and narrow channels in slickrock drainages. The total vegetation cover ranges from near 0 to 100% based on field observation notes, in this patchy community. A number of diagnostic species occur but there is no clear dominant species. The canopy tree layer is low in species diversity, provides sparse cover, and includes *Fraxinus anomala* and *Juniperus osteosperma*. The shrub layer is diverse, provides low to moderate cover, and includes tall, short and dwarf-shrubs, as follows: *Amelanchier utahensis*, *Artemisia bigelovii*, *Cercocarpus intricatus*, *Ephedra viridis*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, and *Symphoricarpos oreophilus*. The herbaceous layer is diverse in terms of species composition and provides low to dense cover. Graminoids characteristic of the community include *Achnatherum hymenoides*, *Agrostis gigantea*, *Bouteloua gracilis*, *Elymus elymoides*, *Elymus trachycaulus*, *Hesperostipa comata*, *Juncus balticus*, *Muhlenbergia asperifolia*, *Sporobolus cryptandrus*, and *Vulpia octoflora*. Forbs may include *Artemisia ludoviciana*, *Asclepias speciosa*, *Castilleja linariifolia*, and *Heterotheca villosa*.

Globally

Data are not available.

MOST ABUNDANT SPECIES

Capitol Reef National Park

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Cercocarpus intricatus</i>
Herb (field)	<i>Achnatherum hymenoides</i> , <i>Agrostis gigantea</i> , <i>Elymus trachycaulus</i> , <i>Muhlenbergia asperifolia</i>
Herb (field)	<i>Artemisia ludoviciana</i> , <i>Castilleja linariifolia</i> , <i>Heterotheca villosa</i>

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Capitol Reef National Park

Asparagus officinalis, *Tamarix chinensis*, *Tragopogon dubius*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: Not applicable.

CLASSIFICATION COMMENTS

Capitol Reef National Park

Vegetation is distributed in drainages and small ponds where sediments have accumulated or fill bedrock cracks. The vegetation helps to settle out and accumulate additional sediments. With precipitation events, the sediments become saturated or inundated. Fire is not expected to occur or very rarely occurs in this community type.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: Not applicable

ELEMENT SOURCES

Capitol Reef National Park Inventory Notes: Plot is along a series of five small waterpockets. Where vegetation grows in the pockets the cover is near 100%. On adjacent slickrock there is almost no vegetation.

Capitol Reef National Park Data: The description is based on 1986 field data (1 plot: CARE.9101).

Local Description Authors: J. Von Loh, mod. D. Clark and J. Coles.

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Appendix G

Illustrated Keys to the Plant Associations of Capitol Reef National Park

Introduction

The vegetation of Capitol Reef National Park was characterized from field data collected between 1986 and 1988 by Romme et al. (1993), and between 2002 and 2004 under the U.S. Geological Survey - National Park Service Vegetation Mapping Program. This key was developed to assist in the accurate field identification of the 175 plant associations, alliances, and park specials described for the Park. Five rare and localized types were added to the key at the request of Park staff, although no plots of these types were sampled: *Arctostaphylos patula* Shrubland, Cushion Plant Sparse Herbaceous Vegetation, *Halogeton glomeratus* Semi-natural Herbaceous Vegetation, *Poa fendleriana* / Non-vascular Herbaceous Vegetation, and Wet Meadows Herbaceous Vegetation. These four types, as well as two others not included in these keys (*Atriplex* spp. Extreme Sparse Shrubland and Mesic Canyon Bottom Shrubland) do not appear in the association descriptions, but are included elsewhere in the project documentation. The keys are illustrated with images taken during the vegetation sampling and accuracy assessment efforts.

This key is structured to facilitate identification of plant associations using one or more dominant or characteristic species in concert with habitat information. Because of natural variation within plant associations, it is possible that a community can be keyed using more than one of the physiognomic keys. Ecotonal communities (areas where dominant species from several associations mix) may be difficult to key. This guide also allows the user to crosswalk plant associations directly to the Capitol Reef National Park vegetation map so that all research may have a common focal point relative to the baseline years of aerial photography (2001 and 2002) and field data collection (1986 to 1988, 2003 to 2005).

How to Use the Key

The key approaches plant association identification at two levels. The first level is physiognomic, allowing the user to determine which major group is being evaluated, e.g., forest, woodland, shrubland or herbaceous. The second level is based on dominant species (sometimes expressed in the key as “characterized by”) and to a lesser extent, habitat and distribution. As an aid to field workers, photographs representing typical situations appear below the association names. Once you’ve reached an association in the key, it always helpful to read the description of the association to confirm you’ve reached the correct type in the key.

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

1. You are observing vegetation that you think is an herbaceous or shrubland community, but it has some tree cover. In this case, try keying the vegetation through the woodland

key as well as the herbaceous or shrubland key. In general with any layer, if it does not cover at least 8% (tree layer) or 5% (shrub or herbaceous layers), it is ignored. The exception is in very sparse communities (see 4 below)

2. The diagnostic layer consists of woody plants that may appear in either a shrub or a tree form, depending on site conditions and age. These species include *Pinus edulis*, *Juniperus osteosperma*, *Cercocarpus ledifolius*, *Quercus gambelii*, *Fraxinus anomala*, and *Tamarix chinensis*. In this key, the first three are ALWAYS considered to be evergreen trees, regardless of their height or growth form, and the rest are considered shrubs, regardless of their height or growth form.
3. You can follow a key to a certain point, but you clearly have something not described in the key. This is to be expected occasionally—very likely you have an association that was not found during the sampling phases of the project.
4. Communities that are sparsely vegetated (e.g., < 10% to 15% total vascular plant cover) should be run through multiple keys. Even though they contain trees or shrubs, they may not fall cleanly into a “woodland” or “shrubland” category. “Sparse” vegetation is defined as having total vascular plant cover of < 10%.
5. Focus on the perennial species in the community, unless it consists almost entirely of annual or ephemeral species, or is highly disturbed or degraded.

Key I: The Major Physiognomic Groups of Capitol Reef National Park

- 1a)** Vegetation woody or appearing woody; the tallest stratum (usually with at least 5% cover) dominated by trees, shrubs, or shrub-like herbs; total vegetation cover may range from sparse to dense **(2)**
- 1b)** Vegetation non-woody; the tallest stratum (usually with at least 5% cover) dominated by grasses, grass-like herbs (graminoids), or broad-leaf herbs (forbs), which may be tall and coarse; total vegetation cover may range from sparse to dense; wetland to upland habitats; characteristic genera include *Achnatherum*, *Aquilegia*, *Artemisia*, *Bouteloua*, *Bromus*, *Carex*, *Eleocharis*, *Hesperostipa*, *Leymus*, *Mimulus*, *Muhlenbergia*, *Phragmites*, *Pleuraphis*, *Sporobolus*, and *Typha* - **Key IV**



- 2a)** **(1)** Tree-dominated forests (interlocking tree canopies) or woodlands (open, non-interlocking tree canopies); characteristic genera include *Acer*, *Celtis*, *Cercocarpus*, *Fraxinus*, *Juniperus*, *Ostrya*, *Picea*, *Pinus*, *Populus*, *Pseudotsuga*, *Quercus*, and *Salix* - **Key II**



- 2b)** Shrub-dominated vegetation; canopies may interlock, but are more commonly less dense and may be extremely sparse. Characteristic genera include *Alnus*, *Amelanchier*, *Arctostaphylos*, *Artemisia*, *Atriplex*, *Betula*, *Cercocarpus*, *Chrysothamnus*, *Coleogyne*, *Cornus*, *Ephedra*, *Ericameria*, *Eriogonum*, *Fallugia*, *Fraxinus*, *Grayia*, *Krascheninnikovia*, *Opuntia*, *Picrothamnus*, *Poliomintha*, *Purshia*, *Quercus*, *Rhus*, *Salix*, *Sarcobatus*, *Shepherdia*, *Suaeda*, *Symphoricarpos*, *Tamarix*, *Vanclevea*, *Zuckia* - **Key III**



Key II: Forest and Woodland Associations of Capitol Reef National Park

- 1a) Deciduous forests or woodlands occupying a variety of habitats including mesic stream banks and riparian areas or high elevation slopes (2)
- 1b) Evergreen forests or woodlands occupying a variety of habitats, typically upland or high elevation sites (16)
- 2a) (1) Forests or woodlands characterized by *Populus tremuloides*, *Celtis laevigata* var. *reticulata*, *Salix gooddingii*, *Fraxinus anomala*, or *Acer negundo*, typically occupying stream banks, mesic areas, or higher elevation slopes (3)
- 2b) *Populus angustifolia* or *Populus fremontii* forests or woodlands occurring within drainage bottoms or on mesic alluvial deposits (10)
- 3a) (2) *Populus tremuloides* forests or woodlands on high elevation plateaus, usually in the lee of ridges where snow collects; typically with an understory of *Symphoricarpos* spp. and often *Rosa woodsii* - ***Populus tremuloides* / *Symphoricarpos oreophilus* Forest [Map Class 22]**



- 3b) Woodlands characterized by *Celtis laevigata* var. *reticulata*, *Fraxinus anomala*, *Acer negundo*, or *Salix gooddingii* occurring along streams in canyon bottoms or in sandstone waterpockets, often with variable species composition (4)
- 4a) (3) *Celtis laevigata* var. *reticulata* woodlands, often with *Juniperus osteosperma* and occurring on floors of Navajo slickrock canyons in the Waterpocket Fold. Most of these canyons have not been surveyed, so a complete vegetation description is not available. Some canyons have netleaf hackberry, but others have only a combination of *Fraxinus anomala*, *Quercus gambelii*, *Rhamnus betulifolia*, *Salix gooddingii*, *Mahonia fremontii*, and occasionally *Acer negundo*. This association name was selected as a placeholder for the slickrock canyons in the southern Waterpocket Fold until further research can be completed - ***Celtis laevigata* var. *reticulata* Slickrock Canyon Woodland [Map Class 26d]**



- 4b)** Woodlands characterized by *Fraxinus anomala*, *Acer negundo*, or *Salix gooddingii*; vegetation cover may be moderate to dense; occurring along stream banks, in canyon bottoms, or in sandstone waterpockets (some *Fraxinus anomala* stands may occur on upland sites) **(5)**
- 5a)** (4) Open *Fraxinus anomala* tall shrublands or woodland mixed with other shrubs and typically occurring on the banks of ephemeral sandy streams or adjacent to drainages in fractured Salt Wash sandstone - ***Fraxinus anomala* Woodland [Map Class 12b]**

NOTE: Map Class 12b describes this and other associations found in intermittent washes in narrow canyons and ravines throughout the park. These associations are highly variable in species composition; the dominant shrubs will vary from canyon to canyon. Some stands are diverse and others contain only a few species, but all reflect a more mesic regime. Typical species include *Cercocarpus intricatus*, *Ericameria nauseosa*, *Fraxinus anomala*, *Ephedra viridis*, *Amelanchier utahensis*, *Shepherdia rotundifolia*, *Mahonia fremontii*, *Symphoricarpos longiflorus*, *Rhus trilobata*, and *Quercus gambelii*.



- 5b)** Woodlands characterized by *Acer negundo* or *Salix gooddingii*; often densely vegetated and occurring in canyon bottoms or in sandstone waterpockets **(6)**
- 6a)** (5) Open woodlands in smaller canyons dominated by *Acer negundo* and with a well-developed shrub understory in which *Ostrya knowltonii*, *Rhus trilobata*, and/or *Quercus gambelii* may be conspicuous **(7)**

- 6b)** *Salix gooddingii* woodlands, sometimes with other species in a mixed canopy, including *Acer negundo* or *Populus fremontii* (9)
- 7a)** (6) Woodlands characterized by dense *Acer negundo* and *Ostrya knowltonii*; stands restricted to Hall's Creek Narrows and the base of north-facing cliffs where water seeps out of the sandstone walls; typical associates include *Quercus gambelii*, *Celtis laevigata* var. *reticulata* and *Rhamnus betulifolia* - ***Acer negundo* - *Ostrya knowltonii* Woodland [Map Class 30]**



- 7b)** *Acer negundo* woodlands with open to dense canopies. The well-developed shrub understory is dominated by a mix of mesic shrubs, among which *Quercus gambelii* or *Rhus trilobata* is dominant (8)
- 8a)** (7) *Acer negundo* woodlands on the floors of slot canyons cross-cutting the Waterpocket Fold. *Quercus gambelii* provides a subcanopy, but the rest of the understory is poorly developed because of the dense canopy and probably also because of periodic scouring by floods; *Symphoricarpos oreophilus* is often the only species with significant cover. Herbaceous species are sparse and variable - ***Acer negundo* / *Quercus gambelii* Woodland [Map Class 30]**

[No Plant Association Photograph Available]

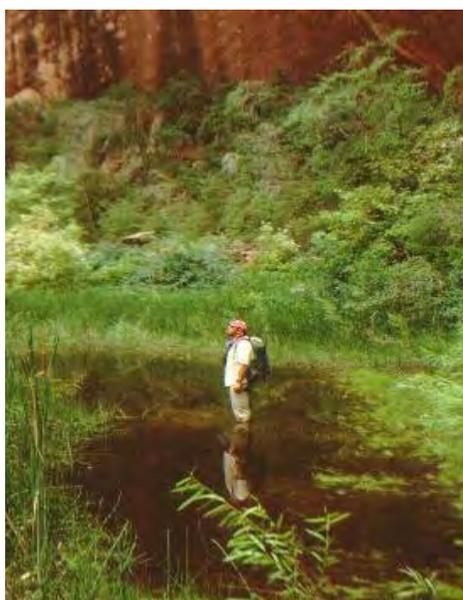
- 8b)** Open *Acer negundo* woodlands on rocky slopes in narrow tributary canyons. *Rhus trilobata* and *Fraxinus anomala* dominate an open shrub layer. Other shrubs present may include *Ephedra viridis*, *Amelanchier utahensis*, and *Mahonia repens*. Herbaceous species provide little cover - ***Acer negundo* / *Rhus trilobata* Woodland [Map Class 30]**

[No Plant Association Photograph Available]

- 9a)** (6) A variable community occupying mesic pockets in Navajo sandstone slickrock; may be associated with a pool of perennial water. These waterpockets contain a variety of wetland vegetation and are isolated in the remote areas of the Waterpocket Fold. *Phragmites australis*, *Salix exigua*, *Salix gooddingii*, *Typha latifolia*, *Acer negundo*, *Populus fremontii*, *Equisetum hyemale*, and *Muhlenbergia asperifolia* may all be present but these communities are highly variable in species composition and are prone to disturbance - **Waterpocket Community [Map Class 25]**



- 9b)** *Salix gooddingii* woodlands typically found near the southern park boundary in Navajo sandstone potholes – ***Salix gooddingii* Temporarily Flooded Woodland Alliance [Map Class 32]**



- 10a)** (2) *Populus angustifolia* woodlands with an understory of *Rhus trilobata* occurring along Polk Creek in the northwestern corner of the park - ***Populus angustifolia* / *Rhus trilobata* Woodland [Map Class 24a]**



- 10b)** *Populus fremontii* woodlands occupying mesic areas in the park (11)
- 11a)** (10) *Populus fremontii* forests or woodlands with an understory of mostly smaller trees or shrubs (12)
- 11b)** *Populus fremontii* woodlands with a predominantly herbaceous understory (15)
- 12a)** (11) *Populus fremontii* forests or woodlands, sometimes with *Tamarix* spp. as a co-dominant. *Salix* species dominate the understory (13)
- 12b)** *Populus fremontii* forests or woodlands with an understory of *Acer negundo* or *Ericameria nauseosa* or *Artemisia tridentata* ssp. *tridentata* shrubs (14)
- 13a)** (12) *Populus fremontii* woodlands with an understory dominated by *Salix exigua* along streams, on banks and terraces. The cottonwood canopy is usually open, with *Tamarix chinensis*, *Ericameria nauseosa* and a diverse herbaceous layer that may include *Juncus balticus*, *Phragmites australis*, and *Schoenoplectus americanus* - ***Populus fremontii* / *Salix exigua* Forest [Map Class 24]**



- 13b)** Woodlands characterized by *Populus fremontii* with an understory of *Salix gooddingii* trees, and typically limited to the area surrounding tanks in the bottom of drainages - ***Populus fremontii* - *Salix gooddingii* Woodland [Map Class 24]**

[No Plant Association Photograph Available]

- 14a)** (12) Mature *Populus fremontii* stands with an understory dominated by *Acer negundo*; *Salix exigua* and *Rhus trilobata* are typical shrubs in the understory; there is often a diverse herbaceous layer in the understory and the vine *Clematis ligusticifolia* is usually present - ***Populus fremontii* / *Acer negundo* Forest [Map Class 24]**



- 14b)** Mature to decadent *Populus fremontii* woodlands with an understory of *Ericameria nauseosa*, and/or *Artemisia tridentata*; occurring on abandoned alluvial terraces within well-developed (broad) floodplains - ***Populus fremontii* / *Ericameria nauseosa* Woodland [Map Class 24]**



- 15a)** (11) *Populus fremontii* woodlands with an understory of mixed mesic forbs, some of which may be non-indigenous; usually in small pockets along the Fremont River or Hall's Creek interspersed with the other types of riparian woodlands - ***Populus fremontii* / Mesic Forbs Woodland [Map Class 24]**



- 15b)** *Populus fremontii* woodlands with an understory of mixed mesic graminoids, some of which may be non-indigenous; these are usually small pockets along the Fremont River, Pleasant Creek, or Hall's Creek, interspersed with the other types of riparian woodland - ***Populus fremontii* / Mesic Graminoids Woodland [Map Class 24]**



- 16a)** (1) Dense evergreen woodlands dominated by *Cercocarpus ledifolius*; the understory is typically sparse, but contains *Artemisia tridentata* ssp. *vaseyana*. If *Artemisia* is absent and mature *Pseudotsuga menziesii* or *Pinus ponderosa* is present, continue to couplet 17. This association occurs in the northwestern corner of the mapping area above 8,000 feet; an occasional *Pinus ponderosa* or *Pinus edulis* tree occurs in some stands; other shrubs may include *Symphoricarpos oreophilus* and *Ericameria nauseosa* - ***Cercocarpus ledifolius* / *Artemisia tridentata* ssp. *vaseyana* Woodland [Map Class 12d]**

NOTE: Map Class 12d includes this association as well as *Pinus edulis* – *Juniperus osteosperma* / *Cercocarpus ledifolius* Woodland; they will occasionally form a mosaic.



- 16b)** Evergreen forests or woodlands characterized by larger, needle or scale-leaved trees, including *Pseudotsuga menziesii*, *Pinus ponderosa*, *Pinus longaeva*, *Picea pungens*, *Pinus edulis*, and *Juniperus osteosperma*. *Cercocarpus ledifolius* may appear in the canopy or subcanopy **(17)**
- 17a)** (16) Woodlands characterized by generally short stature trees including *Pinus edulis* or *Juniperus osteosperma*, or a mixture of the two species **(18)**
- 17b)** Evergreen forests or woodlands characterized by generally tall stature trees including *Pseudotsuga menziesii*, *Pinus ponderosa*, *Pinus longaeva*, or *Picea pungens* **(58)**
- 18a)** (17) *Juniperus osteosperma* woodlands with or without *Pinus edulis* and lacking a developed understory. Herbaceous and shrub cover total less than 5%, and usually much less; biological soil crusts may have very high cover **(19)**
- 18b)** *Juniperus osteosperma* woodlands with or without *Pinus edulis* and possessing a developed understory of either shrubs, grasses, or forbs **(20)**
- 19a)** (18) *Juniperus osteosperma* woodlands without *Pinus edulis* on the Carmel Formation in the north and central portion of the park or on sandy areas in the southern portion of the park and lacking a developed understory. Neither herbaceous nor shrub species has more than 5% cover, and most stands have less than 2% total understory cover. *Cercocarpus intricatus* and *Purshia stansburiana* are occasionally present as a low cover; the understory may have a variety of cushion plants - ***Juniperus osteosperma* / Sparse Understory Woodland [Map Class 15]**



- 19b)** *Juniperus osteosperma* and *Pinus edulis* woodlands lacking a developed understory. Neither herbaceous nor shrub species has more than 5% cover, and most stands have less than 2% total understory cover. Stands may have a sparse understory because they are old-growth, they are on shale substrates with poor water-holding capacity, most of the surface is covered by loose rock, or most of the (usually sandy) surface is covered by biological soil crusts. If the sparse understory consists primarily of low growing and cushion plant species, please go to couplet 57 - ***Pinus edulis* - *Juniperus osteosperma* / Sparse Understory Woodland [Map Class 15d]**

NOTE: This association is often difficult to distinguish on aerial photographs, so it is mapped only when it is known from field work or photo-interpreters were familiar with the mapping area. Northern polygons may have *Cercocarpus montanus*, *Purshia stansburiana*, and *Amelanchier utahensis* with low cover in the understory; if interpreters cannot distinguish this association it will be mapped as Map Class 15.



- 20a)** (18) *Pinus edulis* and *Juniperus osteosperma* woodlands, with an understory dominated by tall, short, and/or dwarf-shrubs (21)
- 20b)** *Pinus edulis* and *Juniperus osteosperma* woodlands, with an understory dominated by herbaceous species (44)
- 21a)** (20) *Juniperus osteosperma* woodlands with or without *Pinus edulis*, usually occupying sites with much exposed slickrock and with a mixed shrub understory in which *Cercocarpus intricatus* is conspicuous and usually dominant (22)
- 21b)** Woodlands occupying a variety of substrates and with other shrubs dominating the understory, although *Cercocarpus intricatus* may be present (23)
- 22a)** (21) Sparse *Juniperus osteosperma* woodlands, typically occupying fractures in exposed Navajo slickrock and dominated by a mixed shrub understory of *Cercocarpus intricatus*. *Amelanchier utahensis*, *Mahonia fremontii*, *Purshia stansburiana*, *Rhus trilobata*, and *Ephedra viridis* may also occur in the understory; this association often grades into *Pinus edulis* - *Juniperus osteosperma* / *Cercocarpus intricatus* Woodland - ***Juniperus osteosperma* / *Cercocarpus intricatus* Woodland [Map Class 16]**



- 22b)** *Pinus edulis* and *Juniperus osteosperma* woodlands with an understory characterized by *Cercocarpus intricatus*; in addition, *Amelanchier utahensis*, *Artemisia bigelovii*, *Mahonia fremontii*, *Purshia stansburiana*, *Rhus trilobata*, and *Ephedra viridis* may also be present. This type often occurs on slickrock with some soil development, but is also found on Moenkopi, Kayenta, or Carmel formations; this association may grade into *Juniperus osteosperma* / *Cercocarpus intricatus* Woodland - ***Pinus edulis* - *Juniperus osteosperma* / *Cercocarpus intricatus* Woodland [Map Class 16]**



- 23a)** (21) *Pinus edulis* and *Juniperus osteosperma* woodlands on colluvial slopes and canyon sides with an understory dominated by *Cercocarpus montanus*; *Amelanchier utahensis* and *Ephedra viridis* are among the many shrubs that may also be present. If *Cercocarpus intricatus* is present, it is with very low cover - ***Pinus edulis* - *Juniperus* spp. / *Cercocarpus montanus* – Mixed Shrubs Woodland [Map Class 16a]**



- 23b)** Utah juniper woodlands with or without *Pinus edulis* and on a variety of substrates and landscape positions. The shrub layer contains a variety of species, but *Cercocarpus* species are absent or have very low relative cover **(24)**

- 24a)** (23) *Juniperus osteosperma* woodlands on deep soils, with or without *Pinus edulis*. The shrub layer is dominated by a species of *Artemisia*: *tridentata*, *bigelovii*, *nova*, or *pygmaea* (25)
- 24b)** Evergreen woodlands on a variety of substrates in which the shrub understory is dominated by species other than *Artemisia*. In a few cases, *Artemisia bigelovii* will be a minor element of a mixed shrub understory on rocky substrates (30)
- 25a)** (24) *Juniperus osteosperma* woodlands with or without *Pinus edulis* and a shrub understory dominated by one of the subspecies of *Artemisia tridentata* (26)
- 25b)** *Juniperus osteosperma* woodlands with or without *Pinus edulis*; the shrub layer dominated by *Artemisia pygmaea*, *Artemisia bigelovii*, or *Artemisia nova* (28)
- 26a)** (25) Evergreen woodlands typically occurring on broad canyon floors with terraces protected from flooding and dominated by *Juniperus osteosperma* with an understory characterized by *Artemisia tridentata* ssp. *tridentata*; most commonly occurs on the sandy flats around Cedar Mesa campground or west of Sandy Ranch - ***Juniperus osteosperma* / *Artemisia tridentata* ssp. *tridentata* Woodland [Map Class 15e]**



- 26b)** *Juniperus osteosperma* woodlands with or without *Pinus edulis* and a shrub layer of *Artemisia tridentata* ssp. *wyomingensis* or *A. tridentata* ssp. *vaseyana* (27)
- 27a)** (26) *Juniperus osteosperma* woodlands typically occurring on warmer sites with shale-derived substrates. The understory is dominated by *Artemisia tridentata* ssp. *wyomingensis*. This association occurs around Sandy Ranch and near Baker Ranch in the north; stands in the Onion Beds have been chained or treated to remove the sagebrush and planted to *Psathyrostachys juncea*; these areas are mapped in the same mapping unit but with a modifier - ***Juniperus osteosperma* / *Artemisia tridentata* ssp. *wyomingensis* Woodland [Map Class 15e]**



- 27b)** *Pinus edulis* and *Juniperus osteosperma* woodlands on deep, well-developed soils with an understory dominated (at least 5%) by *Artemisia tridentata* ssp. *wyomingensis*. Associated shrubs include *Amelanchier utahensis*, *Gutierrezia sarothrae*, *Quercus gambelii*, and *Opuntia polyacantha*. The herbaceous layer is typically sparse, and may include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Poa fendleriana*, and *Pleuraphis jamesii* - ***Pinus edulis* - *Juniperus* spp. / *Artemisia tridentata* (ssp. *wyomingensis*, ssp. *vaseyana*) Woodland [Map Class 15e]**

- 28a)** (25) *Pinus edulis* and *Juniperus osteosperma* woodlands with an understory dominated by the dwarf-shrub *Artemisia pygmaea*; found primarily in the south-central portion of the park - ***Pinus edulis* - *Juniperus osteosperma* / *Artemisia pygmaea* Woodland [Map Class 15d]**



- 28b)** *Juniperus osteosperma* woodlands with *Pinus edulis* and a shrub understory dominated by *Artemisia bigelovii* or *Artemisia nova* (29)
- 29a)** (28) *Pinus edulis* and *Juniperus osteosperma* woodlands occurring on a variety of soils with a short shrub understory dominated by *Artemisia bigelovii*; with a combination of *Ephedra torreyana*, *Ephedra viridis*, *Atriplex confertifolia*, *Gutierrezia sarothrae*, *Chrysothamnus viscidiflorus*, and *Eriogonum corymbosum*. The perennial grasses *Achnatherum hymenoides*, *Bouteloua*

gracilis, and *Elymus elymoides* may be present - ***Pinus edulis* - *Juniperus osteosperma* / *Artemisia bigelovii* Woodland [Map Class 15]**



29b) *Pinus edulis* and *Juniperus osteosperma* woodlands occurring on shale soils with a short shrub understory dominated by *Artemisia nova* - ***Pinus edulis* - *Juniperus osteosperma* / *Artemisia nova* Woodland [Map Class 15f]**



30a) (24) *Pinus edulis* and *Juniperus osteosperma* woodlands with an understory dominated by *Cercocarpus ledifolius*; *Artemisia tridentata* ssp. *vaseyana* may be abundant in these stands - ***Pinus edulis* - *Juniperus osteosperma* / *Cercocarpus ledifolius* Woodland [Map Class 12d]**

NOTE: this association is lumped into Map Class 12d with *Cercocarpus ledifolius* / *Artemisia tridentata* ssp. *vaseyana* Woodland, since the two associations sometimes form a mosaic, the description of *Cercocarpus ledifolius* / *Artemisia tridentata* ssp. *vaseyana* Woodland has a more complete list of understory shrubs.



- 30b)** *Juniperus osteosperma* woodlands with or without *Pinus edulis*, occurring on a variety of substrates and with a shrub understory without significant cover by *Cercocarpus ledifolius* (31)
- 31a)** (30) Evergreen woodlands mostly on sandstone ledges overlain by thin soils; the shrub understory is mixed, but a combination of any of *Purshia stansburiana*, *Coleogyne ramosissima* and/or *Quercus havardii* provides most of the cover. *Artemisia bigelovii*, *Cercocarpus montanus*, and *Cercocarpus intricatus* may be present with very low relative cover (32)
- 31b)** Evergreen woodlands on a variety of substrates, with a shrub understory dominated by species of *Atriplex*, *Arctostaphylos*, *Opuntia*, *Ephedra*, *Purshia*, *Amelanchier*, *Shepherdia*, or *Quercus gambelii*. *Artemisia bigelovii*, *Cercocarpus intricatus*, and *Cercocarpus montanus* may sometimes be present (35)
- 32a)** (31) *Pinus edulis* and *Juniperus osteosperma* woodlands, sometimes sparse, on stable sands or Dakota, Morrison, Carmel, Navajo, and Kayenta sandstone benches topped by a thin layer of soil; the understory is clearly dominated by *Coleogyne ramosissima*. *Purshia stansburiana* and *Quercus havardii* var. *tuckeri* are absent or have only trace cover. Common associated shrubs include *Cercocarpus intricatus*, *Ephedra viridis*, and *Ericameria nauseosa*. The herbaceous layer provides sparse to low cover, mostly *Pleuraphis jamesii*. Forbs are uncommon - ***Pinus edulis* - *Juniperus osteosperma* / *Coleogyne ramosissima* Woodland [Map Class 17]**



- 32b)** Evergreen woodlands, sometimes sparse, with a mixed shrub understory that usually contains *Coleogyne ramosissima*, but always includes *Purshia stansburiana* and/or *Quercus havardii* var. *tuckeri* as an important to co-dominant. *Cercocarpus intricatus* and *Amelanchier utahensis* may be present in more mesic stands **(33)**
- 33a)** (32) Sparse woodlands with a mixed shrub understory in which the total cover is limited by the degree of fracturing of the underlying bedrock. Scattered *Juniperus osteosperma* trees emerge from an open mixed shrub canopy in which *Coleogyne ramosissima* is accompanied by *Purshia stansburiana* and/or *Quercus havardii* var. *tuckeri*. Total shrub cover often exceeds tree cover. Associated shrubs include *Fraxinus anomala*, *Ephedra viridis*, *Gutierrezia sarothrae*, *Yucca* spp, and *Atriplex canescens* in xeric stands; *Cercocarpus intricatus* and *Amelanchier utahensis* are also present in mesic stands - ***Juniperus osteosperma* - (*Pinus edulis*) / *Coleogyne ramosissima* - *Purshia stansburiana* - *Quercus havardii* Wooded Shrubland [Map Class 19c]**
- [No Plant Association Photograph Available]
- 33b)** *Pinus edulis* - *Juniperus osteosperma* woodlands with a shrub understory dominated by either *Quercus havardii* (on deeper sands) or *Purshia stansburiana* (shallow, rocky soils) *Coleogyne ramosissima* is absent or has only trace cover **(34)**
- 34a)** (33) *Pinus edulis* - *Juniperus osteosperma* woodlands found on dunes, sand sheets, or sandy terraces above drainages in the southern portion of the park with an understory characterized by *Quercus havardii* var. *tuckeri* - ***Pinus edulis* - *Juniperus osteosperma* / *Quercus havardii* var. *tuckeri* Woodland [Map Class 16e]**

NOTE: This association is only mapped when known from fieldwork; otherwise it is mapped with *Pinus edulis* - *Juniperus* spp. / *Quercus gambelii* Woodland Map Class 16a or Map Class 16e.



- 34b)** *Pinus edulis* and *Juniperus osteosperma* woodlands with an understory dominated by *Purshia stansburiana*; *Amelanchier utahensis* and *Fraxinus anomala* are often present, while *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Eriogonum corymbosum*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, and *Shepherdia rotundifolia* are more common associates. The herbaceous layer includes *Achnatherum hymenoides*, *Hesperostipa comata*, and *Pleuraphis jamesii*. Sites tend to be on canyon or mesa rims where fractured slickrock bedrock is often exposed - ***Pinus edulis* - *Juniperus osteosperma* / *Purshia stansburiana* Woodland [Map Class 16]**



- 35a)** (31) Woodlands or wooded shrublands, sometimes sparse, often on rocky slopes with a mixed shrub understory dominated by *Amelanchier utahensis*, *Shepherdia rotundifolia*, or a combination of the two. Many other shrubs may also be present,

including *Artemisia bigelovii*, *Cercocarpus intricatus*, and *Cercocarpus montanus* **(36)**

35b) Woodlands on various substrates with a shrub understory dominated by *Atriplex*, *Arctostaphylos*, *Opuntia*, *Ephedra*, or *Quercus gambelii* or *Purshia tridentata*. *Artemisia bigelovii* or *Amelanchier utahensis* may sometimes be present **(38)**

36a) (35) Woodlands or wooded shrublands, sometimes sparse (depending on degree of rock cover), characterized by *Pinus edulis* and *Juniperus osteosperma* and best developed on cool shale slopes covered by colluvium from sandstone cliffs above or less often on gullied sites with deep soils; bedrock is not usually exposed. The understory is characterized by a rich mix of shrubs that usually contains both *Shepherdia rotundifolia* and *Amelanchier utahensis* with significant cover, although they may be patchy. *Fraxinus anomala*, *Rhus trilobata*, and *Mahonia fremontii* are occasionally present and *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Ericameria nauseosa*, *Eriogonum corymbosum*, *Eriogonum microthecum*, *Gutierrezia sarothrae*, and *Opuntia polyacantha* are common associates. The herbaceous layer includes *Achnatherum hymenoides*, *Bouteloua gracilis*, *Leymus salinus*, *Hesperostipa comata*, and *Pleuraphis jamesii* - ***Pinus edulis* - *Juniperus osteosperma* / (*Shepherdia rotundifolia*, *Amelanchier utahensis*) Wooded Shrubland [Map Class 16]**



36b) Woodlands or wooded shrublands, sometimes sparse on warm colluvial or Carmel Formation slopes, with a shrub understory dominated by either *Shepherdia rotundifolia* or *Amelanchier utahensis*, but not both species **(37)**

37a) (36) *Pinus edulis* woodlands with some *Juniperus osteosperma* on slopes of Carmel Formation. *Amelanchier utahensis* codominates the shrub layer with *Quercus gambelii*. The shale soils form a desert pavement that, when combined with rocky colluvial slopes, inhibits the growth of herbaceous vegetation. Associated shrubs include *Cercocarpus montanus* and *Symphoricarpos oreophilus*. If *Shepherdia rotundifolia* is present it is with very low cover. *Poa fendleriana* is the only consistent herbaceous species - ***Pinus edulis* - *Juniperus osteosperma* / *Amelanchier utahensis* Woodland [Map Class16]**

[No Plant Association Photograph Available]

37b) *Pinus edulis* - *Juniperus osteosperma* woodlands or wooded shrublands, sometimes sparse, on hot rocky slopes or alluvial flats with deep soils, with an understory dominated by *Shepherdia rotundifolia*. There is little or no *Amelanchier utahensis* present and associated shrubs are quite variable depending on the substrate, but may include *Artemisia bigelovii*, *Chrysothamnus viscidiflorus*, *Rhus trilobata*, *Fraxinus anomala*, *Mahonia fremontii*, *Atriplex confertifolia*, *Ephedra torreyana*, *Ephedra viridis*, *Eriogonum corymbosum*, *Chrysothamnus viscidiflorus*, *Artemisia nova*, and *Gutierrezia sarothrae*. The herbaceous layer usually contributes less than 5% total cover, but *Leymus salinus* is a common herbaceous element - ***Pinus edulis* - *Juniperus osteosperma* / *Shepherdia rotundifolia* Woodland [Map Class 15]**





- 38a) (35)** *Pinus edulis* - *Juniperus osteosperma* woodlands occurring in slickrock drainages with some soil development. The understory is dominated by *Arctostaphylos patula* or *A. pungens*, but *Cercocarpus intricatus*, *Amelanchier utahensis*, and *Rhus trilobata* are often present. Stands occasionally merge with *Pinus ponderosa* Slickrock Sparse Vegetation although this association tends to occur on level or even south-facing slopes, whereas *Pinus ponderosa* Slickrock Sparse Vegetation is restricted to north-facing, protected areas with higher soil moisture levels - ***Pinus edulis* - *Juniperus osteosperma* / *Arctostaphylos patula* Woodland [Map Class 16e]**



- 38b)** Evergreen woodlands on a variety of substrates, with a shrub understory dominated by species of *Atriplex*, *Opuntia*, *Ephedra*, or *Quercus gambelii* or *Purshia tridentata*. *Artemisia bigelovii* or *Amelanchier utahensis* may sometimes be present **(39)**
- 39a)** (38) Pinyon-juniper woodlands occurring along the interface of the Dakota and Mancos formations in the Strike Valley, primarily along Notom Road near Cedar Mesa campground; the somewhat sparse understory is dominated by species of *Atriplex* (*canescens*, *gardneri*, or *confertifolia*) Scattered *Mahonia fremontii*, *Artemisia tridentata*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Gutierrezia sarothrae*, and *Opuntia polyacantha* providing sparse cover. Common graminoids include *Bromus tectorum* and *Pleuraphis jamesii*. Forbs typically provide less than 1% total cover, and *Eriogonum inflatum* is often present.

Cryptogams provide up to 27% cover - ***Pinus edulis* - *Juniperus osteosperma* / *Atriplex* spp. Woodland [Map Class 15d]**



- 39b)** Evergreen woodlands on a variety of substrates, with a shrub understory dominated by species of *Opuntia*, *Ephedra*, or *Quercus gambelii* or *Purshia tridentata*. *Artemisia bigelovii* or *Amelanchier utahensis* may sometimes be present **(40)**
- 40a)** (39) *Pinus edulis* and *Juniperus osteosperma* woodlands on sandy substrates, with a dense cover of *Opuntia fragilis* and usually with *Bouteloua gracilis* and/or *Muhlenbergia pungens*; areas around George Peak also have *Leptodactylon pungens* in the understory and *Achnatherum hymenoides* may be present. Many of the areas where this association occurs are inaccessible to cattle so the dense cactus is not a consequence of grazing; a few sites on Dry Bench and in Paradise Flats were grazed, but this does not seem to affect the species composition - ***Pinus edulis* - *Juniperus osteosperma* / *Opuntia fragilis* Woodland [Map Class 15b]**



- 40b)** Evergreen woodlands on a variety of substrates, with a shrub understory dominated by species of *Ephedra* or *Quercus gambelii* or *Purshia tridentata*. *Artemisia bigelovii* or *Amelanchier utahensis* may sometimes be present **(41)**

- 41a)** (40) *Pinus edulis* and *Juniperus osteosperma* woodlands occurring in mesic canyons and on rocky slopes (typically north facing) with an understory dominated by *Quercus gambelii*, *Amelanchier utahensis*, *Mahonia fremontii*, and *Shepherdia rotundifolia* shrubs are often present in the understory - ***Pinus edulis* - *Juniperus* spp. / *Quercus gambelii* Woodland [Upland stands = Map Class 16c; Canyon bottom stands = Map Class 16e]**



- 41b)** Evergreen woodlands on a variety of substrates, with a shrub understory dominated by species of *Ephedra* or *Purshia tridentata*. *Artemisia bigelovii* or *Amelanchier utahensis* may sometimes be present (42)
- 42a)** (41) Woodlands in the higher elevations of CARE on rocky ridges. The canopy is dominated by *Pinus edulis* and *Juniperus scopulorum* and the understory by *Purshia tridentata* with at least 15% cover. *Artemisia nova* is commonly associated with a few percent cover. Herbaceous species are sparse. Scattered *Pinus ponderosa* emerge through the canopy with a few percent cover - ***Pinus edulis* – *Juniperus osteosperma* / *Purshia tridentata* Woodland [Map Class 16]**

[No Plant Association Photograph Available]

- 42b)** Evergreen woodlands on various substrates, with a shrub understory dominated by *Ephedra* spp. *Artemisia bigelovii* or *Amelanchier utahensis* may be present (43)
- 43a)** (42) *Pinus edulis* and *Juniperus osteosperma* woodlands with an understory dominated by *Ephedra torreyana*. *Artemisia bigelovii* is often present to co-dominant. This type is best developed on ledges covered with fine alluvial gravel associated with exposures of Morrison Formation (Salt Wash member) and Entrada Formation in the northern part of the park. It also occurs on the drier slopes throughout the mapping area. Understory shrubs are variable depending on the substrate, but may include *Atriplex confertifolia*, *Eriogonum corymbosum*, *Chrysothamnus viscidiflorus*, *Shepherdia rotundifolia*, *Artemisia nova*, and *Gutierrezia sarothrae* - ***Pinus edulis* - *Juniperus osteosperma* / *Ephedra torreyana* - *Artemisia bigelovii* Woodland [Map Class 15]**



- 43b)** *Pinus edulis* and *Juniperus osteosperma* woodlands with an understory dominated by *Ephedra viridis*; with *Shepherdia rotundifolia*, *Amelanchier utahensis*, *Mahonia fremontii*, *Purshia stansburiana*, and *Rhus trilobata*. This association has only been found around Wagon Box Mesa and along Burr Trail Road above the switchbacks where it mixes with *Pinus edulis* - *Juniperus osteosperma* / *Purshia stansburiana* Woodland - ***Pinus edulis* - *Juniperus osteosperma* / *Ephedra viridis* Woodland [North-facing slopes = Map Class 16; Uplands = Map class 15d; Talus slopes = Map Class 40]**



- 44a)** (20) *Juniperus osteosperma* woodlands with or without *Pinus edulis* and with an herbaceous understory dominated by native or nonnative grasses, although forbs are generally present with low cover **(45)**
- 44b)** *Juniperus osteosperma* woodlands with or without *Pinus edulis* and with an herbaceous understory (sometimes sparse) dominated by forbs, although grasses are generally present with low cover **(57)**
- 45a)** (44) *Juniperus osteosperma* woodlands with or without *Pinus edulis* and with an herbaceous understory dominated by native bunch or rhizomatous grasses, although forbs are generally present with low cover **(46)**
- 45b)** Juniper woodlands with or without *Pinus edulis* and with an herbaceous understory dominated by exotic grasses (*Bromus tectorum* or *Psathyrostachys juncea*), although forbs are generally present with low cover **(56)**

- 46a)** (45) *Juniperus osteosperma* woodlands with or without *Pinus edulis* and with an herbaceous understory dominated by species of *Hesperostipa* **(47)**
- 46b)** *Juniperus osteosperma* woodlands with or without *Pinus edulis* and with an herbaceous understory dominated by species of *Leymus*, *Bouteloua*, *Pleuraphis*, *Achnatherum*, or *Muhlenbergia* **(49)**
- 47a)** (46) *Pinus edulis* - *Juniperus osteosperma* woodlands with an understory characterized predominantly by *Hesperostipa neomexicana*; this association was described for CARE based on one 1986 plot recorded by Romme; there is no location data other than a note that it was found on the Torrey 15-minute quad. We can only assume they identified the grass correctly and this association occurs somewhere in the central section of the park - ***Pinus edulis* - *Juniperus osteosperma* / *Hesperostipa neomexicana* Woodland [Map Class 14]**

[No Plant Association Photograph Available]

- 47b)** *Juniperus osteosperma* woodlands with or without *Pinus edulis* and with an herbaceous understory dominated by *Hesperostipa comata* **(48)**
- 48a)** (47) Sparse *Juniperus osteosperma* woodlands with an understory of *Hesperostipa comata*; this association occurs at the lower elevations and grades into *Pinus edulis* - *Juniperus osteosperma* / *Hesperostipa comata* Woodland as the elevation increases - ***Juniperus osteosperma* / *Hesperostipa comata* Woodland [Map Class 14]**



- 48b)** *Pinus edulis* - *Juniperus osteosperma* woodlands with an understory dominated by *Hesperostipa comata* - ***Pinus edulis* - (*Juniperus monosperma*, *Juniperus osteosperma*) / *Hesperostipa comata* Woodland [Map Class 14]**



49a) (46) *Juniperus osteosperma* woodlands with or without *Pinus edulis* and with an herbaceous understory dominated by *Leymus salinus* (50)

49b) *Juniperus osteosperma* woodlands with or without *Pinus edulis* and with an herbaceous understory dominated by species of *Bouteloua*, *Pleuraphis*, *Achnatherum*, or *Muhlenbergia* (51)

50a) (49) *Juniperus osteosperma* woodlands with understory dominated by *Leymus salinus* (tending to occur on north-facing shale slopes); *Pinus edulis* may be present, but typically provides sparse cover - ***Juniperus osteosperma* / *Leymus salinus* Woodland [Map Class 14]**

[No Plant Association Photograph Available]

50b) *Pinus edulis* and *Juniperus osteosperma* woodlands typically on shale soils with an understory characterized by *Leymus salinus* - ***Pinus edulis* - *Juniperus* spp. / *Leymus salinus* Woodland [Map Class 14]**



51a) (49) *Juniperus osteosperma* woodlands with or without *Pinus edulis* and with an herbaceous understory dominated by species of *Bouteloua gracilis* (52)

51b) Utah juniper woodlands with or without *Pinus edulis* and with an herbaceous understory dominated by *Pleuraphis*, *Achnatherum*, or *Muhlenbergia* (53)

- 52a)** (51) *Juniperus osteosperma* woodlands with an understory dominated or co-dominated by *Bouteloua gracilis* - ***Juniperus osteosperma* / *Bouteloua gracilis* Woodland [Map Class 14]**



- 52b)** *Pinus edulis* and *Juniperus osteosperma* woodlands with an understory dominated by *Bouteloua gracilis*; the understory usually contains *Ephedra torreyana* and *Artemisia bigelovii* with low cover - ***Pinus edulis* - (*Juniperus osteosperma*) / *Bouteloua gracilis* Woodland [Map Class 14]**



- 53a)** (51) *Juniperus osteosperma* woodlands with or without *Pinus edulis* and with an herbaceous understory dominated by *Pleuraphis jamesii* **(54)**
- 53b)** Utah juniper woodlands with or without *Pinus edulis* and with an herbaceous understory dominated by species of *Achnatherum* or *Muhlenbergia* **(55)**
- 54a)** (53) *Juniperus osteosperma* woodlands with an understory dominated or co-dominated by *Pleuraphis jamesii*. Shrubs, if present, do not form a layer - ***Juniperus osteosperma* / *Pleuraphis jamesii* Woodland [Map Class 14]**



- 54b)** *Pinus edulis* and *Juniperus osteosperma* woodlands on rocky sites and with an understory dominated by *Pleuraphis jamesii*. Associated grasses may include *Achnatherum hymenoides*, *Bouteloua gracilis*, and *Hesperostipa comata* with lesser cover. The understory usually also contains scattered shrubs, including *Atriplex confertifolia*, *Gutierrezia sarothrae*, *Shepherdia rotundifolia*, *Ephedra torreyana*, *Chrysothamnus viscidiflorus*, or *Artemisia bigelovii* with low cover. Total vegetation cover rarely exceeds 30% - ***Pinus edulis* - *Juniperus osteosperma* / *Pleuraphis jamesii* Woodland [Map Class 14]**



- 55a)** (53) *Pinus edulis* and *Juniperus osteosperma* woodlands on dunes or sand sheets, with an herbaceous understory dominated by *Muhlenbergia pungens*, sometimes with *Achnatherum hymenoides* present. Shrubs have low cover, but may include *Opuntia polyacantha* - ***Pinus edulis* - *Juniperus osteosperma* / *Muhlenbergia pungens* Woodland [Map Class 14]**

[No Plant Association Photograph Available]

- 55b)** *Pinus edulis* - *Juniperus osteosperma* woodlands on deeper soils with an understory characterized by *Achnatherum hymenoides* - ***Pinus edulis* -**

***Juniperus osteosperma* / *Achnatherum hymenoides* Woodland [Map Class 14]**

[No Plant Association Photograph Available]

- 56a)** (45) *Pinus edulis* and *Juniperus osteosperma* woodlands with an understory predominantly of the invasive, annual grass *Bromus tectorum*; sites were heavily grazed in the past; this association occurs primarily along the Notom-Burr Trail Road in the southern portion of the park - ***Pinus edulis* - *Juniperus osteosperma* / *Bromus tectorum* Semi-natural Woodland [Map Class 14b]**

NOTE: This association will only be mapped if it is known from field visits; otherwise, these areas will be mapped as Map Class 14.

[No Plant Association Photograph Available]

- 56b)** Young woodlands of *Pinus edulis* and *Juniperus osteosperma* trees with an understory characterized by the introduced bunchgrass *Psathyrostachys juncea*; found in the Onion Beds area where BLM treated areas to remove trees and sagebrush and then planted nonnative grasses and forbs to improve grazing potential in the area - ***Pinus edulis* - *Juniperus osteosperma* / *Psathyrostachys juncea* Semi-natural Woodland [Map Class 14c]**



- 57a)** (44) *Pinus edulis* - *Juniperus osteosperma* woodlands with an understory of mostly cushion plants, including *Arenaria eastwoodiae*, *Enceliopsis nudicaulis*, *Erigeron compactus*, *Erigeron pumilus*, *Eriogonum alatum*, *Frasera albomarginata*, *Heterotheca villosa*, *Hymenopappus filifolius*, *Paronychia sessiliflora*, *Polygala subspinosa*, *Stenotus armerioides*, *Tetraneuris acaulis*, and *Tetraneuris depressa*. *Petradoria pumila* is absent or has only trace cover; *Amelanchier utahensis* and *Purshia stansburiana* are occasionally present as very low cover; these areas are mapped only when known from fieldwork; otherwise, they are mapped as 15d with sparse understory - ***Pinus edulis* - *Juniperus osteosperma* / Cushion Plant Woodland [Map Class 15d]**



- 57b)** *Pinus edulis* and *Juniperus osteosperma* woodlands with an understory of sparse *Petradoria pumila* and other cushion plants; this association was described by plots recorded in 1986 in the Wagon Box Mesa area, but since their exact location is unknown, they were placed into the same unit with the association above - ***Pinus edulis* - *Juniperus osteosperma* / *Petradoria pumila* Woodland [Map Class 15d]**

NOTE: These cushion plant associations are mapped only when known from fieldwork; otherwise they are mapped as 15d with sparse understory.

[No Plant Association Photograph Available]

- 58a)** (17) *Picea pungens* woodlands or forests with an understory of *Cornus sericea*; this association is rare in the park, only occurring in upper Deep Creek drainage in a narrow Navajo sandstone slickrock canyon - ***Picea pungens* / *Cornus sericea* Woodland [Map Class 35]**

[No Plant Association Photograph Available]

- 58b)** *Pseudotsuga menziesii*, *Pinus longaeva*, or *Pinus ponderosa* woodlands; sometimes the canopy contains a combination of these species, in various habitats **(59)**
- 59a)** (58) Woodlands dominated by *Pinus longaeva* or *Pinus ponderosa*. If *Pseudotsuga menziesii* is present it is with low cover **(60)**
- 59b)** Woodlands or forests dominated by *Pseudotsuga menziesii*. Tall pines may be present with lower cover **(69)**
- 60a)** (59) Woodlands characterized by *Pinus longaeva*, although some *Pseudotsuga menziesii* trees may be present; occurs in the northwestern portion of the mapping area; typically there is a sparse understory of cushion plants, but a few scattered *Amelanchier utahensis*, *Cercocarpus montanus*, or *Purshia*

stansburiana may be present; all known sites in the mapping area are on the Carmel Formation - ***Pinus longaeva* Woodland [Map Class 20]**



60b) Woodland or forest characterized by *Pinus ponderosa* with a shrub-dominated or sparse understory. *Pseudotsuga menziesii* may be present with low cover **(61)**

61a) (60) Sparse woodlands, sometimes with dwarfed trees, characterized by *Pinus ponderosa* rooted in joints and fractures in slickrock sandstone. Scattered *Pinus edulis* and *Juniperus osteosperma* or *Juniperus scopulorum* trees may form a subcanopy. The sparse shrub layer may include *Amelanchier utahensis*, *Cercocarpus intricatus*, and *Arctostaphylos patula*. Herbaceous species provide less than 5% total cover and forbs tend to have higher cover than grasses - ***Pinus ponderosa* Slickrock Sparse Vegetation [Map Class 21]**



61b) *Pinus ponderosa* woodlands occurring on sites with at least some soil development, with a sparse or shrub-dominated understory **(62)**

62a) (61) *Pinus ponderosa* woodlands with a sparse (<5% cover) understory of mixed graminoids, forbs, and shrubs (including the succulent *Opuntia fragilis*) - ***Pinus ponderosa* / Sparse Understory Woodland [Map Class 33]**



62b) *Pinus ponderosa* woodlands with a sparse to dense understory composed primarily of woody shrubs **(63)**

63a) (62) *Pinus ponderosa* woodlands with an understory principally of *Arctostaphylos patula* short shrubs; *Amelanchier utahensis*, *Fraxinus anomala*, *Cercocarpus intricatus*, *Juniperus communis*, *Purshia tridentata*, and *Yucca harrimaniae* may also occur - ***Pinus ponderosa* / *Arctostaphylos patula* Woodland [Map Class 21]**



63b) *Pinus ponderosa* woodlands with an understory principally of *Artemisia nova*, *Artemisia tridentata* ssp. *vaseyana*, *Cercocarpus ledifolius*, *Quercus gambelii*, or *Purshia tridentata*; some stands may have overstories that include sparse to low cover of *Pseudotsuga menziesii* **(64)**

64a) (63) *Pinus ponderosa* woodlands with an understory principally of *Artemisia nova* short shrubs - ***Pinus ponderosa* / *Artemisia nova* Woodland [Map Class 33]**



64b) Ponderosa pine woodlands with an understory principally of *Artemisia tridentata* ssp. *vaseyana*, *Cercocarpus ledifolius*, *Quercus gambelii*, or *Purshia tridentata* **(65)**

65a) (64) Ponderosa pine woodlands with an understory principally of *Cercocarpus ledifolius* tall shrubs or small trees; the shrubs *Artemisia tridentata* ssp. *vaseyana* and *Purshia tridentata* may also be present. This association occurs only in the northwestern corner of the park where *Pinus ponderosa* are invading into the *Cercocarpus ledifolius* / *Artemisia tridentata* ssp. *vaseyana* Woodland - ***Pinus ponderosa* / *Cercocarpus ledifolius* Woodland [Map Class 33]**



65b) *Pinus ponderosa* woodlands with an understory principally of *Artemisia tridentata* ssp. *vaseyana*, *Quercus gambelii*, or *Purshia tridentata* short shrubs **(66)**

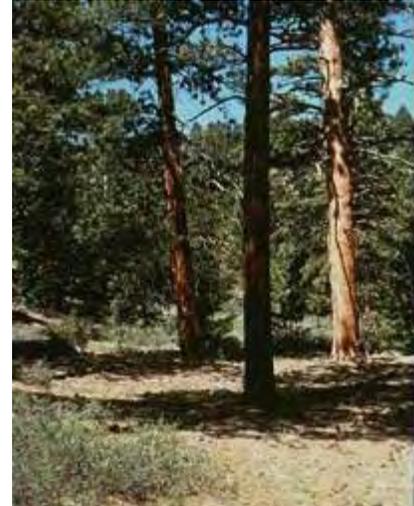
66a) (65) Woodlands at higher elevations on canyon sides and mesa tops characterized by *Pinus ponderosa*. The shrub understory is dominated by *Quercus gambelii* tall shrubs with occasional *Artemisia tridentata* ssp. *vaseyana*, *Cercocarpus montanus*, *Shepherdia rotundifolia*, and *Opuntia fragilis*. *Pinus edulis*, *Juniperus osteosperma*, and *Pseudotsuga menziesii* may be scattered through the canopy or form a very open subcanopy - ***Pinus ponderosa* / *Quercus gambelii* Woodland [Map Class 33a]**



- 66b)** *Pinus ponderosa* woodlands with an understory principally of *Purshia tridentata* and/or *Artemisia tridentata* ssp. *vaseyana* shrubs **(67)**
- 67a)** (66) Woodlands with a canopy of *Pinus ponderosa* and *Pseudotsuga menziesii* and an understory dominated by *Purshia tridentata* short shrubs; *Artemisia nova* and *Symphoricarpos oreophilus* are often present, but *Artemisia tridentata* ssp. *vaseyana* is absent or has trace cover - ***Pinus ponderosa* - *Pseudotsuga menziesii* / *Purshia tridentata* Woodland [Map Class 23a]**



- 67b)** Ponderosa pine woodlands or forests with an understory of *Purshia tridentata* with or without *Artemisia tridentata* ssp. *vaseyana* **(68)**
- 68a)** (67) Ponderosa pine woodlands with an understory principally of *Purshia tridentata* - ***Pinus ponderosa* / *Purshia tridentata* Woodland [Map Class 33]**



- 68b)** *Pinus ponderosa* woodlands with an understory principally of *Artemisia tridentata* ssp. *vaseyana*, with lesser cover of *Purshia tridentata* and *Symphoricarpos oreophilus* usually present – ***Pinus ponderosa* / *Artemisia tridentata* ssp. *vaseyana* Woodland [Map Class 33]**

[No Plant Association Photograph Available]

- 69a)** (59) Sparse *Pseudotsuga menziesii* woodlands with either a sparse understory or a mix of shrubs in the understory, occurring on steep scree slopes, narrow slot canyons, or north-facing canyon slopes between 6,000–7,000 feet elevation; with a combination of *Amelanchier utahensis*, *Shepherdia rotundifolia*, *Fraxinus anomala*, *Pinus edulis*, *Pinus ponderosa*, and *Juniperus osteosperma* - ***Pseudotsuga menziesii* Scree Woodland [Map Class 23a]**



- 69b)** *Pseudotsuga menziesii* woodlands or forests occurring on scree slopes or with an understory principally of species of the genera *Cercocarpus*, *Acer*, *Betula*, *Quercus*, or *Symphoricarpos* (70)

- 70a)** (69) *Pseudotsuga menziesii* woodlands or forests with a tall shrub understory dominated by the genus *Cercocarpus* (71)
- 70b)** *Pseudotsuga menziesii* woodlands or forests with a tall or short shrub understory of the genera *Acer*, *Betula*, *Quercus*, or *Symphoricarpos* (72)
- 71a)** (70) *Pseudotsuga menziesii* woodlands or forests with an understory principally of *Cercocarpus ledifolius* tall shrubs or small trees; associated trees can include *Pinus ponderosa*, *Pinus edulis*, *Juniperus osteosperma*, *Juniperus scopulorum* and *Pinus longaeva*; *Artemisia tridentata*, *Purshia tridentata*, and *Symphoricarpos oreophilus* are usually present in the understory - ***Pseudotsuga menziesii* / *Cercocarpus ledifolius* Woodland [Map Class 23a]**



- 71b)** *Pseudotsuga menziesii* woodlands or forests with an understory principally of *Cercocarpus montanus*; found at about 8,000 feet elevation on north-facing slopes of major canyons (e.g., Bulberry Canyon) within the Fold; *Amelanchier utahensis* and *Shepherdia rotundifolia* are common understory shrubs - ***Pseudotsuga menziesii* / *Cercocarpus montanus* Forest [Map Class 23a]**



- 72a)** (69) *Pseudotsuga menziesii* forests in shaded canyons with scattered *Pinus ponderosa* trees. The understory is dominated by *Acer glabrum*; *Populus angustifolia* provides an open subcanopy; the shrub layer includes *Amelanchier*

utahensis, *Symphoricarpos oreophilus*, *Cornus sericea*, *Quercus gambelii*, and *Rosa woodsii*. The herbaceous layer is sparse and the vine *Clematis columbiana* may be present. This association is only known from the head of North Coleman Canyon - ***Pseudotsuga menziesii* / *Acer glabrum* Forest [Map Class 23c]**



72b) *Pseudotsuga menziesii* woodlands or forests with an understory principally of *Betula*, *Quercus*, or *Symphoricarpos* (73)

73a) (71) Woodlands along stream banks and characterized by *Pseudotsuga menziesii* with an understory principally of *Betula occidentalis*; a combination of *Acer negundo*, *Salix amygdaloides*, *Ericameria nauseosa*, *Quercus gambelii*, *Rhus aromatica*, and *Salix exigua* are present in the understory; to date this association has only been recorded just outside the park in upper Sheets Gulch - ***Pseudotsuga menziesii* / *Betula occidentalis* Woodland [Map Class 23c]**



73b) Forests occurring in mesic sites and characterized by *Pseudotsuga menziesii* with an understory principally of the genera *Quercus* or *Symphoricarpos* (74)

74a) (73) Forests characterized by *Pseudotsuga menziesii* with an understory principally of *Symphoricarpos oreophilus* short shrubs; a few scattered *Pinus ponderosa* or seral *Populus tremuloides* may be present; *Mahonia repens* and *Rosa woodsii* are usually in the understory with low cover; this association occurs along the northwestern boundary of the park - ***Pseudotsuga menziesii* / *Symphoricarpos oreophilus* Forest [Map Class 23a]**

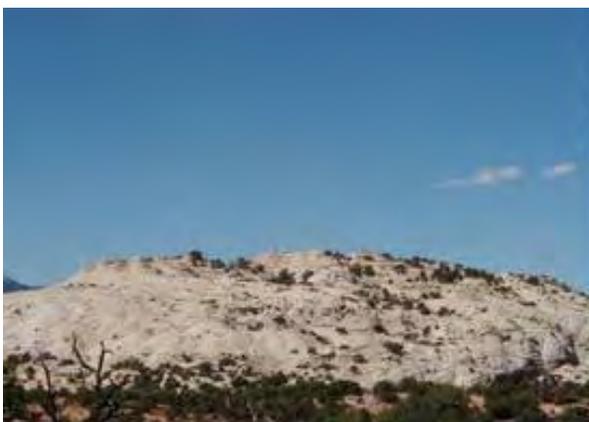


74b) Forests on the steep lower slopes of shaded canyons between 6,000–8,000 feet elevation, characterized by *Pseudotsuga menziesii*. *Pinus ponderosa* may be scattered throughout the canopy. *Quercus gambelii* forms a dense subcanopy or tall shrub layer; there is usually a combination of *Acer glabrum*, *Rosa woodsii*, and *Symphoricarpos longiflorus*, *Amelanchier utahensis*, *Shepherdia rotundifolia*, *Fraxinus anomala*, and *Pinus edulis* in the understory providing low cover - ***Pseudotsuga menziesii* / *Quercus gambelii* Forest [Map Class 23c]**



Key III: Shrubland Associations of Capitol Reef National Park

- 1a)** Tall or short shrublands or shrubby woodlands occupying cracks, soil pockets or waterpockets on exposed slickrock or between fins of sandstone **(2)**
- 1b)** Tall, short, or dwarf-shrublands occupying developed soils in various habitats **(5)**
- 2a)** (1) Slickrock tall or short shrubland typically characterized by arid conditions supporting sparse cover of *Cercocarpus intricatus* (found primarily on Navajo sandstone, but occasionally on Wingate or Kayenta formations); *Fraxinus anomala*, *Rhus trilobata*, *Ephedra viridis*, and *Artemisia bigelovii* are often present but not dominant; it occurs all along the Waterpocket Fold - ***Cercocarpus intricatus* Slickrock Sparse Vegetation [Map Class 19]**



- 2b)** Slickrock tall shrubland typically characterized by mesic conditions due to the rapid runoff and accumulation of water in drainages, waterpockets, and other low lying areas of slickrock **(3)**
- 3a)** (2) Tall shrublands dominated by *Celtis laevigata* var. *reticulata*, often with *Juniperus osteosperma* occurring on intermittent canyon floodplains; stands occur in Navajo Sandstone slickrock canyons or drainages emerging from the Waterpocket Fold. The type is restricted to deep, narrow canyons or to the base of north-facing cliffs where water permanently seeps out of the sandstone walls. Most of these canyons have not been surveyed so an accurate vegetation description is not available. Some canyons have *Celtis laevigata* var. *reticulata*, but others have only a combination of *Fraxinus anomala*, *Quercus gambelii*, *Rhamnus betulifolia*, *Salix gooddingii*, *Mahonia fremontii*, and occasionally *Acer negundo*. This association name is a placeholder for the slickrock canyons in the southern Waterpocket Fold until more data are available - ***Celtis laevigata* var. *reticulata* Slickrock Canyon Woodland [Map Class 26d]**



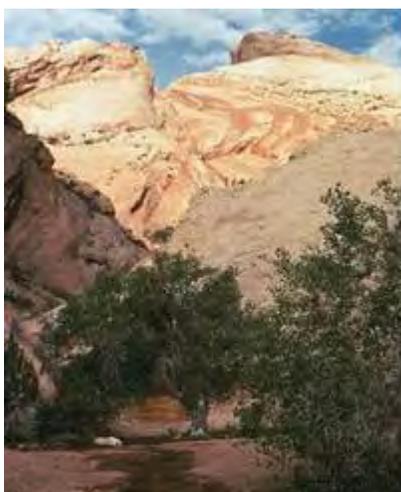
- 3b)** Diverse shrublands or shrubby woodlands in mesic areas of slickrock in narrow slots between fins or wet sandstone pockets; may contain *Pinus ponderosa* trees and various shrubs, but does not contain *Celtis laevigata* var. *reticulata* trees
(4)

- 4a)** (3) A variable community occupying mesic narrow slots between fins; and may include *Pinus ponderosa*, *Pseudotsuga menziesii*, or *Pinus edulis* trees; shrub layer is diverse and includes *Acer glabrum*, *Amelanchier utahensis*, *Fraxinus anomala*, *Cercocarpus intricatus*, *Ericameria nauseosa*, *Mahonia fremontii*, *Rhus trilobata*, and *Shepherdia rotundifolia*. This association is rare in the park, occurring primarily in the Wingate Formation but occasionally on Navajo Sandstone; it is restricted to deep, narrow slot canyons in between sandstone fins; most of these fin areas have not been surveyed so an accurate vegetation description is not available. This association name was selected as a placeholder for these fin canyons until further research is available - **Slickrock Fin Pocket**
[Map Class 27]





- 4b)** A variable community occupying mesic pockets in Navajo Sandstone slickrock; may be associated with a pool of perennial water. These waterpockets contain a variety of upland and wetland vegetation and are isolated in the remote areas of the Waterpocket Fold; *Phragmites australis*, *Cercocarpus intricatus*, *Salix exigua*, *Salix gooddingii*, *Typha latifolia*, *Acer negundo*, *Fraxinus anomala*, *Populus fremontii*, *Equisetum hyemale*, and *Muhlenbergia asperifolia* may all be present, but these communities are highly variable and prone to disturbance - **Waterpocket Community [Map Class 25]**



- 5a)** (1) Vegetation characterized by tall shrubs characterized by the genera *Amelanchier*, *Betula*, *Cornus*, *Quercus*, *Rhus*, *Salix*, or *Tamarix* occurring in mesic habitats **(6)**
- 5b)** Vegetation characterized by dwarf or short shrubs in the genera *Atriplex*, *Arctostaphylos*, *Artemisia*, *Fallugia*, *Gutierrezia*, *Krascheninnikovia*, *Poliomintha*, *Eriogonum*, *Grayia*, *Ericameria*, *Coleogyne*, *Chrysothamnus*, *Sarcobatus*, *Ephedra*, *Symphoricarpos*, or *Zuckia* occurring in diverse habitats **(16)**
- 6a)** (5) Tall shrublands occupying mesic sites dominated by *Betula*, *Cornus*, *Rhus*, *Salix*, and *Tamarix* **(7)**

- 6b)** Tall shrublands occupying drier upland sites including the genera *Amelanchier*, *Fraxinus*, and *Quercus* **(12)**
- 7a)** (6) Tall shrublands occupying stream banks, canal banks, and other mesic sites characterized by dense *Betula occidentalis*; typical associated species include *Alnus incana*, *Salix* sp., *Acer negundo*, *Fraxinus anomala*, *Cornus stolonifera*, *Shepherdia argentea*, or *Ribes aureum*; it occurs in the northwestern portion of the mapping area and in the Fremont River gorge - ***Betula occidentalis* Shrubland [Map Class 26c]**



- 7b)** Tall shrublands occupying saturated to mesic sites and characterized by the genera *Cornus*, *Rhus*, *Salix*, or *Tamarix* **(8)**
- 8a)** (7) Tall shrublands characterized by *Cornus sericea* known from upper Deep Creek in a narrow slot canyon of Navajo sandstone occupying small, wet, almost marsh-like riparian sites - ***Cornus sericea* Shrubland [Map Class 26b]**

[No Plant Association Photograph Available]

- 8b)** Tall shrublands characterized by either of the genera *Rhus*, *Salix*, or *Tamarix* occupying drainages, stream banks, and/or other mesic sites **(9)**
- 9a)** (8) Tall shrublands characterized by the non-indigenous, invasive shrub *Tamarix chinensis*; widespread throughout the park and intermixed with *Populus fremontii* riparian woodlands - ***Tamarix* spp. Temporarily Flooded Semi-natural Shrubland [Map Class 64]**



- 9b)** Tall shrublands characterized by *Rhus trilobata* or *Salix exigua* occupying riparian habitats, stream banks, or other mesic areas **(10)**
- 10a)** (9) Shrublands on stream banks or other mesic sites dominated by *Salix exigua* **(11)**
- 10b)** Tall shrublands on deep sediments deposited on stream terraces where the water table tends to remain high throughout the growing season. The vegetation is dominated by *Rhus trilobata*, although a few shrubs of *Salix exigua* and *Betula occidentalis* are also present. The herbaceous layer is poorly developed because of the dense shade and competition by the shrubs and because these terraces are periodically scoured by floods - ***Rhus trilobata* Intermittently Flooded Shrubland [Map Class 32]**

[No Plant Association Photograph Available]

- 11a)** (10) Tall shrublands occupying riparian habitats, stream banks, or other mesic areas characterized by *Salix exigua* with few other species, occurring on substrates of exposed gravel, cobbles or sand; an understory of a few, scattered forbs and grasses is usually present - ***Salix exigua* / Barren Shrubland [Map Class 32]**



- 11b)** Tall shrublands occupying riparian habitats, stream bank, or other mesic areas characterized by *Salix exigua* with a nearly continuous understory of graminoid species characterized by *Scirpus pungens*, *Carex nebrascensis*, *Muhlenbergia asperifolia*, *Agrostis stolonifera*, *Eleocharis palustris*, and/or *Phragmites australis* - ***Salix exigua* / Mesic Graminoids Shrubland [Map Class 32]**



- 12a)** (6) Tall shrublands dominated by *Amelanchier utahensis*, typically found on steep north-facing talus slopes of Chinle Formation with Kayenta and Wingate sandstones talus overlying the red-brown clay. Scattered pinyon pine or juniper trees may be present with less than 8% cover. Associated to co-dominant shrubs include *Fraxinus anomala*, *Mahonia fremontii*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, and *Shepherdia rotundifolia*. *Quercus gambelii* is absent or a very minor component of the shrub layer. The herbaceous layer is sparse, with less than 3% total cover and may include *Achnatherum hymenoides* or *Poa fendleriana* - ***Amelanchier utahensis* Shrubland [Map Class 40]**

NOTE: Map Class 40 is used for this and other associations found on steep talus slopes throughout the park. Stands are highly variable in species composition, but cannot be classified as woodlands because the tree cover is generally less than 8%. The dominant shrubs vary from one area to the next. Some areas are very diverse with many species (including *Ericameria nauseosa*, *Fraxinus anomala*, or *Mahonia fremontii*); others contain only a few species. The map class is intended to encompass all non-woodland shrub areas on talus slopes and ridges until further information is available.



- 12b)** Shrublands on upland sites and canyon bottoms characterized by *Fraxinus anomala* or *Quercus* species; *Amelanchier utahensis* may be present to co-dominant **(13)**
- 13a)** (12) Tall shrublands characterized by a mixed open shrub canopy dominated by *Fraxinus anomala*, typically occurring on the banks of ephemeral sandy streams, but some stands occur in the uplands on shattered Salt Wash sandstone exposures - ***Fraxinus anomala* Woodland [Map Class 12b]**

NOTE: Map Class 12b describes this and other associations found in intermittent washes in narrow canyons and ravines throughout CARE. These associations are highly variable in species composition. The dominant shrubs vary from one canyon to the next. Some areas are very diverse with many species and others contain only a few species, but all represent the more mesic regime for these ephemeral washes. Typical species include *Cercocarpus intricatus*, *Ericameria nauseosa*, *Fraxinus anomala*, *Ephedra viridis*, *Amelanchier utahensis*, *Shepherdia rotundifolia*, *Mahonia fremontii*, *Symphoricarpos longiflorus*, *Rhus trilobata*, and *Quercus gambelii*.



- 13b)** Tall shrublands on variable sites and dominated by *Quercus* species **(14)**
- 14a)** (13) Shrublands characterized by *Quercus havardii* var. *tuckeri* on sand dunes, sand sheets, and sand pockets on slickrock; *Quercus havardii* var. *tuckeri* is dominant or co-dominant, although *Coleogyne ramosissima*, *Purshia stansburiana*, *Artemisia filifolia*, *Ephedra viridis*, *Gutierrezia sarothrae*, and *Shepherdia rotundifolia* may provide low cover or be co-dominant - ***Quercus havardii* var. *tuckeri* Shrubland [Map Class 10a]**



- 14b)** Tall shrublands characterized by *Quercus gambelii* typically occurring in canyon bottoms or on high mountain slopes **(15)**
- 15a)** (14) Tall shrublands of higher elevations on Dry Bench and around the Lampstand, dominated by *Quercus gambelii*, with *Amelanchier utahensis* present to co-dominant. *Artemisia tridentata* ssp. *vaseyana* or *A. t.* ssp. *wyomingensis* are present and may have substantial cover. Scattered *Pinus edulis* trees may be present; this association occurs in large openings among pinyon-juniper woodlands. Most stands in the park are unburned and have scattered oak/serviceberry pockets among sagebrush; however, where this association extends onto the adjacent national forest, controlled burns removed the sagebrush and stands were seeded with nonnative perennial grasses to enhance grazing. Sagebrush is replaced by *Ericameria nauseosa* in the burned phase of this association and seeded nonnative grasses dominate the understory - ***Quercus gambelii* - *Amelanchier utahensis* Shrubland [Map Class 13b]**

NOTE: Burned areas will be mapped as unit 13b but with a modifier.



- 15b)** Tall shrublands characterized by *Quercus gambelii* on nearly level, abandoned terraces or in intermittent washes in the southern portion of the park; usually occurring as small patches; *Amelanchier utahensis* is not present and *Mahonia fremontii* may be present; the ground layer is characterized by young oak

sprouts, with sparse grass and forb species present. Individual plants of *Pinus edulis* or tall shrubs may be present - ***Quercus gambelii* / Sparse Understory Shrubland [Map Class 16e]**



- 16a)** (5) Dwarf-shrublands of *Atriplex corrugata* or *Atriplex gardneri*, usually found on shale badlands or low elevation clay soils derived from Morrison, Summerville, Moenkopi or Mancos shales (17)
- 16b)** Short shrublands characterized by taller *Atriplex (canescens)*, *Arctostaphylos*, *Artemisia*, *Fallugia*, *Gutierrezia*, *Krascheninnikovia*, *Poliomintha*, *Eriogonum*, *Grayia*, *Ericameria*, *Coleogyne*, *Sarcobatus*, *Chrysothamnus*, *Ephedra*, *Symphoricarpos*, or *Zuckia* and occurring throughout the park in diverse habitats (21)
- 17a)** (16) Dwarf-shrublands characterized by *Atriplex corrugata*; some stands are mixed with sparse to low cover of *Atriplex confertifolia* or *Atriplex gardneri*; occurring on Mancos, Chinle, Curtis, or Moenkopi formation clays throughout the mapping area - ***Atriplex corrugata* Dwarf-shrubland [Map Class 4]**



- 17b)** Dwarf-shrublands characterized by *Atriplex gardneri*; other species of *Atriplex* often present. *Atriplex corrugata* is sparse or absent (18)

- 18a)** (17) Dwarf-shrublands characterized by *Atriplex gardneri* with *Xylorhiza venusta* present, providing low to moderate cover; *Chrysothamnus viscidiflorus* may also occur with low cover - ***Atriplex gardneri* / *Xylorhiza venusta* Dwarf-shrubland [Map Class 4]**



- 18b)** Dwarf-shrublands characterized by *Atriplex gardneri* co-occurring with low to moderate cover of grasses or co-occurring with a variety of other short and dwarf-shrubs **(19)**

- 19a)** (18) Dwarf-shrublands characterized by *Atriplex gardneri* with low cover of a variety of short shrubs including *Atriplex confertifolia* and *Chrysothamnus viscidiflorus*, but lacking a developed herbaceous understory - ***Atriplex gardneri* Dwarf-shrubland [Map Class 4]**



19b) Dwarf-shrublands characterized by *Atriplex gardneri* with low cover of a variety of shrubs such as *Atriplex confertifolia* or *Chrysothamnus viscidiflorus* and an understory of bunchgrasses including *Achnatherum hymenoides* or *Pleuraphis jamesii* **(20)**

20a) (19) Dwarf-shrublands characterized by *Atriplex gardneri* with the medium to tall bunchgrass *Achnatherum hymenoides* present in sparse to low cover - ***Atriplex gardneri* / *Achnatherum hymenoides* Dwarf-shrubland [Map Class 4]**

[No Plant Association Photograph Available]

20b) Dwarf-shrublands characterized by *Atriplex gardneri* with the short bunchgrass *Pleuraphis jamesii* present in sparse to low cover - ***Atriplex gardneri* / *Pleuraphis jamesii* Dwarf-shrubland [Map Class 4]**



21a) (16) Short shrublands occupying large sandy pockets on Navajo Sandstone (to date, known from only one location in the southern part of the park); *Grayia spinosa* is dominant with perennial bunchgrasses co-dominating; Utah juniper trees may provide sparse to low cover - ***Grayia spinosa* Shrubland [Map Class 18c]**



- 21b)** Shrublands occupying a variety of substrates characterized by *Atriplex*, *Arctostaphylos*, *Artemisia*, *Fallugia*, *Gutierrezia*, *Krascheninnikovia*, *Poliomintha*, *Eriogonum*, *Ericameria*, *Coleogyne*, *Chrysothamnus*, *Sarcobatus*, *Ephedra*, *Symphoricarpos*, *Vanclevea*, or *Zuckia* **(22)**
- 22a)** (21) Short shrublands typically occupying sand dunes, sand sheets, or sandy alluvial terraces and characterized by *Eriogonum leptocladon*, *Poliomintha incana*, *Artemisia filifolia*, or *Vanclevea stylosa* **(23)**
- 22b)** Short shrublands occupying a variety of substrates characterized by species of *Arctostaphylos*, *Artemisia*, *Atriplex*, *Fallugia*, *Gutierrezia*, *Krascheninnikovia*, *Ericameria*, *Eriogonum*, *Coleogyne*, *Sarcobatus*, *Chrysothamnus*, *Ephedra*, *Symphoricarpos*, or *Zuckia* **(25)**
- 23a)** (22) Short shrublands occurring on dunes characterized by *Eriogonum leptocladon* with significant graminoid cover of *Muhlenbergia pungens*; this association was described for CARE by one Romme plot collected in 1986; the area is located along the northeastern park boundary just below Rock Springs Bench, if it occurs elsewhere in the park it will most likely be there or in Cathedral Valley - ***Eriogonum leptocladon* / *Muhlenbergia pungens* Shrubland [Map Class 9]**



- 23b)** Short shrublands typically occurring on dunes, sand sheets, and sandy alluvial terraces characterized by *Poliomintha incana*, *Artemisia filifolia*, and/or *Vanclevea stylosa* **(24)**
- 24a)** (23) Short shrublands characterized by *Artemisia filifolia* occurring on sand dunes or mixed with alkali tolerant shrubs on high alluvial terraces primarily in the southern end of the mapping area; there are a few pockets of this association in the South Desert. This association tends to have more shrub diversity so some *Coleogyne ramosissima* or *Ephedra viridis* may be present - ***Artemisia filifolia* Colorado Plateau Shrubland [Map Class 9]**



- 24b)** Short shrublands occupying active sand dunes and characterized by a combination of *Poliomintha incana* and/or *Vancleavea stylosa* and usually with *Artemisia filifolia*, all of which may vary in cover; *Eriogonum leptocladon* and *Coleogyne ramosissima* are often present - ***Poliomintha incana* - *Artemisia filifolia* - *Vancleavea stylosa* Shrubland [Map Class 9]**



- 25a)** (22) Short shrublands typically occurring along washes and characterized by *Atriplex canescens*, *Ericameria nauseosa*, or *Fallugia paradoxa* (26)
- 25b)** Short shrublands occupying a variety of substrates characterized by the genera *Arctostaphylos*, *Artemisia*, *Atriplex*, *Eriogonum*, *Coleogyne*, *Sarcobatus*, *Ephedra*, *Symphoricarpos*, *Zuckia*, or *Ericameria* (not growing in a wash channel), or on steep talus slopes or Moenkopi shale flats dominated by *Chrysothamnus viscidiflorus* (28)
- 26a)** (25) Short shrublands characterized by *Fallugia paradoxa* and typically occurring on the banks and bars of intermittent streams in the slickrock canyons; *Fallugia paradoxa* is dominant or co-dominant, but many other shrubs are usually present, including the look-alike *Purshia stansburiana* - ***Fallugia paradoxa* Desert Wash Shrubland [Map Class 12b]**

NOTE: Map Class 12b used for this association is mapped in the intermittent washes in narrow canyons and ravines throughout the park. This association and others occurring in these drainages are highly variable in species composition. The dominant shrubs will vary from one canyon to the next. Some areas are very diverse with many species, and others contain only a few species, but all represent the more mesic regime for these ephemeral washes. Typical species include *Cercocarpus intricatus*, *Ericameria nauseosa*, *Fraxinus*

anomala, *Ephedra viridis*, *Amelanchier utahensis*, *Shepherdia rotundifolia*, *Mahonia fremontii*,
Symphoricarpos longiflorus, *Rhus trilobata*, and *Quercus gambelii*.



- 26b)** Sparse short shrublands occurring on the banks, channels, and point bars of intermittent washes in which the dominant shrub is either *Atriplex canescens* or *Ericameria nauseosa* (27)
- 27a)** (26) Mixed short shrublands characterized by *Ericameria nauseosa* occupying canyon bottoms, washes, and wash banks - ***Ericameria nauseosa* Desert Wash Shrubland [Narrow canyon bottoms = Map Class 12b; washes and banks on broader valley floors = Map Class 11]**



- 27b)** Sparse short shrublands in wash bottoms or sometimes on terraces if there has been recent gullyng of the stream channel. This type was sampled once on a wash bottom. The vegetation is characterized by scattered shrubs of *Atriplex canescens*; associated shrubs include *Fraxinus anomala*, *Rhus trilobata*, and *Ericameria nauseosa*. Sapling *Populus fremontii* may grow along the channel banks. The herbaceous layer is sparse; the only reported species are *Achnatherum hymenoides* and *Wyethia scabra* - ***Atriplex canescens* Desert Wash Shrubland [Map Class 12b]**

[No Plant Association Photograph Available]

- 28a)** (25) Short shrublands occupying a variety of substrates characterized by the genera *Arctostaphylos*, *Artemisia*, *Atriplex*, *Eriogonum*, *Gutierrezia*, *Krascheninnikovia*, *Coleogyne*, *Sarcobatus*, *Ephedra*, *Symphoricarpos*, or *Zuckia* **(33)**
- 28b)** Short shrublands characterized by *Ericameria nauseosa* or *Chrysothamnus viscidiflorus* typically on terraces adjacent to ephemeral streams (*Ericameria*) or on steep talus slopes or flats of Moenkopi shale (*Chrysothamnus*) **(29)**
- 29a)** (28) Short shrublands characterized by *Chrysothamnus viscidiflorus* and typically occupying steep talus slopes, often on Chinle Formation below cliffs of Kayenta or Wingate sandstone; *Artemisia bigelovii*, *Atriplex canescens*, *Ephedra viridis*, and *Shepherdia rotundifolia* may occur with low cover. Sparse shrublands dominated by *Chrysothamnus viscidiflorus* may also occur on flats of Moenkopi shale - ***Chrysothamnus viscidiflorus* Talus Shrubland [Map Class 40]**

NOTE: Map Class 40 is found on steep talus slopes throughout the park. Stands are highly variable in species composition, but cannot be classified as woodlands because the tree cover is generally less than 8%. The dominant shrubs vary from one area to the next. Some areas are very diverse with many species (including *Ericameria nauseosa*, *Fraxinus anomala*, or *Mahonia fremontii*); others contain only a few species. The map class is intended to encompass all non-woodland shrub areas on talus slopes and ridges until further information is available.



- 29b)** Short shrublands characterized by *Ericameria nauseosa* occupying valley floors in or adjacent to ephemeral streams **(30)**
- 30a)** (29) Shrublands characterized by *Ericameria nauseosa* with moderate to high cover of the non-indigenous annual *Bromus tectorum*; found along Notom Road accessing the southern portion of the park on the broad Hall's Creek floodplain - ***Ericameria nauseosa* / *Bromus tectorum* Semi-natural Shrubland [Map Class 11]**

[No Plant Association Photograph Available]

30b) Short shrublands characterized by *Ericameria nauseosa*; if *Bromus tectorum* is present it provides only sparse to low cover **(31)**

31a) (30) Short shrublands characterized by *Ericameria nauseosa* with low to moderate cover of the short grass *Bouteloua gracilis*; found in the northern portion of the park and on Rock Springs Bench - ***Ericameria nauseosa* / *Bouteloua gracilis* Shrub Herbaceous Vegetation [Map Class 13z]**



31b) Short shrublands characterized by *Ericameria nauseosa* with an understory characterized by *Sporobolus airoides* or with no conspicuous dominant understory; occupying wash bottoms and stream terraces of sand deposits **(32)**

32a) (32) Shrublands characterized by *Ericameria nauseosa* with the bunchgrasses *Achnatherum hymenoides* and *Sporobolus airoides* providing low to moderate cover - ***Ericameria nauseosa* / *Sporobolus airoides* Shrubland [Map Class 11]**



32b) Short shrublands characterized by *Ericameria nauseosa* occupying alluvial sand deposits and sand sheets; typically sparsely vegetated - ***Ericameria nauseosa* Sand Deposit Sparse Shrubland [Map Class 11]**



- 33a)** (28) Short shrublands occupying moderately deep soils throughout the park and characterized by *Coleogyne ramosissima* **(34)**
- 33b)** Short shrublands occupying various habitats throughout the park and characterized by *Arctostaphylos*, *Artemisia*, *Ericameria*, *Eriogonum*, *Gutierrezia*, *Krascheninnikovia*, *Atriplex*, *Shepherdia*, *Sarcobatus*, *Ephedra*, *Symphoricarpos*, or *Zuckia* **(36)**
- 34a)** (33) Shrublands characterized by *Coleogyne ramosissima* with *Purshia stansburiana* typically occupying the Salt Wash Member of the Morrison Formation or Entrada Sandstone slickrock. *Quercus havardii* var. *tuckeri* may or may not be present - ***Coleogyne ramosissima* - *Purshia stansburiana* - *Quercus havardii* var. *tuckeri* Shrubland [Map Class 19d]**



- 34b)** Short shrublands characterized by *Coleogyne ramosissima*, sometimes with cover provided by the short bunchgrass *Pleuraphis jamesii* **(35)**
- 35a)** (34) Short shrublands characterized by *Coleogyne ramosissima* with *Pleuraphis jamesii* and other grasses typically contributing over 5% cover. Other shrubs such as *Atriplex confertifolia* or *Ephedra* spp. may be present - ***Coleogyne ramosissima* / *Pleuraphis jamesii* Shrubland [Map Class 10]**



- 35b)** Short shrublands characterized by *Coleogyne ramosissima* occupying sand sheets, landslide deposits or Carmel Formation clay; *Coleogyne ramosissima* is always dominant and *Ericameria nauseosa*, *Artemisia filifolia* and *Ephedra* spp. are often present; perennial herbaceous species typically contribute less than 5% cover - ***Coleogyne ramosissima* Shrubland [Map Class 10]**



- 36a)** (33) Short shrublands occupying shale badlands or sand dunes and characterized by the genus *Eriogonum* **(37)**
- 36b)** Short or dwarf-shrublands occupying a variety of substrates and characterized by species within the genera *Arctostaphylos*, *Artemisia*, *Atriplex*, *Ericameria*, *Sarcobatus*, *Ephedra*, *Shepherdia*, *Symphoricarpos*, or *Zuckia* **(39)**
- 37a)** (36) Short shrublands occurring on dunes characterized by *Eriogonum leptocladon* with significant graminoid cover of *Muhlenbergia pungens*; this association was described by one Romme plot collected in 1986; the area is located along the northeastern boundary of the park just below Rock Springs Bench; if it occurs elsewhere in the park it will most likely be in that general area or in Cathedral Valley - ***Eriogonum leptocladon* / *Muhlenbergia pungens* Shrubland [Map Class 9]**

[No Plant Association Photograph Available]

37b) Sparse dwarf *Eriogonum* shrublands on barren badlands of the Morrison, Moenkopi, or Entrada formations **(38)**

38a) (37) Dwarf shrublands occupying shale badlands and characterized by sparse to low canopy cover of *Eriogonum corymbosum*; found on the Moenkopi Formation; *Ephedra torreyana*, *Atriplex confertifolia*, and *Atriplex cuneata* may be present with low cover - ***Eriogonum corymbosum* Badlands Sparse Vegetation [Map Class 4a]**



38b) Sparse dwarf shrublands characterized by *Eriogonum leptocladon* occurring on barren hills of the Entrada or Moenkopi formations – ***Eriogonum leptocladon* Sparse Vegetation [Map Class 13a]**

[No Plant Association Photograph Available]

39a) (36) Short shrublands occupying alkaline to saline soils often near or on terraces or drainages and characterized by *Sarcobatus vermiculatus*, often with *Atriplex* spp. or *Artemisia tridentata* **(40)**

39b) Short or dwarf-shrublands occupying many substrates and characterized by the genera *Arctostaphylos*, *Artemisia* (without *Sarcobatus*), *Atriplex*, *Ephedra*, *Ericameria*, *Gutierrezia*, *Krascheninnikovia*, *Shepherdia*, *Symphoricarpos*, or *Zuckia* **(44)**

40a) (39) Short shrublands characterized by *Sarcobatus vermiculatus* and *Artemisia tridentata*, typically occurring on deep alkaline soils of terraces or alluvial deposits - ***Sarcobatus vermiculatus* / *Artemisia tridentata* Shrubland [Map Class 11]**

[No Plant Association Photograph Available]

40b) Black greasewood shrublands, sometimes with *Atriplex canescens* and occurring in various habitats; *Artemisia tridentata* may be present providing sparse cover but does not contribute significantly to overall canopy cover **(41)**

- 41a)** (40) Black greasewood shrublands with low to moderate cover of *Atriplex confertifolia*; *Picrothamnus desertorum* and/or *Suaeda moquinii* may be present. The habitat is usually a saline stream terrace. If both *Sarcobatus vermiculatus* and *Atriplex confertifolia* are present and the setting is more upland, see couplet 74 - ***Sarcobatus vermiculatus* / *Atriplex confertifolia* - (*Picrothamnus desertorum*, *Suaeda moquinii*) Shrubland [Map Class 11a]**



- 41b)** Vegetation characterized by *Sarcobatus vermiculatus* in various habitats; *Atriplex confertifolia* may be present, but contributes little to the canopy cover (42)

- 42a)** (41) Black greasewood shrublands occurring along drainage seeps characterized by high cover of the understory rhizomatous grass *Distichlis spicata* - ***Sarcobatus vermiculatus* / *Distichlis spicata* Shrubland [Map Class 11a]**

[No Plant Association Photograph Available]

- 42b)** *Sarcobatus vermiculatus* shrublands and the tall bunchgrass *Sporobolus airoides* of various habitats; may include disturbed sites with *Bromus tectorum* cover (43)

- 43a)** (42) Sparse alkaline shrublands on low-level terraces and valley floors characterized by an open canopy of *Sarcobatus vermiculatus* with an understory dominated by *Sporobolus airoides*. Associated shrubs include *Opuntia polyacantha*, *Ephedra torreyana*, *Atriplex canescens*, *Atriplex confertifolia*, and *Suaeda torreyana*. The herbaceous layer provides sparse cover. Cryptogam cover is variable, ranging from sparse to 80% cover - ***Sarcobatus vermiculatus* / *Sporobolus airoides* Shrubland [Map Class 11a]**



- 43b)** Open shrublands of *Sarcobatus vermiculatus*; *Atriplex canescens* may also be present. Stands may be disturbed by grazing with significant cover by *Bromus tectorum* or exotic annual forbs - ***Sarcobatus vermiculatus* Disturbed Shrubland [Map Class 11a]**



- 44a)** (39) Short, mostly sparse shrublands dominated by the genus *Ephedra* (45)
- 44b)** Short sparse to dense shrublands occupying a variety of substrates and characterized by the genera *Arctostaphylos*, *Artemisia*, *Atriplex*, *Gutierrezia*, *Krascheninnikovia*, *Shepherdia*, *Symphoricarpos*, or *Zuckia* (52)
- 45a)** (44) Short and dwarf-shrublands characterized by *Ephedra torreyana* and occupying various upland habitats (46)

- 45b)** Short and dwarf-shrublands characterized by *Ephedra viridis* and occupying various upland habitats **(50)**
- 46a)** (45) Shrublands characterized by *Ephedra torreyana* with sparse understory or well-developed biotic crust, occasionally occurs with other shrubs including *Atriplex* species or *Artemisia bigelovii* **(47)**
- 46b)** Shrublands characterized by *Ephedra torreyana* with understory of the shortgrass *Bouteloua gracilis* or medium to tall bunchgrass *Achnatherum hymenoides*; the short bunchgrass, *Pleuraphis jamesii*, is almost always present **(49)**
- 47a)** (46) Shrublands characterized by *Ephedra torreyana*, *Atriplex* spp., and occasionally *Ericameria nauseosa* or *Purshia stansburiana*; typically sparse and occupying gypsum soils on the Carmel Formation; the dominant vegetation is the non-vascular ground lichen layer - ***Ephedra torreyana* - (*Atriplex* spp.) / Nonvascular Gypsum Sparse Vegetation [Map Class 5]**



- 47b)** Shrublands characterized by *Ephedra torreyana* that may provide sparse to moderate cover or contain *Artemisia bigelovii* as a co-dominant species **(48)**
- 48a)** (47) Sparse shrublands usually co-dominated by *Ephedra torreyana* and *Artemisia bigelovii* on slopes, ledges, and flats covered with alluvial gravels. Substrates include sandstone and shale of the Summerville, Entrada, Curtis, Chinle, Carmel, and Emery formations, as well as the Salt Wash Member of the Morrison Formation. This is a variable association that characteristically also includes a combination of *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Ericameria nauseosa*, *Tetradymia spinosa*, *Eriogonum corymbosum*, and/or *Gutierrezia sarothrae* - ***Ephedra torreyana* - *Artemisia bigelovii* Sparse Vegetation [Map Class 13]**



48b) Shrublands characterized by *Ephedra torreyana* occurring primarily on hills of Entrada Sandstone outcrops and typically providing very sparse cover; *Atriplex confertifolia*, *Ericameria nauseosa*, *Eriogonum leptocladon*, or *Gutierrezia sarothrae* may be present - ***Ephedra torreyana* Sparse Vegetation [Map Class 13a]**

49a) (46) Shrublands characterized by *Ephedra torreyana* occurring on level sites with a coating of coarse alluvium derived from basalt, typically characterized by an understory dominated by the short grasses *Bouteloua gracilis* and *Pleuraphis jamesii*, but also often including significant cover by *Hesperostipa comata* and *Achnatherum hymenoides*; known only from Johnson Mesa - ***Ephedra torreyana* / *Bouteloua gracilis* - *Pleuraphis jamesii* Shrubland [Map Class 13h]**



49b) Shrublands characterized by *Ephedra torreyana* occurring primarily on sandy habitats derived from Entrada sandstone or Summerville Formation, typically characterized by an understory of the medium to tall bunchgrass *Achnatherum hymenoides* and the short bunchgrass *Pleuraphis jamesii*; *Atriplex confertifolia*, *Ericameria nauseosa*, *Eriogonum leptocladon*, or *Gutierrezia sarothrae* may be present with low cover. *Artemisia bigelovii* is absent or has only trace cover - ***Ephedra torreyana* / *Achnatherum hymenoides* - *Pleuraphis jamesii* Shrubland [Map Class 13a]**



- 50a)** (45) Shrublands characterized by *Ephedra viridis* occurring on disturbed sites and characterized in the understory by the invasive annual grass, *Bromus tectorum* - ***Ephedra viridis* / *Bromus tectorum* Semi-natural Shrubland [Map Class 13x]**



- 50b)** Shrublands characterized by the rhizomatous form of *Ephedra viridis* occurring on relatively undisturbed sandy sites and characterized in the understory by native perennial grasses **(51)**
- 51a)** (50) Sparse shrublands characterized by *Ephedra viridis* on sandy substrates, with a sometimes dense understory dominated by either or both of the bunchgrasses *Achnatherum hymenoides* and/or *Hesperostipa comata*; known from Hall's Creek drainage just north of the Hall's Creek Overlook access trail - ***Ephedra viridis* / (*Achnatherum hymenoides* - *Hesperostipa comata*) Shrubland [Map Class 13y]**



- 51b)** Shrublands or shrub-herbaceous vegetation characterized by *Ephedra viridis* occurring on sandy substrates and with a sometimes dense understory characterized by the short bunchgrass *Pleuraphis jamesii*; areas often interspersed between patches of *Coleogyne ramosissima* Shrubland - ***Ephedra viridis* / *Pleuraphis jamesii* Shrubland [Map Class 13x]**



- 52a)** (44) Shrublands characterized by *Arctostaphylos patula*, *Artemisia* species, or *Symphoricarpos oreophilus* occupying various sites with shale or sandy soils **(53)**
- 52b)** Shrublands characterized by *Atriplex* species, *Gutierrezia*, *Shepherdia*, *Krascheninnikovia*, or *Zuckia brandegeei* occupying various sites with shale or sandy soils, although sometimes covered by sandstone talus **(65)**
- 53a)** (52) Short shrublands characterized by *Arctostaphylos patula*; found near the top of VABM Bitter in the Fold. This association was not sampled and therefore is not included in the classification or association descriptions - ***Arctostaphylos patula* Shrubland (Park Special) [Map Class 41]**

[No Plant Association Photograph Available]

- 53b)** Shrublands characterized by *Artemisia* (*bigelovii*, *nova*, or *tridentata*) or *Symphoricarpos oreophilus* occurring in a variety of habitats **(54)**

- 54a)** (53) Shrublands characterized by *Artemisia bigelovii* or *Artemisia nova* typically occupying dry, rocky slopes or bedrock ledges or at high elevations among *Pinus ponderosa* stands (55)
- 54b)** Shrublands characterized by *Artemisia tridentata* or *Symphoricarpos oreophilus* occupying dry to mesic deeper soils of slopes and lowlands (57)
- 55a)** (54) Short mixed shrublands on sandy, gentle slopes dominated by *Artemisia bigelovii*. If *Ephedra torreyana* is present, return to couplet 46. Associated shrubs include *Eriogonum microthecum*, *Opuntia polyacantha*, *Yucca harrimaniae*, *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Ericameria nauseosa*, *Eriogonum corymbosum*, or *Gutierrezia sarothrae*. The herbaceous layer is patchy, but *Pleuraphis jamesii* generally dominates the layer - ***Artemisia bigelovii* Shrubland [Map Class 13]**

[No Plant Association Photograph Available]

- 55b)** Short shrublands characterized by *Artemisia nova* typically occurring between openings within *Pinus ponderosa* stands at higher elevations (56)
- 56a)** (55) Short shrublands characterized by *Artemisia nova* with low to moderate cover of *Purshia tridentata* short shrubs and an understory characterized by the short bunchgrass *Poa fendleriana*; this type typically occurs in openings within ponderosa pine woodlands at higher elevations - ***Artemisia nova* - *Purshia tridentata* / *Poa fendleriana* Shrubland [Map Class 13e]**



- 56b)** Short shrublands characterized by *Artemisia nova* typically without *Purshia tridentata*, but with the short bunchgrass *Poa fendleriana* present - ***Artemisia nova* / *Poa fendleriana* Shrubland [Map Class 12c]**



- 57a)** (54) Short shrublands characterized by *Symphoricarpos oreophilus* often mixed with *Artemisia tridentata* ssp. *vaseyana* or *Artemisia nova* and typically occurring along edges of quaking aspen groves or in swales on high elevation plateaus - ***Symphoricarpos oreophilus* Shrubland [Map Class 13f]**



- 57b)** Short shrublands characterized by *Artemisia tridentata* (ssp. *tridentata*, *vaseyana*, or *wyomingensis*), often with an understory of grasses or with a variety of graminoids providing sparse cover (58)
- 58a)** (57) Short shrublands dominated by *Artemisia tridentata* (any subspecies) occupying deep soils. *Ericameria nauseosa* is a common associate in the canopy and while there may be a variety of herbaceous species in the sparse understory, none has more than trace cover except exotic species such as *Bromus tectorum*. These sites are degraded by grazing - ***Artemisia tridentata* – (*Ericameria nauseosa*) / *Bromus tectorum* Semi-natural Shrubland [Map Class 11c]**



- 58b)** Shrublands dominated by *Artemisia tridentata* where the subspecies is known (ssp. *tridentata*, *vaseyana*, or *wyomingensis*) with an understory typically dominated by perennial grasses, native or introduced, but sometimes with a barren or weed-dominated herbaceous layer **(59)**
- 59a)** (58) Tall shrublands dominated by *Artemisia tridentata* ssp. *tridentata*, usually located in bottomland situations. If *Sarcobatus vermiculatus* is co-dominant, please return to couplet 41. Grasses dominate the understory **(60)**
- 59b)** Wyoming or mountain big sagebrush shrublands, usually in upland habitats and with various species in the understory **(61)**
- 60a)** (59) Shrublands dominated by *Artemisia tridentata* ssp. *tridentata* on bottomlands or alluvial plains. Associated shrubs include *Atriplex canescens* and *Opuntia polyacantha*. *Sporobolus airoides* dominates the herbaceous understory; most sites contain either *Sporobolus cryptandrus* or *Bromus tectorum* - ***Artemisia tridentata* ssp. *tridentata* / *Sporobolus airoides* Shrubland [Map Class 11c]**
- [No Plant Association Photograph Available]
- 60b)** Shrublands dominated by *Artemisia tridentata* ssp. *tridentata* with an understory dominated by the short bunchgrass *Pleuraphis jamesii*, sometimes with significant cover by *Bromus tectorum* - ***Artemisia tridentata* ssp. *tridentata* / *Pleuraphis jamesii* Shrubland [Map Class 11c]**



- 61a)** (59) Short shrublands of *Artemisia tridentata* (usually ssp. *wyomingensis* or ssp. *tridentata*) with an understory dominated by the medium-tall bunchgrass *Achnatherum hymenoides*; often on high alluvial terraces with sandy, non-saline soils - ***Artemisia tridentata* / *Achnatherum hymenoides* Shrubland [Map Class 11c]**

[No Plant Association Photograph Available]

- 61b)** Short shrublands characterized by *Artemisia tridentata* (ssp. *vaseyana* or *wyomingensis*) with an understory that is characterized by other grasses or by annual forbs or is nearly barren **(62)**
- 62a)** (61) Short shrublands characterized by *Artemisia tridentata* (ssp. *vaseyana* or *wyomingensis*) and an understory dominated by the native grasses *Poa fendleriana* or *Bouteloua gracilis* **(63)**
- 62b)** Short shrublands with a canopy dominated by *Artemisia tridentata* ssp. *wyomingensis* and an understory dominated by exotic forb or grass species, or sometimes nearly completely barren **(64)**
- 63a)** (62) Short shrublands characterized by *Artemisia tridentata* ssp. *vaseyana* with an understory characterized by the short bunchgrass *Poa fendleriana* often occurring in openings between *Populus tremuloides* stands - ***Artemisia tridentata* ssp. *vaseyana* / *Poa fendleriana* Shrubland [Map Class 13f]**



63b) Short shrublands characterized by *Artemisia tridentata* ssp. *wyomingensis* with an understory characterized by the shortgrass *Bouteloua gracilis* - ***Artemisia tridentata* ssp. *wyomingensis* / *Bouteloua gracilis* Shrubland [Map Class 13d]**



64a) (62) Short shrublands near the Onion Beds and on adjacent BLM lands, with a canopy of *Artemisia tridentata* ssp. *wyomingensis* with an understory dominated by *Psathyrostachys juncea*, sometimes with scattered relict *Achnatherum hymenoides* and *Bouteloua gracilis*. *Gutierrezia sarothrae* or *Opuntia polyacantha* may be present with very low cover - ***Artemisia tridentata* ssp. *wyomingensis* / (*Agropyron cristatum*, *Psathyrostachys juncea*) Seeded Grasses Semi-natural Shrubland [Map Class 11c]**



- 64b)** Short shrublands on alluvial flats or terraces, with a canopy of *Artemisia tridentata* ssp. *wyomingensis* on sites severely degraded by grazing or other uses. The understory is dominated by weedy and exotic annual plants, or those that increase under heavy grazing, including *Descurainia pinnata*, *Bromus tectorum*, *Schoenocrambe linifolia*, *Opuntia polyacantha*, and *Lappula occidentalis*. Tufts of relict native grasses may remain - **Artemisia tridentata ssp. wyomingensis / Disturbed Understory Semi-natural Shrubland [Map Class 11c]**



- 65a)** (52) Dwarf shrublands on poor soils or historically disturbed sites of valley bottoms; *Gutierrezia sarothrae* dominates a mixed canopy with *Atriplex canescens* and *Ericameria nauseosa*. The understory includes *Bouteloua gracilis* and *Sporobolus airoides*. Biological soil crusts have minimal cover and no forbs were recorded - **Gutierrezia sarothrae / Sporobolus airoides - Pleuraphis jamesii Shrub Herbaceous Vegetation [Map Class 11]**

[No Plant Association Photograph Available]

- 65b)** Short shrublands on a variety of substrates and landscape positions, but primarily alkaline or saline soils of lower slopes, toe slopes, valley bottoms or terraces. One type is known from steep shale slopes overlain by sandstone colluvium. The dominant shrubs in these communities are *Krascheninnikovia lanata*, *Atriplex canescens*, *Atriplex confertifolia*, *Shepherdia rotundifolia*, or *Zuckia brandegeei* **(66)**
- 66a)** (65) Short or dwarf-shrublands dominated by *Krascheninnikovia lanata* **(67)**
- 66b)** Short shrublands dominated by *Atriplex canescens*, *Atriplex confertifolia*, *Shepherdia rotundifolia*, or *Zuckia brandegeei*; other shrubs such as *Artemisia bigelovii* may be co-dominant **(68)**
- 67a)** (66) *Krascheninnikovia lanata* dwarf-shrublands on dry terraces with an understory dominated by the bunchgrass *Pleuraphis jamesii*. Associated shrubs

with lesser cover include *Mahonia fremontii*, *Artemisia tridentata*, and *Atriplex canescens*. Other herbaceous species may include *Achnatherum hymenoides* (may be codominant) and *Hesperostipa comata*. Pinyon and juniper trees may be scattered through stands - ***Krascheninnikovia lanata* / *Pleuraphis jamesii* Dwarf-shrubland [Map Class 11]**

[No Plant Association Photograph Available]

- 67b)** *Krascheninnikovia lanata* dwarf-shrublands on deep soils of valley floors. The understory is sparse or poorly developed, either because of difficult growing conditions or more often because of disturbance and there are no strongly diagnostic native species with more than trace cover. Associated shrubs include *Atriplex confertifolia* and *Chrysothamnus viscidiflorus* with low cover. If *Atriplex confertifolia* is co-dominant, go to couplet 74. *Malcolmia africana* and *Halogeton glomeratus* are common understory species - ***Krascheninnikovia lanata* Dwarf-shrubland [Map Class 11]**

[No Plant Association Photograph Available]

- 68a)** (66) Short or dwarf-shrublands occupying heavy clay soils derived from the Chinle, Mancos, or Moenkopi formations characterized by *Zuckia brandegeei*, but often mixed with other shrubs including *Atriplex confertifolia* and *Atriplex gardneri* - ***Zuckia brandegeei* Sparse Vegetation [Map Class 4]**



- 68b)** Short shrublands of alkaline soils or talus slopes dominated by *Atriplex canescens* (sometimes co-dominated by *Artemisia bigelovii*) or *Atriplex confertifolia* **(69)**
- 69a)** (68) Short shrublands of a variety of habitats in which *Atriplex canescens* is dominant, occasionally with *Artemisia bigelovii* as a co-dominant **(70)**
- 69b)** Shrublands in a variety of habitats dominated by *Atriplex confertifolia* **(74)**
- 70a)** (69) Short shrublands with a diverse but sparse canopy co-dominated by *Atriplex canescens* and *Artemisia bigelovii* occupying steep south-facing talus slopes,

typically occurring on the Chinle Formation below sheer cliffs of Kayenta or Wingate sandstone. As many as 16 total shrub species may occur in any one stand - ***Atriplex canescens* – *Ephedra viridis* Talus Shrubland [Map Class 40]**

NOTE: This map class is intended to encompass all non-wooded tall shrublands on talus slopes and ridges until more information is available. It is used for this association as well as *Amelanchier utahensis* Shrubland and *Chrysothamnus viscidiflorus* Talus Shrubland. These associations occupy treeless ridges or steep, often inaccessible talus slopes throughout. They are highly variable in composition but cannot be classified as woodlands. The dominant shrubs vary from one area to the next; some areas are very diverse (including *Ericameria nauseosa*, *Chrysothamnus viscidiflorus*, *Amelanchier utahensis*, *Fraxinus anomala*, or *Mahonia fremontii*), while others contain only a few species.



70b) Short shrublands characterized by *Atriplex canescens*, not on talus; *Artemisia bigelovii* is absent (71)

71a) (70) Short shrublands characterized by *Atriplex canescens* with absent to sparse cover of grasses on deep, sandy soils, and fine-textured soils of alluvial benches. This association can be distinguished from similar shrublands by a lack of any diagnostic herbaceous species in the understory, or an understory overwhelmingly dominated by annual or exotic species - ***Atriplex canescens* Shrubland [Map Class 11]**



- 71b)** Short shrublands dominated by *Atriplex canescens* with an understory dominated to co-dominated by *Bouteloua gracilis*, *Sporobolus airoides*, or *Pleuraphis jamesii* **(72)**
- 72a)** (71) Short shrublands characterized by *Atriplex canescens* with an understory dominated by *Bouteloua gracilis* or *Pleuraphis jamesii* **(73)**
- 72b)** Open short shrublands characterized by *Atriplex canescens* on deep, alkaline sands, sometimes with scattered *Artemisia filifolia*, *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Krascheninnikovia lanata*, *Gutierrezia sarothrae*, and *Sarcobatus vermiculatus*. *Sporobolus airoides* dominates the diverse herbaceous layer - ***Atriplex canescens* / *Sporobolus airoides* Shrubland [Map Class 11]**



- 73a)** (72) Short shrublands characterized by *Atriplex canescens* with an understory dominated by the shortgrass *Bouteloua gracilis*. This association can occur on wash terraces and may include a high cover of exotic annuals such as *Bromus tectorum* - ***Atriplex canescens* / *Bouteloua gracilis* Shrubland [Map Class 11]**



- 73b)** Fourwing saltbush shrublands with an understory characterized by the short bunchgrass *Pleuraphis jamesii*; this association was documented at CARE in one plot (photo below) that was highly disturbed by long-term heavy grazing. The majority of cover was by non-native forbs. A pure form of this association as

defined in the global description may be present in CARE, but has not yet been found - ***Atriplex canescens* / *Pleuraphis jamesii* Shrubland [Map Class 11]**



- 74a)** (69) Short shrublands in which *Atriplex confertifolia* is co-dominant with *Krascheninnikovia lanata* or *Sarcobatus vermiculatus* (75)
- 74b)** Short shrublands where *Atriplex confertifolia* is dominant and the understory consists of grasses or is sparse or consists of disturbed species (76)
- 75a)** (74) Short shrublands characterized by *Atriplex confertifolia* with moderate cover of *Krascheninnikovia lanata*, co-dominating the stands; occurs in the South Desert and west into the Fold on the Carmel Formation - ***Atriplex confertifolia* - *Krascheninnikovia lanata* Shrubland [Map Class 6]**



- 75b)** Short shrublands characterized by *Atriplex confertifolia* with sparse to low cover of *Sarcobatus vermiculatus* - ***Atriplex confertifolia* - *Sarcobatus vermiculatus* Shrubland [Map Class 11a]**

[No Plant Association Photograph Available]

- 76a)** (74) *Atriplex confertifolia* shrublands with a sparse or poorly developed understory consisting of species that indicate disturbance - ***Atriplex confertifolia* Great Basin Shrubland [Map Class 6]**



76b) Shadscale shrublands with the short bunchgrass *Pleuraphis jamesii* significant to dominant in the understory **(77)**

77a) (76) Short shrublands characterized by *Atriplex confertifolia* with the understory characterized by the medium to tall bunchgrass *Achnatherum hymenoides* - ***Atriplex confertifolia* / *Achnatherum hymenoides* Shrubland [Map Class 6]**



77b) Shadscale shrublands with *Pleuraphis jamesii* providing low to moderate cover - ***Atriplex confertifolia* / *Pleuraphis jamesii* Shrubland [Map Class 6]**



Key IV: Herbaceous Associations of Capitol Reef National Park

- 1a)** Herbaceous vegetation occupying mesic sites, including wetlands, perennial drainages, seeps, and springs **(2)**
- 1b)** Herbaceous vegetation occupying xeric and upland sites, including dry washes, valley bottoms, terraces, and benches; community not controlled by mesic conditions **(8)**
- 2a)** (1) Vegetation associated with hanging gardens; typical species include *Mimulus eastwoodiae*, *Carex aurea*, and *Aquilegia micrantha*. Stands can contain a diversity of species depending on their size, amount of perennial moisture, and exposure, including *Brickellia longifolia*, *Calamagrostis scopulorum*, *Epilobium ciliatum*, *Smilacina stellata*, *Adiantum capillus-veneris*, and *Epipactis gigantea*. Wetland and/or upland shrubs are often present with low cover relative to the herbaceous species - ***Aquilegia micrantha* - *Mimulus eastwoodiae***
Herbaceous Vegetation [Map Class 31]



- 2b)** Vegetation dominated by graminoids growing in saturated or inundated soil of seeps, springs, or streams, but not hanging gardens. Dominant vegetation includes *Juncus*, *Schoenoplectus*, *Typha*, *Phragmites*, or *Eleocharis* **(3)**

- 3a)** (2) Graminoid vegetation of terraces, stream banks, or riparian areas dominated by the tall grass *Phragmites australis*; within CARE this association often forms small patches in a mosaic with other wetland associations - ***Phragmites australis* Western North America Temperate Semi-natural Herbaceous Vegetation [Map Class 25]**



- 3b)** Graminoid vegetation of terraces, stream banks, depressions, or riparian areas dominated or co-dominated by species of *Juncus*, *Schoenoplectus*, *Typha*, or *Eleocharis*, or a mixture of mesic species (4)
- 4a)** (3) Short graminoid vegetation (typically <0.5m tall) occupying mesic, saturated, or inundated sites and dominated by *Eleocharis palustris* - ***Eleocharis palustris* Herbaceous Vegetation [Map Class 25]**

[No Plant Association Photograph Available]

- 4b)** Tall graminoid vegetation (typically >0.5m tall) occupying mesic, saturated, or inundated sites characterized by species of *Juncus*, *Schoenoplectus*, or *Typha* or a mixture of mesic graminoid species (5)
- 5a)** (4) Tall graminoid vegetation on stream margins with saturated to inundated soils and dominated by *Typha latifolia* - ***Typha (latifolia, angustifolia)* Western Herbaceous Vegetation [Map Class 25]**

[No Plant Association Photograph Available]

- 5b)** Medium to tall graminoid vegetation occupying mesic to inundated sites and dominated by *Juncus balticus*, *Schoenoplectus pungens*, or a mix of mesic graminoid species (6)
- 6a)** (5) Medium to tall graminoid vegetation occupying mesic to inundated sites and dominated by *Juncus balticus* or *Schoenoplectus pungens* (7)

- 6b)** Medium to tall graminoid vegetation occupying mesic to inundated sites and characterized by a mixture of mesic graminoid species; typically occurs northwest of the park. This type had no sampled plots and therefore is not included in the classification - **Wet Meadow Herbaceous Vegetation [Map Class 36]**



- 7a)** (6) Medium to tall graminoid vegetation occupying mesic to inundated sites and characterized by a near-monoculture of *Juncus balticus*. This type had no sampled plots and therefore is not included in the classification – ***Juncus balticus* Herbaceous Vegetation [Map Class 25]**

[No Plant Association Photograph Available]

- 7b)** Medium to tall graminoid vegetation occupying mesic to inundated sites and characterized by *Schoenoplectus pungens* – ***Schoenoplectus pungens* Herbaceous Vegetation [Map Class 25]**



- 8a)** (1) Herbaceous vegetation of xeric sites characterized by forb species of *Artemisia*, *Arenaria*, *Enceliopsis*, *Erigeron*, *Eriogonum*, *Frasera*, *Heterotheca*, *Hymenopappus*, *Paronychia*, *Polygala*, *Stenotus*, or *Tetranneuris*. Graminoids generally have lower cover than forbs (9)
- 8b)** Perennial grassland and herbaceous vegetation of xeric sites characterized by grass species of *Achnatherum*, *Bouteloua*, *Hesperostipa*, *Leymus*, *Muhlenbergia*,

Pleuraphis, *Poa*, or *Sporobolus*. Disturbed sites may be dominated by nonnative species such as *Bromus tectorum*, *Halogeton glomeratus*, or *Psathyrostachys juncea* (10)

- 9a) (8) Herbaceous vegetation characterized by the forb *Artemisia frigida* accompanied by bunchgrasses in *Bouteloua*, *Achnatherum*, and/or *Poa* and occupying rocky basalt substrates; found in the northwestern portion of the park – ***Artemisia frigida* – (*Bouteloua gracilis* - *Achnatherum hymenoides* – *Poa secunda*) – Lichens Rocky Mesa Herbaceous Vegetation [Map Class 12a]**



- 9b) Herbaceous vegetation characterized by cushion plants with sparse cover in the northwestern corner of the park. Characteristic species include the forbs *Arenaria eastwoodiae*, *Enceliopsis nudicaulis*, *Erigeron compactus*, *Erigeron pumilus*, *Eriogonum alatum*, *Frasera albomarginata*, *Heterotheca villosa*, *Hymenopappus filifolius*, *Paronychia sessiliflora*, *Polygala subspinosa*, *Stenotus armerioides*, *Tetraneuris acaulis*, and *Tetraneuris depressa* – **Sparse Cushion Plant Sparse Herbaceous Vegetation [Map Class 43]**

NOTE: This association is not included in the classification because of the sensitivity of the characteristic species.

[No Plant Association Photograph Available]

- 10a) (8) Herbaceous vegetation characterized by short grasses of the genera *Pleuraphis*, *Poa*, *Muhlenbergia*, or *Bouteloua*, or consisting primarily of the exotic species *Bromus tectorum* or *Halogeton glomeratus* (11)
- 10b) Herbaceous vegetation of xeric sites characterized by taller bunchgrasses of the genera *Achnatherum*, *Hesperostipa*, *Leymus*, or *Sporobolus* (19)
- 11a) (10) Active to stabilized sand dunes community dominated by *Muhlenbergia pungens*, although many other herbaceous (and a few shrub) species characteristic of sandy habitats are also present with low cover – ***Muhlenbergia pungens* Herbaceous Vegetation [Map Class 8]**

[No Plant Association Photograph Available]

- 11b)** Bunchgrasses occurring on various substrates and dominated by species of *Bouteloua*, *Pleuraphis*, or *Poa*, or dominated by the exotic species *Bromus tectorum* or *Halogeton glomeratus* **(12)**
- 12a)** (11) Short grasslands characterized by *Poa fendleriana* or by *Pleuraphis jamesii* with or without *Sporobolus airoides*, or overwhelmingly dominated by the exotic weedy annual species *Bromus tectorum* or *Halogeton glomeratus* **(15)**
- 12b)** Short grasslands characterized by *Bouteloua* species and/or *Pleuraphis jamesii*; *Sporobolus airoides* or *Hesperostipa comata* may be present in some stands **(13)**
- 13a)** (12) Short grasslands occurring primarily on the south-facing slope of Johnson Mesa, but occasionally seen in the Carmel Formation on the east-facing slopes of the Fold north of Notom; characterized by co-dominance of *Bouteloua eriopoda* and *Pleuraphis jamesii*, also sometimes there is substantial cover by *Bouteloua gracilis*, occupying volcanic rock substrates. *Ephedra torreyana*, *E. viridis*, and/or *Atriplex confertifolia* may be present - ***Bouteloua eriopoda* - *Pleuraphis jamesii* Herbaceous Vegetation [Map Class 8b]**



- 13b)** Short grasslands dominated or co-dominated by *Bouteloua gracilis*, accompanied by significant cover of either *Pleuraphis jamesii* or *Hesperostipa comata* **(14)**
- 14a)** (13) Short grasslands on valley floors. The grass layer consists of *Bouteloua gracilis* patches interspersed with *Hesperostipa comata*. *Bromus tectorum* may be abundant. Shrubs are present, consisting of scattered individuals of *Atriplex canescens* and *Artemisia tridentata* ssp. *wyomingensis*. The high cover by cheatgrass indicates a history of disturbance - ***Bouteloua gracilis* - *Hesperostipa comata* Herbaceous Vegetation [Map Class 8]**

[No Plant Association Photograph Available]

- 14b)** Grasslands on gravelly toe slopes dominated by patches of *Bouteloua gracilis* alternating with patches of *Pleuraphis jamesii*. Disturbed stands may have significant cover of *Bromus tectorum*. Scattered shrubs have a few percent cover and include *Atriplex canescens* and *Chrysothamnus viscidiflorus*; *Juniperus osteosperma* trees may be present with less than 10% cover - ***Bouteloua gracilis* - *Pleuraphis jamesii* Herbaceous Vegetation [Map Class 8]**

[No Plant Association Photograph Available]

- 15a)** (12) Grasslands dominated by *Poa fendleriana* or by *Pleuraphis jamesii* with or without *Sporobolus airoides* **(16)**
- 15b)** Herbaceous communities overwhelmingly dominated by the exotic species *Bromus tectorum* or *Halogeton glomeratus* **(18)**
- 16a)** (15) Muttongrass grasslands with moderate to high ground cover by nonvascular species; known from Billings Point within CARE. This community was not sampled and so is not include within the classification - ***Poa fendleriana* / Non-vascular Herbaceous Vegetation [Map Class 8c]**



- 16b)** Grasslands dominated by *Poa fendleriana* or by *Pleuraphis jamesii* with or without *Sporobolus airoides* **(17)**
- 17a)** (16) Grasslands characterized by co-dominance of the short bunchgrass *Pleuraphis jamesii* and the tall bunchgrass *Sporobolus airoides*. Short shrubs that may be present include *Atriplex confertifolia*, *Ericameria nauseosa*, and *Gutierrezia sarothrae* - ***Pleuraphis jamesii* - *Sporobolus airoides* Herbaceous Vegetation [Map Class 8]**



- 17b)** Grasslands dominated by *Pleuraphis jamesii*; *Sporobolus airoides* may be present, but provides sparse cover (typically <1%); *Atriplex canescens*, *Atriplex confertifolia*, and *Sarcobatus vermiculatus* may be present with a few percent cover - ***Pleuraphis jamesii* Herbaceous Vegetation [Map Class 8]**



- 18a)** (15) Degraded communities on a variety of substrates, sometimes burned, dominated by *Bromus tectorum* – ***Bromus tectorum* Semi-natural Herbaceous Vegetation [Map Class 11a]**

[No Plant Association Photograph Available]

- 18b)** Degraded communities, usually on saline or alkaline shale substrates, dominated by sparse to dense cover of *Halogeton glomeratus* – ***Halogeton glomeratus* Semi-natural Herbaceous Vegetation [Map Class 65]**

[No Plant Association Photograph Available]

- 19a)** (10) Grasslands dominated by species of *Hesperostipa* (may include stands with low cover by *Juniperus osteosperma* trees) **(20)**
- 19b)** Grasslands characterized by tall bunchgrasses of the genera *Sporobolus*, *Leymus*, or *Achnatherum*; if *Juniperus osteosperma* is present it provides only sparse cover **(21)**

- 20a)** (19) Wooded grasslands characterized by low cover (<8%) of *Juniperus osteosperma* and having an understory with moderate cover of the tall bunchgrass *Hesperostipa comata*; this association is found at lower elevations and grades into *Pinus edulis* - *Juniperus osteosperma* / *Hesperostipa comata* Woodland as the elevation increases - ***Juniperus osteosperma* / *Hesperostipa comata* Woodland [Map Class 14]**

NOTE: This association will only be mapped if it is known from fieldwork, otherwise these areas will be mapped into Map Class 14.



- 20b)** Grasslands characterized by the tall bunchgrass *Hesperostipa comata* - ***Hesperostipa comata* Great Basin Herbaceous Vegetation [Map Class 8]**



- 21a)** (19) Grasslands dominated by either *Sporobolus airoides* or *Sporobolus flexuosus* on stream terraces, floodplains, or valley floors **(22)**
- 21b)** Grasslands characterized by the tall bunchgrass genera *Achnatherum* or *Leymus*, occurs in a variety of upland habitats (may have a variety of associated grass species and sparse shrub cover) **(23)**
- 22a)** (21) Grasslands dominated by the tall bunchgrass *Sporobolus flexuosus*, often found on alluvial benches and terraces above drainages; *Atriplex canescens*,

Ephedra viridis, and *Opuntia polyacantha* may be present with low cover -
***Sporobolus flexuosus* Herbaceous Alliance [Map Class 8]**



- 22b)** Grasslands (sometimes sparse on Entrada Sandstone) occupying deep, well-developed, alkaline soils on canyon bottoms and floodplains. *Sporobolus airoides* dominates the vegetation. Shrubs may be present, but do not have enough cover to constitute a stratum (<5%); common shrub species include *Sarcobatus vermiculatus*, *Gutierrezia sarothrae*, and *Atriplex canescens*. Other herbaceous species may include *Pleuraphis jamesii*, *Bouteloua gracilis*, *Achnatherum hymenoides*, and *Salsola tragus* - ***Sporobolus airoides* Southern Plains Herbaceous Vegetation [Map Class 8]**

[No Plant Association Photograph Available]

- 23a)** (21) Sparse grasslands characterized by *Leymus salinus* (may contain sparse cover of the short shrubs *Atriplex confertifolia* and *Chrysothamnus viscidiflorus*), typically found on north-facing slopes on Morrison or Mancos formations shale with some colluvial sandstone fragments - ***Leymus salinus* Shale Sparse Vegetation [Map Class 8a]**



- 23b)** Grasslands characterized by *Achnatherum hymenoides* and sparse cover of *Hesperostipa comata* (may have some sparse shrub cover) **(24)**

- 24a)** (23) Grasslands dominated by *Achnatherum hymenoides* (sometimes with sparse cover of *Hesperostipa comata*) with low cover of shrubs, including *Atriplex canescens* and *Artemisia frigida*. The substrate is sandy flats, but not dunes or recent alluvium - ***Achnatherum hymenoides* Shrub Herbaceous Alliance [Map Class 8]**



- 24b)** Sparse grasslands characterized by *Achnatherum hymenoides* (sparse to low cover of *Hesperostipa comata* may occur) with low cover of shrub species; typically occurs on deep stabilized dunes or sandy point bars along intermittent streams; shrubs that may be present with low cover include *Atriplex canescens*, *Ephedra viridis*, *Eriogonum microthecum*, *Gutierrezia sarothrae*, and *Opuntia polyacantha* - ***Achnatherum hymenoides* Colorado Plateau Herbaceous Vegetation [Map Class 8]**



Index to the Plant Associations Documented from Capitol Reef National Park

Acer negundo - Ostrya knowltonii Woodland	658
Acer negundo / Quercus gambelii Woodland	658
Acer negundo / Rhus trilobata Woodland	658
Achnatherum hymenoides Colorado Plateau Herbaceous Vegetation.....	738
Achnatherum hymenoides Shrub Herbaceous Alliance	738
Amelanchier utahensis Shrubland.....	698
Aquilegia micrantha - Mimulus eastwoodiae Herbaceous Vegetation	729
Arctostaphylos patula Shrubland	717
Artemisia bigelovii Shrubland	718
Artemisia filifolia Colorado Plateau Shrubland.....	704
Artemisia frigida – (Bouteloua gracilis - Achnatherum hymenoides – Poa secunda) – Lichens Rocky Mesa Herbaceous Vegetation	732
Artemisia nova - Purshia tridentata / Poa fendleriana Shrubland.....	718
Artemisia nova / Poa fendleriana Shrubland	718
Artemisia tridentata – (Ericameria nauseosa) / Bromus tectorum Semi-natural Shrubland	719
Artemisia tridentata / Achnatherum hymenoides Shrubland	721
Artemisia tridentata ssp. tridentata / Pleuraphis jamesii Shrubland	720
Artemisia tridentata ssp. tridentata / Sporobolus airoides Shrubland.....	720
Artemisia tridentata ssp. vaseyana / Poa fendleriana Shrubland	721
Artemisia tridentata ssp. wyomingensis / (Agropyron cristatum, Psathyrostachys juncea) Seeded Grasses Semi-natural Shrubland.....	722
Artemisia tridentata ssp. wyomingensis / Bouteloua gracilis Shrubland	722
Artemisia tridentata ssp. wyomingensis / Disturbed Understory Semi-natural Shrubland	723
Atriplex canescens – Ephedra viridis Talus Shrubland	724
Atriplex canescens / Bouteloua gracilis Shrubland	726
Atriplex canescens / Pleuraphis jamesii Shrubland	727
Atriplex canescens Desert Wash Shrubland	706
Atriplex confertifolia - Sarcobatus vermiculatus Shrubland	727
Atriplex confertifolia / Achnatherum hymenoides Shrubland	728
Atriplex confertifolia Great Basin Shrubland	727
Atriplex corrugata Dwarf-shrubland	701
Atriplex gardneri / Achnatherum hymenoides Dwarf-shrubland	703
Atriplex gardneri / Pleuraphis jamesii Dwarf-shrubland	703
Atriplex gardneri / Xylorhiza venusta Dwarf-shrubland.....	702
Atriplex gardneri Dwarf-shrubland.....	702
Betula occidentalis Shrubland.....	696
Bouteloua eriopoda - Pleuraphis jamesii Herbaceous Vegetation	733
Bouteloua gracilis - Hesperostipa comata Herbaceous Vegetation.....	733
Bouteloua gracilis - Pleuraphis jamesii Herbaceous Vegetation	734
Bromus tectorum Semi-natural Herbaceous Vegetation.....	735
Celtis laevigata var. reticulata Slickrock Canyon Woodland.....	656, 693
Cercocarpus intricatus Slickrock Sparse Vegetation.....	693
Cercocarpus ledifolius / Artemisia tridentata ssp. vaseyana Woodland	662
Chrysothamnus viscidiflorus Talus Shrubland	707
Coleogyne ramosissima - Purshia stansburiana - Quercus havardii var. tuckeri Shrubland	709
Coleogyne ramosissima / Pleuraphis jamesii Shrubland.....	709

Coleogyne ramosissima Shrubland	710
Cornus sericea Shrubland	696
Eleocharis palustris Herbaceous Vegetation.....	730
Ephedra torreyana - (Atriplex spp.) / Nonvascular Gypsum Sparse Vegetation	714
Ephedra torreyana - Artemisia bigelovii Sparse Vegetation.....	714
Ephedra torreyana / Achnatherum hymenoides - Pleuraphis jamesii Shrubland	715
Ephedra torreyana / Bouteloua gracilis - Pleuraphis jamesii Shrubland.....	715
Ephedra torreyana Sparse Vegetation.....	715
Ephedra viridis / (Achnatherum hymenoides - Hesperostipa comata) Shrubland	716
Ephedra viridis / Bromus tectorum Semi-natural Shrubland.....	716
Ephedra viridis / Pleuraphis jamesii Shrubland	717
Ericameria nauseosa / Bromus tectorum Semi-natural Shrubland	717
Ericameria nauseosa / Sporobolus airoides Shrubland.....	718
Ericameria nauseosa Desert Wash Shrubland	706
Eriogonum corymbosum Badlands Sparse Vegetation	711
Eriogonum leptocladon / Muhlenbergia pungens Shrubland	704, 710
Eriogonum leptocladon Sparse Vegetation	711
Fallugia paradoxa Desert Wash Shrubland	705
Fraxinus anomala Woodland	657, 699
Grayia spinosa Shrubland	703
Gutierrezia sarothrae / Sporobolus airoides - Pleuraphis jamesii Shrub Herbaceous Vegetation	723
Halogeton glomeratus Semi-natural Herbaceous Vegetation.....	725
Hesperostipa comata Great Basin Herbaceous Vegetation.....	736
Juncus balticus Herbaceous Vegetation	731
Juniperus osteosperma - (Pinus edulis) / Coleogyne ramosissima - Purshia stansburiana - Quercus havardii Wooded Shrubland	671
Juniperus osteosperma / Artemisia tridentata ssp. tridentata Woodland.....	667
Juniperus osteosperma / Artemisia tridentata ssp. wyomingensis Woodland	667
Juniperus osteosperma / Bouteloua gracilis Woodland	681
Juniperus osteosperma / Hesperostipa comata Woodland	679, 736
Juniperus osteosperma / Leymus salinus Woodland.....	680
Juniperus osteosperma / Pleuraphis jamesii Woodland	682
Juniperus osteosperma / Sparse Understory Woodland.....	663
Krascheninnikovia lanata / Pleuraphis jamesii Dwarf-shrubland	724
Krascheninnikovia lanata Dwarf-shrubland	724
Leymus salinus Shale Sparse Vegetation.....	737
Muhlenbergia pungens Herbaceous Vegetation	732
Phragmites australis Western North America Temperate Semi-natural Herbaceous Vegetation	730
Picea pungens / Cornus sericea Woodland	684
Pinus edulis - (Juniperus monosperma, Juniperus osteosperma) / Hesperostipa comata Woodland	679
Pinus edulis - (Juniperus osteosperma) / Bouteloua gracilis Woodland.....	681
Pinus edulis - Juniperus osteosperma / (Shepherdia rotundifolia, Amelanchier utahensis) Wooded Shrubland.....	673
Pinus edulis - Juniperus osteosperma / Achnatherum hymenoides Woodland.....	683
Pinus edulis - Juniperus osteosperma / Amelanchier utahensis Woodland	674

Pinus edulis - Juniperus osteosperma / Arctostaphylos patula Woodland.....	675
Pinus edulis - Juniperus osteosperma / Artemisia bigelovii Woodland.....	669
Pinus edulis - Juniperus osteosperma / Artemisia nova Woodland	669
Pinus edulis - Juniperus osteosperma / Atriplex spp. Woodland.....	676
Pinus edulis - Juniperus osteosperma / Bromus tectorum Semi-natural Woodland	683
Pinus edulis - Juniperus osteosperma / Cercocarpus intricatus Woodland.....	666
Pinus edulis – Juniperus osteosperma / Cercocarpus ledifolius Woodland.....	669
Pinus edulis - Juniperus osteosperma / Coleogyne ramosissima Woodland.....	670
Pinus edulis - Juniperus osteosperma / Cushion Plant Woodland	683
Pinus edulis - Juniperus osteosperma / Ephedra torreyana - Artemisia bigelovii Woodland	677
Pinus edulis - Juniperus osteosperma / Ephedra viridis Woodland.....	678
Pinus edulis - Juniperus osteosperma / Hesperostipa neomexicana Woodland.....	679
Pinus edulis - Juniperus osteosperma / Muhlenbergia pungens Woodland.....	682
Pinus edulis - Juniperus osteosperma / Opuntia fragilis Woodland	676
Pinus edulis - Juniperus osteosperma / Petradoria pumila Woodland	684
Pinus edulis - Juniperus osteosperma / Pleuraphis jamesii Woodland.....	682
Pinus edulis - Juniperus osteosperma / Psathyrostachys juncea Semi-natural Woodland	683
Pinus edulis - Juniperus osteosperma / Purshia stansburiana Woodland.....	672
Pinus edulis – Juniperus osteosperma / Purshia tridentata Woodland	677
Pinus edulis - Juniperus osteosperma / Quercus havardii var. tuckeri Woodland.....	671
Pinus edulis - Juniperus osteosperma / Shepherdia rotundifolia Woodland	674
Pinus edulis - Juniperus osteosperma / Sparse Understory Woodland	664
Pinus edulis - Juniperus spp. / Artemisia tridentata (ssp. wyomingensis, ssp. vaseyana) Woodland	668
Pinus edulis - Juniperus spp. / Cercocarpus montanus –Mixed Shrub Woodland	666
Pinus edulis - Juniperus spp. / Leymus salinus Woodland.....	680
Pinus edulis - Juniperus spp. / Quercus gambelii Woodland	677
Pinus longaeva Woodland.....	685
Pinus ponderosa - Pseudotsuga menziesii / Purshia tridentata Woodland	688
Pinus ponderosa / Arctostaphylos patula Woodland.....	686
Pinus ponderosa / Artemisia nova Woodland.....	686
Pinus ponderosa / Cercocarpus ledifolius Woodland.....	687
Pinus ponderosa / Quercus gambelii Woodland	687
Pinus ponderosa / Sparse Understory Woodland	685
Pinus ponderosa Slickrock Sparse Vegetation	685
Pleuraphis jamesii - Sporobolus airoides Herbaceous Vegetation	734
Pleuraphis jamesii Herbaceous Vegetation	735
Poa fendleriana / Non-vascular Herbaceous Vegetation	734
Poliomintha incana - Artemisia filifolia - Vanclevea stylosa Shrubland	705
Populus angustifolia / Rhus trilobata Woodland.....	660
Populus fremontii - Salix gooddingii Woodland	661
Populus fremontii / Acer negundo Forest	661
Populus fremontii / Ericameria nauseosa Woodland.....	661
Populus fremontii / Mesic Forbs Woodland.....	661
Populus fremontii / Mesic Graminoids Woodland	662
Populus tremuloides / Symphoricarpos oreophilus Forest	656
Pseudotsuga menziesii / Acer glabrum Forest	691
Pseudotsuga menziesii / Cercocarpus ledifolius Woodland.....	690

Pseudotsuga menziesii / Cercocarpus montanus Forest.....	690
Pseudotsuga menziesii / Quercus gambelii Forest.....	692
Pseudotsuga menziesii / Symphoricarpos oreophilus Forest	692
Pseudotsuga menziesii Scree Woodland.....	689
Quercus gambelii - Amelanchier utahensis Shrubland	700
Quercus gambelii / Sparse Understory Shrubland	701
Quercus havardii var. tuckeri Shrubland.....	699
Rhus trilobata Intermittently Flooded Shrubland.....	697
Salix exigua / Barren Shrubland	697
Salix exigua / Mesic Graminoids Shrubland	698
Salix gooddingii Temporarily Flooded Woodland Alliance.....	659
Sarcobatus vermiculatus / Artemisia tridentata Shrubland.....	711
Sarcobatus vermiculatus / Atriplex confertifolia - (Picrothamnus desertorum, Suaeda moquinii) Shrubland	712
Sarcobatus vermiculatus / Distichlis spicata Shrubland.....	712
Sarcobatus vermiculatus / Sporobolus airoides Shrubland	712
Sarcobatus vermiculatus Disturbed Shrubland	713
Slickrock Fin Pocket.....	694
Sparse Cushion Plant Sparse Herbaceous Vegetation.....	732
Sporobolus airoides Southern Plains Herbaceous Vegetation	737
Sporobolus flexuosus Herbaceous Alliance	737
Tamarix spp. Temporarily Flooded Semi-natural Shrubland.....	696
Typha (latifolia, angustifolia) Western Herbaceous Vegetation	730
Waterpocket Community	695
Zuckia brandegeei Sparse Vegetation	724

Appendix H

Modified Anderson Land Use/Land Cover Classification

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 Petrochemical 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					
	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	4.22211 Rice Fields
			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 water craft. 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)

1.15 Bay/estuary - the inlets or arms of the sea that extend inland

1.16 Sea/ocean - an area of the great body of salt water that covers much of the earth

1.2 Perennial Ice/Snow - areas covered year-round with snow and ice

1.21 Snowfield - permanent snow not underlain by a glacier

1.22 Glacier - a body of ice and snow, showing evidence of past or present flow

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, crop lands, 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. 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, which 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 which 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.

2.221 Petro-chemical Refinery - structures and all associated equipment and grounds used for processing petro-chemicals. Include associated waste ponds.

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 which 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 lands 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)

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 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.

2.261 Airport - Includes the maintained active and overrun areas of the runways, landing strips, and taxiways, with the intervening land; along with the plane tie-down areas, terminals, hangers, related fuel storage facilities, service buildings, parking lots, navigation aids, and airport offices. Rental car lots integrated with the airport should be included with the airport.

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 hazardous-waste disposal sites, landfills, or dumps. Do not include reclaimed disposal areas or those covered with vegetation.

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 lose 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% 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 oak.

4.121 Deciduous Shrub land - areas where 75% or more of the land cover can be determined to be shrubs that lose 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, creosote, saltbush, greasewood, 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

4.132 Citrus - trees or shrubs cultivated in orchards or groves that bear edible fruit such as orange, lemon, lime, grapefruit, and pineapple.

4.133 Non-managed Citrus - orchards or groves containing fruit bearing trees or shrubs that are no longer maintained or harvested by humans. Evidence of non-managed citrus includes the growth of non citrus shrubs, trees, and grasses within a orchard or grove.

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.

4.2221 Irrigated Small Grains - areas used for the production of small grain crops where a visible irrigation system is in place to supply water including the flooding of entire fields.

4.22211 Rice Fields - a cereal grass cultivated extensively in warm climates and used as a staple food. Rice is grown on submerged land in coastal plains, tidal deltas, and river basins of tropical, semi-tropical, semi-tropical, and temperate regions of Louisiana, Texas, California, Missouri, Arkansas, and Mississippi. The fields are characterized by a slope of less than .5% and have many dikes that meander parallel to the contours of the land surface. The dikes, which are the most significant characteristic of the rice fields, may be small in height and are used to hold water. At times, the rice fields may be covered in water.

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

4.2232 Sugar Cane - a very tall tropical grass up to 15 feet high with thick tough stems that is cultivated as the main source of sugar. It can be found in tropical and sub-tropical areas of the United States such as Florida, Hawaii, and Texas.

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. Pasture lands can have a wide range of cultivation levels. It can be managed by seeding, fertilizing, application of herbicides, plowing, mowing, or baling. Pasture land 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.

4.31 Woody Wetland - areas dominated by woody vegetation. Includes seasonally flooded bottom land, 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 open bogs.

Appendix I

Accuracy Assessment Analysis

This section contains the results of the analysis of accuracy assessment field data. Each of the more than 1300 accuracy assessment field plots was compared with the polygon in which it was located. 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 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 Capitol Reef's vegetation map was 49.8%. We therefore inspected the original plot data, plot photographs, and aerial imagery for approximately 670 plots of accuracy assessment field data to create the table that follows. The final step in the process was to present the table in January, 2006 to CARE 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 followed the preference of park staff.

Map Unit	Final Map Code	Map Unit Name	Problem	Proposed Resolution	Decision 1/31/06
1 (PS)	S-BENT	Bentonite Badlands	None. Mapped as encountered. Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
2a		Atriplex corrugata Dwarf-shrubland	Significant confusion with MU4, minor confusion with MU6.	Combine MU2a, MU4 and MU6 into map unit 6 and rename.	Combine MU2a & MU4 into MU4 and rename.
4	S-MATS	Saltbush Badlands Shrubland Complex	Significant confusion with MU6. Minor confusion with MU14 and MU15.	Combine MU2a, MU4 and MU6 into map unit 6 and rename.	See MU2a.
4a	S-BUCK	Crispleaf Buckwheat Badlands Sparse Vegetation	Minor confusion with MU4 and a little with MU13.	Retain map unit as is.	Retain map unit as is.
5	S-GYPS	Gypsum Badlands Sparse Vegetation	Map unit is good; 90% CI will contain 80% accuracy. Minor confusion with MU13 and MU6.	Retain map unit as is.	Retain map unit as is.
6	S-ATCO	Shadscale Shrubland Complex	Close to being a good map unit - will be close to 80% accuracy with 90% CI without modification. Confusion is mostly with map units in the 13 series.	Combine MU2a, MU4 and MU6 into map unit 6 and rename.	Retain map unit as is. Do not combine with 2a and 4. Accept lower accuracy because of significant ecological differences between MU2a/4 and MU6.
8	H-GRAS	Mixed Grasslands Complex	Many points fell in shrub herbaceous types that should have keyed either to shrubland or herbaceous. Key was written so that herbaceous wasn't an option. We added MU8 as a secondary, call because of this problem. With the corrections, this is a good map unit.	Keep as a map unit. Revise key so that shrub herbaceous stands can key to grassland as well as shrubland.	Accept proposed resolution. Fix key.
8a	H-LESA	Salina Wildrye Shale Sparse Grassland	None. Mapped as encountered. Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
8b	H-BGPL	Black Grama – Galleta Herbaceous Vegetation	No points in the polygon mapped as this MU. The points called MU8b by AA crews are all close to the MU8b polygon on Johnson Mesa.	Retain map unit as is.	Retain map unit as is.
8c	H-POFE	Muttongrass / Non-vascular Herbaceous Vegetation	None. Mapped as encountered. Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.

Map Unit	Final Map Code	Map Unit Name	Problem	Proposed Resolution	Decision 1/31/06
9	S-ARFI	Sand Sage Shrubland Complex	Some confusion with other sandy types: Atriplex canescens types (MU11b) or Ephedra/grass (13x, 13y).	Can accept MU with less than 80% accuracy (although is close), or combine with 11b and/or 13x/y.	90% CI includes 80% accuracy. Retain map unit as is.
10	S-BLAC	Blackbrush Shrubland Complex	Is a good map unit.	Absorb polys of MU17 and rename map unit.	Retain map unit as is.
10a	S-QUHA	Tucker Oak Shrubland	Is a good map unit.	Keep as is. Make sure that the key and map unit description read so that if there is any oak present it cannot be MU10.	Retain map unit as is.
11	S-WASH	Desert Wash Shrubland Mosaic	This map unit is an umbrella for wash bottom shrublands (11a, b, c, 13c, 13g). The AA point is correct if any of the field calls are any of these units. The model was imperfect in that the mappers tried to extrapolate the wash bottom type up the Mancos shale toeslopes, where the veg was actually MU4 or MU6.	Keep map unit, but redefine it as belonging strictly to bottoms and terraces of the major drainages. Tiny erosional tributaries on shales without alluvial deposition can be moved to MU2a/4 or MU6.	Accept proposed resolution. Throw out the AA points that were identified in the field as MU6 (6 points). Relabel the polygons in Halls Creek on the Mancos Shale slope. Absorb polys of MU11b, MU13c and MU13g.
11a	S-BLGR	Black Greasewood Shrubland Complex	Basically a good map unit. Minor confusion with other map units in the same group (11b, 13g).	Keep as a map unit. All polygons with plots or AA points that are this MU remain labeled 11a. If polygons have no plots or AA points, also leave as MU11a. If AA point is another MU, move to MU11 and leave linework as is.	Retain map unit as is, no relabeling of any polys.
11b		Atriplex canescens Shrubland Complex	Significant confusion with other units in the umbrella group, as well as with BROTEC types in Halls Creek.	Keep as a map unit. All polygons with plots or AA points that are this MU remain labeled 11b. If no plots or AA points, also leave as MU11b. If AA point is another MU, move to MU11 and leave linework as is.	Relabel MU11b polygons to MU11. Eliminate MU11b.
11c	S-ARTR	Big Sagebrush Shrubland Complex	Correct about 60% of the time. Confusion is mostly with other units in the umbrella group.	Keep as a map unit. All polygons with plots or AA points that are this MU remain labeled 11c. If no plots or AA points, also leave as MU11c. If AA point is another MU, move to MU11 and leave linework as is.	Retain MU11c as is, without any relabeling.
12a	H-ROME	Fringed Sagebrush – Lichens Rocky Mesa Herbaceous Vegetation	Not accuracy assessed. Found once by AA crews in a polygon labeled 8.	Retain map unit as is.	Retain map unit as is. Park can re-label the AA crews' found poly if they want.

Map Unit	Final Map Code	Map Unit Name	Problem	Proposed Resolution	Decision 1/31/06
12b	S-MESI	Mesic Canyon Bottom Shrubland Complex	Some confusion with MU16, which has the same shrub components as MU12b.	Modify the key to allow <8% PJ cover in the Mesic Canyon Bottom Shrubland element of the map unit, which otherwise is limited to tall wash shrubs.	Retain map unit and fix key.
12c	S-ARPO	Black Sagebrush / Muttongrass Shrubland	None. Mapped as encountered. Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
12d	W-CELE	Curl-leaf Mountain Mahogany Woodland Complex	A rare type, 14 polys in the entire mapping area. 3 of 5 points sampled were correct.	Accept accuracy of 60%. A potential solution is to adjust the linework to more accurately depict the actual distribution of this type.	Retain map unit. Accept lower accuracy because the issue is veg density, not a bad concept.
13	S-MXDD	Mixed Desert Shrubland Complex	This is an umbrella type meant to cover mixed desert shrubland when it could not be determined that they were 13a, h, x, y. The major confusion was with MU15, which has trees; was an issue of tree density and determining whether these points were wooded or shrubland. When a determination of woodland (MU14, or MU15) was made in the field, inspection of the aerial photos showed tree cover to be significantly less than the field call.	This type should be called correct if it is classed as either 13 or any of the more detailed types (13a, h, x, or y). Make sure the key allows stands with marginal tree cover (8% or less) to go either to mixed desert shrubland or woodland with a mixed desert shrubland understory.	Retain map unit as is. Fix key. Map unit description should make it clear that this is an umbrella unit, polygons of which may include the 13a,h,x,y type and which may also include undifferentiated mixed desert shrublands dominated by one or another Ephedra. Write map unit descriptions to maintain its distinct umbrella character from the more detailed subset map units (13a, h, x, y).
13a	S-EPTO	Torrey Mormon Tea Shrubland Complex	Some confusion MU5 and MU6.	To fix the confusion with MU6, modify the key so that if you have any ARTBIG or EPHTOR in the stand, it cannot go to MU6. Otherwise is a good map unit, although confusion with MU5 is due to difficulty in determining crypto crust cover from 6000 feet.	Retain map unit as is, fix key.
13b	S-GOSB	Gambel Oak / Serviceberry Shrubland	None.	Retain map unit as is.	Retain map unit as is.
13c		Ericameria nauseosa Shrubland Complex	Some confusion with other map units in the 11 series and the 13 series.	Keep as a map unit. All polygons with plots or AA points that are this MU remain labeled 13c. If no plots or AA points, also leave as MU13c. If AA point is another MU, move to MU11 and leave linework as is.	Eliminate 13c as a map unit. Relabel all polygons MU11.

Map Unit	Final Map Code	Map Unit Name	Problem	Proposed Resolution	Decision 1/31/06
13d	S-WYSA	Wyoming Sagebrush / Blue Grama Shrubland	None	Retain map unit as is.	Retain map unit as is.
13e	S-BSCU	Black Sagebrush – Bitterbrush / Muttongrass Shrubland	The problem with this map unit is disagreement about the cover of trees - whether a stand is woodland or shrubland with a few trees. Photos of the two AA points indicate that tree cover is too low for a woodland and these points are actually shrublands.	Modify key to allow stands with less than 8% tree cover to go either to woodland or shrubland associations.	Retain map unit as is. Fix key.
13f	S-MSSN	Mountain Sagebrush – Snowberry Shrubland Complex	Not accuracy assessed. Found once by AA crews in a polygon labeled 13b.	Retain map unit as is.	Retain map unit as is.
13g		Ericameria nauseosa / Bromus tectorum Semi-natural Shrubland	Only one poly sampled. Was called 11b.	Keep as a map unit. All polygons with plots or AA points that are this MU remain labeled 13g. If no plots or AA points, also leave as MU13g. If AA point is another MU, move to MU11 and leave linework as is.	Eliminate 13g as a map unit. Relabel all polygons MU11.
13h	S-ETGG	Torrey Mormon Tea / Blue Grama – Galleta Shrubland	None	Retain map unit as is.	Retain map unit as is.
13x	S-EVGC	Green Mormon Tea / Galleta – Cheatgrass Shrubland Complex	Most of this type occurs outside the park boundary. 29 of the 30 AA points were placed in a single polygon which represented a misapplication of the map unit concept (occurs only in the Airport area, not in the South Desert). The map unit concept is good.	Retain this map unit. Relabel the polygon with the 29 incorrect AA points to MU13. Inspect all polygons labeled 13x in the north half of the park for the misapplication of the concept. Keep polygons in the vicinity of the airport that are the correct application of the concept.	Implement proposed solution. Throw out the AA points in the north end.
13y	S-EVRN	Green Mormon Tea / Indian Ricegrass – Needle and Thread Shrubland	Some confusion with MU8 and MU9, which are other sand types and occur in mosaics with MU13y.	Retain map unit as is.	Retain map unit as is.
13z	S-RURA	Rubber Rabbitbrush / Blue Grama Shrub Herbaceous Vegetation	The only confusion is with MU8, which is the shrubless version.	Make sure that the key and map unit description read so that one can go to either shrubland or grassland if 5-15% shrub cover.	Retain map unit as is. Fix key.

Map Unit	Final Map Code	Map Unit Name	Problem	Proposed Resolution	Decision 1/31/06
14	W-PJMG	Pinyon - Juniper / Mixed Grass Woodland Complex	Confusion with MU15b. The signature is difficult to distinguish and there is a good deal of overlap - some of the points identified as MU15b also have high grass cover.	Basically a good map unit. Could refine the key to make it easier to go to both types if a PJ/Opuntia plot has high grass cover. Absorb polygons of MU14a.	Retain map unit as is. Fix key.
14a		Juniperus osteosperma / Mixed Grass Woodland Complex	Mappers were attempting to model an elevational gradient between Juniper woodlands and PJ woodlands. This model was unsuccessful.	Eliminate this map unit, fold all polygons into MU14.	Eliminate MU14a. Inspect the 22 polygons labeled 14a and re-label or dissolve as appropriate.
14b	W-PJCH	Pinyon - Juniper / Cheatgrass Semi-natural Woodland	Mapped as encountered. AA crews did not find any new polygons of this type. Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
14c	W-PJPJ	Pinyon - Juniper / Russian Wildrye Semi-natural Woodland	Mapped as encountered. AA crews did not find any new polygons of this type. Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
15	W-PJXE	Pinyon - Juniper / Xeric Shrubs Woodland Complex	This map unit is meant to be an umbrella unit for a group of PJ / xeric shrub woodlands (15a, b, c, d.). The MU should be called correct if any of the field calls are any of these units.	If all the more detailed types are included, this is a good map unit. Keep as is. Absorb polys of 15c.	Retain map unit. Absorb all polygons of MU15c.
15a		Pinus edulis - Juniperus osteosperma / Cushion Plant Woodland Complex	Major confusion with MU15/15d (PJ/sparse understory). This is understandable because the cushion plants that characterize MU15a are always sparse in cover.	To reduce confusion with MU15d, revise key to point users to PJ/cushion plant if they are on Morrison or Carmel formations in the northern part of the park and stands contain Artemisia pygmaea, Petradoria pumila, Physaria acutifolia, Hymenoxys acaulis etc., even if the understory is sparse.	Absorb this map unit into 15d.
15b	W-PJOP	Pinyon - Juniper / Brittle Prickly Pear Woodland	The only confusion is with MU14. The signature is difficult to distinguish and there is a good deal of overlap - some of the points identified as MU14 also contain Opuntia.	Basically a good map unit. Could refine the key to make it easier to go to both types if a PJ/Opuntia plot has high grass cover.	Retain as a map unit. Fix key.

Map Unit	Final Map Code	Map Unit Name	Problem	Proposed Resolution	Decision 1/31/06
15c		Juniperus osteosperma / Sparse Understory Woodland	Significant confusion with the umbrella MU15.	Eliminate this map unit. Fold all polygons into MU15.	Eliminate map unit and fold all polygons into MU15.
15d	W-PJSP	Pinyon - Juniper / Sparse Understory Woodland	Some confusion with MU14. This is partly because if grass cover is less than about 8%, it is hard to see on aerials. It is also because large polygons labeled PJ/sparse can have patches of grass and vice versa.	If borderline plots are counted as correct, is a good map unit. Revise field key so that plots with <8% grass can also go to PJ/sparse. Some polygons could have their linework refined, but is not a big deal.	Retain map class. Absorb polygons of 15a (with modifier and linework retained).
15e	W-PJWS	Pinyon - Juniper / Sagebrush Woodland Complex	No problems.	Retain map unit as is.	Retain map unit as is.
15f	W-PJBS	Pinyon - Juniper / Black Sagebrush Woodland	Significant confusion with MU14 and MU16. This type occurs mostly in the environs. It was found rarely by the AA crews in polygons labeled 15. It was significantly mis-mapped in Paradise Flats and Jones Bench; neither place supports this type.	Keep as a map unit but inspect all polygons and make a judgment call to (1) retain MU15f as the label, (2) dissolve polygon into surrounding poly(s), or (3) relabel polygon as something else.	Accept proposed resolution.
16	W-PJME	Pinyon - Juniper / Mesic Shrubs Woodland Complex	This is an umbrella map unit for PJ/mesic shrubs and includes 16a, b.	No problems with map unit concept. Revise the key so that if a stand has any CERINT, PURSTA, MAHFRE, and RHUARO it cannot be classified as any of the associations in the MU15a, b, etc. series. Absorb polygons of MU16b.	Retain map unit as is. Fix key. This type is undermapped, but accept lower producer's accuracy.
16a	W-PJMM	Pinyon - Juniper / Mountain Mahogany and Gambel Oak Woodland	Minor confusion with map units with other tall shrubs.	Is a good map unit. Absorb upland polygons of MU16c	Accept proposed resolution.
16b		Pinus edulis - Juniperus osteosperma / Arctostaphylos patula Woodland	Some confusion in signatures of ARCPAT and QUESPP. In the drainages/wash bottoms leading out of the Waterpocket Fold.	If a stand has more than 1% of ARCPAT and is on slickrock, it should go to MU16b. An option to is to eliminate this map unit but keep the linework and relabel all polygons MU16. Another solution is to retain the map unit on an as-observed basis only and otherwise move polygons to MU16.	Relabel all polygons to MU16e.

Map Unit	Final Map Code	Map Unit Name	Problem	Proposed Resolution	Decision 1/31/06
16c		Pinus edulis - Juniperus spp. / Quercus gambelii Woodland	Major confusion with MU16a because the signatures of oak and CERMON are similar.	Eliminate MU16c and fold the upland polygons into MU16a. Canyon bottom polygons of MU16c should be moved to 16e. Fix key so that one can only go to slickrock fin pocket if one is truly in a slickrock fin pocket, not just in a slickrock canyon/drainage.	Accept proposed resolution.
16e	W-PJOM	Pinyon - Juniper / Oak and Manzanita Woodland	None. Initially mapped as encountered and not accuracy assessed.	No problems with this map unit. Change name to account for both QUEGAM and QUEHAV. Absorb wash bottom polys of MU16a and all polys of MU28. Include in AA.	Accept proposed resolution.
17	W-PJBB	Pinyon - Juniper / Blackbrush Woodland	Major confusion is with other ledgy slickrock types.	Juniper cover is always marginal as a woodland. Eliminate MU17 and fold polys into MU10 into a Blackbrush Woodland/Shrubland map unit.	Retain map unit as is; accuracy is marginal but is useful to retain this MU because wildlife habitat characteristics are different than MU10.
18		Pinus edulis - Juniperus osteosperma / Atriplex spp. Woodland	Confusion is with PJ/sparse, as most stands of PJ/ATRSP have a pretty sparse understory.	Can just fold MU18 into MU15d, or can keep MU18 on an as-encountered basis (has a plot or point in it) and fold the rest of the polygons into MU15.	Fold all polygons into 15d. Amend key so that 15d understory can include Atriplex spp. cover <5%.
18c	S-GRSP	Spiny Hopsage Shrubland	None. Mapped as encountered. Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
19	S-LLMM	Little-leaf Mountain Mahogany Slickrock Sparse Vegetation	Major confusion with MU16, which is in wash bottoms but can include PJ/CERINT. This is because the PJ/CERINT type is split between two environments (slickrock and wash bottoms) and two map units.	Add PJ/CERINT to the list for this map unit and change the map unit name to include treed plots on slickrock. This redefined unit is a good map unit. Advise users of the key that they need to note that if they are in PJ/CERINT, they must also note whether they are on slickrock or in a wash bottom.	Retain map unit as is, revise field key as recommended in proposed resolution. Leave PJ/CERINT in MU16 and 12b.
19a		Pinus ponderosa Slickrock Sparse Vegetation	Major confusion with MU21.	Eliminate this map unit and rename all polygons MU21.	Accept proposed resolution.

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

Map Unit	Final Map Code	Map Unit Name	Problem	Proposed Resolution	Decision 1/31/06
19c	W-PJBC	Pinyon - Juniper / Blackbrush – Cliffrose – Tucker Oak Wooded Shrubland	Map unit concept is good. Key is poor at getting the user to it because there are no well-defined association concepts for it. This is a PJ/mixed mesic slickrock type limited to the sandstone layers within the Mancos and the Salt Wash member of the Morrison Fm.	Keep map unit. Remove COLRAM-PURSTA-QUEHAV shrubland concept from this map unit, because it is on deep sands in Halls Creek. Will need a name for the new map unit.	Accept proposed resolution.
19d	S-BCTO	Blackbrush – Cliffrose – Tucker Oak Shrubland	New map unit. Use it to map stands of COLRAM-PURSTA-QUEWEL shrubs that were removed from MU19c.	Review polygons of 19c and relabel polys to 19d as needed. This is an easy map unit to recognize, but is mostly outside the park.	Accept proposed resolution.
20	W-PILO	Bristlecone Pine Woodland	No problems.	Retain map unit as is.	Retain map unit as is.
21	W-PPGM	Ponderosa Pine / Greenleaf Manzanita Woodland	No problems. Minor confusion with MU16b, which makes sense based on the variable cover of PJ vs. PINPON.	Retain map unit as is.	Retain map unit as is. Absorb polygons of 19a.
22	W-ASPE	Aspen / Snowberry Forest	Not accuracy assessed. No polygons in the park.	Retain map unit as is.	Retain map unit as is.
23a	W-DFME	Douglas-fir Montane Woodland Complex	Major confusion with 23c and MU16.	Retain this map unit. Move the PSEMEN / scree association from 23c to 23a. This will make the concepts of 23c (canyon bottom Doug fir) and 23a (upland Doug fir) consistent. Make sure that field key is clear that unless the canopy is dominated or co-dominated by PINPON and/or PSEMEN, it goes to a MU16 association (dominated by PJ). Absorb polys of MU23b.	Accept proposed resolution.
23b		Pseudotsuga menziesii / Cercoarpus montanus Forest	Confusion with MU23b and MU16.	Eliminate this map unit and fold polygons into MU23a.	Accept proposed resolution.

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

Map Unit	Final Map Code	Map Unit Name	Problem	Proposed Resolution	Decision 1/31/06
23c	W-DOFI	Douglas-fir Canyon Woodland Complex	Confusion with other map units in the 23 series as well as with map units in the 16 series.	Retain map unit but only on an as-encountered basis. Fold all other polygons into 23a. Or eliminate map unit and combine all PSEMEN stands into a single map unit.	Accept first option of proposed resolution.
24	W-POFR	Fremont Cottonwood Woodland Complex	No problems with mapping this type.	Retain map unit as is.	Retain map unit as is. Absorb polygons of MU24c.
24a	W-POAN	Narrowleaf Cottonwood Woodland	Confusion with MU24c. Not accuracy assessed.	Good map unit.	Retain map unit as is.
24c		Populus fremontii / Acer negundo Forest	Confusion with MU24a and MU24.	Is a good map concept but is extremely rare in the park. ID in the field would be aided if key had ACENEG types.	Eliminate map unit. Fold all polygons into 24. Fix field key.
25	H-SEEP	Springs and Seeps Mosaic	Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
26b	S-COSE	Red-osier Dogwood Shrubland	Not accuracy assessed. One poly in park.	Retain map unit as is.	Retain map unit as is.
26c	S-BEOC	River Birch Shrubland	None. Mapped as encountered. Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
26d	W-HACK	Netleaf Hackberry Slickrock Canyon Woodland	Mapped only as encountered. One poly in park. Not accuracy assessed, two stands found by crews, mapped as 24c and 28.	Retain map unit as is.	Retain map unit as is. Change labels on polys found by AA crews.
27	C-FINP	Slickrock Fin Pocket	Not accuracy assessed. Not found by the AA crews.	Retain map unit as is.	Retain map unit as is.
28		Quercus gambelii Shrubland	Major confusion with PJ/oak types (e.g., 16e).	Eliminate this map unit. Fold all polygons into MU16e.	Accept proposed resolution.
30	W-BOEL	Box Elder Woodland Complex	Not accuracy assessed. AA crews found several ACNE stands without OSKN that should be assigned to MU30.	Amend key so that ACNE woodlands are included. Otherwise a good map unit.	Fix key, amend map unit description.
31	H-HANG	Hanging Gardens Herbaceous Vegetation	Mapped as point data, not polygons. Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.

Map Unit	Final Map Code	Map Unit Name	Problem	Proposed Resolution	Decision 1/31/06
32	S-WILL	Willow Shrubland Complex	The problem with this map unit is that the polygons were too coarse and included terrace and upland communities.	Keep as is with low accuracy or remap or lump this map unit with MU24.	Accept lower accuracy; because the type was mapped in polygons coarser than the extremely narrow belts of Salix. Polygons the size of the community would have been too narrow to map or assess.
33	W-POPI		Confusion is with MU23a. This is because some marginal or ecotonal stands have some Douglas fir in them.	Revise key to force users to go to the DF type only if DF has more than about 5% cover (more than a T or 1%).	Retain map unit, fix key.
33a	W-PPQG	Ponderosa Pine / Gambel Oak Woodland	No problems with mapping this type.	Retain map unit as is.	Retain map unit as is.
34	C-TINJ	Tinajas	Point data, not polygons, not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
35	W-BSRD	Blue Spruce / Red-Osier Dogwood Woodland	Is in the park, but is rare and was not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
36	C-MXDW	Wet Meadow Herbaceous Vegetation	Only outside the park, not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
40	S-TALM	Talus Mixed Shrubland Complex	Major confusion with MU16 and to a lesser extent, MU15 and MU13. The conflict is with whether the sampled stand is a woodland or a shrubland with a few trees. There is a disconnect between the mapping concept (less than 8% trees = shrubland), and the classification concept (total cover is ignored in sparse stands; relative cover of trees and shrubs determines woodland vs. shrubland).	When errors created by the disconnect are corrected, accuracy is acceptable. Inspect polygons of MC40 to determined if they are on talus shrublands and if tree cover is less than 8%. Relabel wooded ridgeline stands from 40 to 16.	Accept proposed resolution.
41	S-MANZ	Greenleaf Manzanita Shrubland	Not accuracy assessed. Mapped as encountered. AA crews did not encounter new polys of this type.	Retain map unit as is.	Retain map unit as is.
43	H-CUSH	Sparse Cushion Plant Herbaceous Vegetation	Not accuracy assessed. AA crews did not find any polygons of this type.	Retain map unit as is.	Retain map unit as is.

USGS-NPS Vegetation Mapping Program
 Capitol Reef National Park

Map Unit	Final Map Code	Map Unit Name	Problem	Proposed Resolution	Decision 1/31/06
63	H-ABAN	Abandoned Fields	Not accuracy assessed. AA crews did not find any polygons of this type.	Retain map unit as is.	Retain map unit as is.
64	S-TARU	Tamarisk Temporarily Flooded Shrubland	No problems with mapping this type. Minor confusion with MU13 because some polygons were drawn to include terraces that support rabbitbrush.	Retain map unit as is.	Retain map unit as is.
65	H-HAGL	Halogeton Semi-Natural Herbaceous Vegetation	Mapped as encountered. Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
60	L-ORCH	Orchards	Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
66	L-RESI	Residential Developments	Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
67	L-FACI	NPS Facilities	Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
71	G-MUDC	Mudstone Cliffs	Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
72	G-TALU	Bare Talus/Slides	Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
73	G-SAND	Unvegetated Sand	Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
74	G-SLIC	Unvegetated Sandstone	Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
75	L-MINE	Mines, Quarries, Mine tailings	Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
76	L-POND	Stock ponds	Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
76a	L-DTCH	Ditches	Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
77	G-WASH	Barren wash bottom	Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
77a	G-STRM	Perennial stream	Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
78t	L-ROAD	Roads- paved	Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
78u	L-ROAD	Roads- unpaved	Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.
79	L-CULT	Cultivated fields	Not accuracy assessed.	Retain map unit as is.	Retain map unit as is.

Appendix J

Map Class Descriptions for Capitol Reef National Park

Introduction

This document provides a visual guide and description of the map classes for the Capitol Reef National Park Vegetation Mapping Project. Seventy vegetation map classes are described in this guide. Four unvegetated geologic map classes and twelve land use classes are not included. One vegetated map class (C-TINJ / Tinajas) is excluded from the guide because there is insufficient information to document it.

Each of the vegetation map classes associated in this guide is documented by:

- ground photographs (if available)
- a list of component NVC associations and ecological systems
- common plant species
- examples of each map class signature taken from the ortho imagery with delineated polygons
- descriptions of the photo signature
- a description of the ecology and distribution of the map class within 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 a feel for the imagery and an understanding of the relationships between the vegetation classification and mapping.

Upland Forest and Woodland

12d Curl-leaf Mountain Mahogany Woodland Complex (W-CELE)

Associations:

Cercocarpus ledifolius / *Artemisia tridentata* ssp. *vaseyana*
Woodland

Pinus edulis - *Juniperus osteosperma* / *Cercocarpus ledifolius*
Woodland

Common species:

Pinus edulis
Artemisia tridentata ssp. *vaseyana*
Cercocarpus ledifolius
Poa fendleriana

Project Specifics:

Frequency = 17 total polygons
8 polygons in CARE, 9 in the environs
Total area = 106 ha / 262 acres (<1%)
42 ha / 105 acres CARE
64 ha / 157 acres environs
Average polygon size = 6.2 ha / 15.4 acres
Producer's accuracy = 60% ± 36%
User's accuracy = 75% ± 36%



Interpretation:

Polygons of this type are located on the upper east and north-facing slopes around Billings Point. It typically occurs on gray volcanic or white Carmel Formation substrates. The large, flat, gray-green crowns of curl-leaf mountain mahogany are plainly visible among the rounded, dark green crowns of the pinyon pine. Adjacent polygons include Douglas Fir Montane Woodland Complex (23a) and Muttongrass / Non-vascular Herbaceous Vegetation (8c).

Distribution/Ecology/Composition:

This type occurs above 8,000 feet elevation in the northwestern corner of the mapping area near Billings Point. These areas tend to be protected from fire, or have not burned in a long time. Most stands are very dense with a closed canopy of curl-leaf mountain mahogany and scattered pinyon pines. The understory includes mountain big sagebrush and sometimes also mountain snowberry or rubber rabbitbrush. An occasional ponderosa pine grows within dense stands. Muttongrass is the most common herbaceous species.



Photo credits: NPS

14 Pinyon - Juniper / Mixed Grass Woodland Complex (W-PJMG)

Associations:

Juniperus osteosperma / *Bouteloua gracilis* Woodland
Juniperus osteosperma / *Hesperostipa comata* Woodland
Juniperus osteosperma / *Leymus salinus* Woodland
Juniperus osteosperma / *Pleuraphis jamesii* Woodland
Pinus edulis - *Juniperus* spp. / *Leymus salinus* Woodland
Pinus edulis - (*Juniperus osteosperma*) / *Bouteloua gracilis* Woodland
Pinus edulis - (*Juniperus monosperma*, *Juniperus osteosperma*) / *Hesperostipa comata* Woodland
Pinus edulis - *Juniperus osteosperma* / *Hesperostipa neomexicana* Woodland
Pinus edulis - *Juniperus osteosperma* / *Muhlenbergia pungens* Woodland
Pinus edulis - *Juniperus osteosperma* / *Pleuraphis jamesii* Woodland
Pinus edulis - *Juniperus osteosperma* / *Achnatherum hymenoides* Woodland

Common species:

Juniperus osteosperma
Pinus edulis
Achnatherum hymenoides
Bouteloua gracilis
Hesperostipa comata
Hesperostipa neomexicana
Leymus salinus
Muhlenbergia pungens
Pleuraphis jamesii

Project Specifics:

Frequency = 883 total polygons
655 polygons in CARE, 228 in the environs
Total area = 3,989 ha / 9,858 acres (3%)
2,968 ha / 7,334 acres CARE
1,021 ha / 2,524 ac environs
Average polygon size = 4.5 ha / 11.2 acres
Producer's accuracy = 77% ± 10%
User's accuracy = 61% ± 9%



Interpretation:

This map class occurs in medium to large, regularly shaped polygons. It is a common and widely distributed pinyon-juniper map class, occurring on all aspects on moderately deep and deep soils that are mainly derived from sandstone or eolian sources. Slopes vary from level to moderately steep. The understory appears as a uniform smooth tan to light gray-green color. Adjacent map classes often include Mixed Grasslands Complex (8) or Pinyon – Juniper / Xeric Shrubs Woodlands Complex (15).

Distribution/Ecology/Composition:

These woodlands are distributed throughout the low and middle elevations of the mapping area. They are recognized by having less than 5% cover by shrubs and more than 5% cover by native bunchgrasses. Many stands mapped as this unit are probably close to the 5% cutoff and therefore may key to other map classes. Substrates vary from sandy to loamy, but are generally deeper and less rocky than shrub-dominated stands. Stands are found on all aspects. Stand canopies vary from open to moderately closed.



Photo credits: NPS



Photo credit: NPS

14b Pinyon - Juniper / Cheatgrass Semi-natural Woodland (W-PJCH)

Associations:

Pinus edulis - *Juniperus osteosperma* / *Bromus tectorum* Semi-natural Woodland

Common species:

Juniperus osteosperma
Pinus edulis
Bromus tectorum

Project Specifics:

Frequency = 3 total polygons
3 polygons in CARE, 0 in the environs
Total area = 1.6 ha / 3.9 acres (<<1%)
1.6 ha / 3.9 acres CARE
0 ha / 0 ac environs
Average polygon size = 0.5 ha / 1.3 acres
Not accuracy assessed

Interpretation:

This map class occurs primarily along the Notom Road and Hall's Creek. It is uncommon, occupying level ground with moderately deep to deep soils derived from eolian deposits. The understory appears as a uniform smooth reddish tan color. Adjacent map classes often include Shadscale Shrubland Complex (6), or Pinyon–Juniper / Xeric Shrubs Woodlands Complex (15).



Distribution/Ecology/Composition:

This woodland type is distributed primarily in the Hall's Creek drainage south of Bitter Creek Divide to around the Post. It is recognized by having less than 5% cover by shrubs and more than 5% cover by cheatgrass. Native grasses, if present, have much less cover than cheatgrass. Some of the stands mapped as this unit are probably close to this 5% cutoff. Cheatgrass cover varies widely from year to year depending on timing and amount of winter precipitation. Substrates vary from sandy to loamy, but are generally deeper and less rocky than shrub-dominated stands. Stands are found on the valley floor where heavy grazing has occurred for decades. Stand canopies vary from open to moderately closed.

No ground photo available

14c Pinyon - Juniper / Russian Wildrye Semi-natural Woodland (W-PJPJ)

Associations:

Pinus edulis - *Juniperus osteosperma* / *Psathyrostachys juncea* Semi-natural Woodland

Common species:

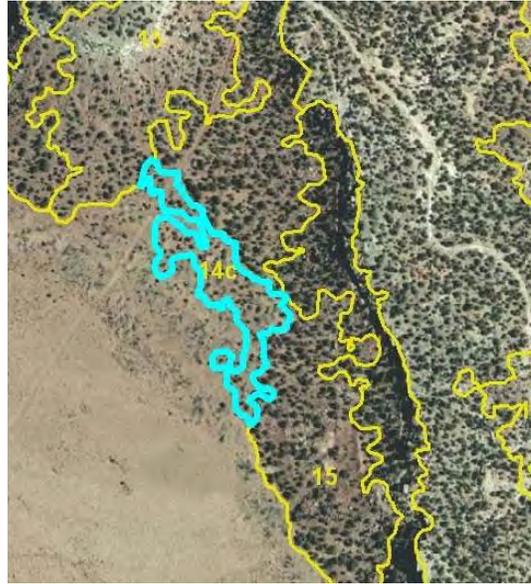
Juniperus osteosperma
Pinus edulis
Psathyrostachys juncea

Project Specifics:

Frequency = 1 total polygon
0 polygons in CARE, 1 in the environs
Total area = 0.9 ha / 2.3 acres (<<1%)
0 ha / 0 acres CARE
0.9 ha / 2.3 ac environs
Average polygon size = 0.9 ha / 2.3 acres
Not accuracy assessed

Interpretation:

Only one polygon of this rare map class was mapped (in the Onion Beds area). It occurs on a nearly level slope on moderately deep to deep soils mainly derived from sandstone. The understory appears as a mottled light brown and gray-green color. Adjacent map classes include Big Sagebrush Shrubland Complex (11c), or Pinyon – Juniper / Xeric Shrubs Woodlands Complex (15).



Distribution/Ecology/Composition:

This woodland type is documented only around the Onion Beds. It is recognized by having less than 5% cover by shrubs and more than 5% cover of the perennial non-native grass Russian wildrye. There are many dead stumps of sagebrush scattered throughout the polygons. Substrates tend to be sandy loam. Most of the stands have open canopies since the areas were cleared and seeded to enhance grazing potential.



Photo credit: NPS

15 Pinyon - Juniper / Xeric Shrubs Woodland Complex (W-PJXE)

Associations:

Pinus edulis – *Juniperus osteosperma* / *Ephedra torreyana* – *Artemisia bigelovii* Woodland
Pinus edulis – *Juniperus osteosperma* / *Artemisia bigelovii* Woodland
Pinus edulis – *Juniperus osteosperma* / *Shepherdia rotundifolia* Woodland
Juniperus osteosperma / Sparse Understory Woodland

Common species:

Juniperus osteosperma
Pinus edulis
Artemisia bigelovii
Atriplex confertifolia
Chrysothamnus viscidiflorus
Ephedra torreyana
Eriogonum corymbosum
Gutierrezia sarothrae
Shepherdia rotundifolia
Achnatherum hymenoides
Bouteloua gracilis

Project Specifics:

Frequency = 1,554 total polygons
992 polygons in CARE, 562 in the environs
Total area = 7,456 ha / 18,425 acres (5%)
4,830 ha / 11,936 acres CARE
2,626 ha / 6,489 ac environs
Average polygon size = 4.8 ha / 11.9 acres
Producer's accuracy = 90% ± 6%
User's accuracy = 77% ± 7%



Interpretation:

Polygons are regular to elongate and medium to large in size. This map class is among the most common and widely distributed pinyon-juniper types in the mapping area, occurring on all aspects in moderately deep to shallow soils that are derived from sandstone or eolian sources. Most examples are sparsely vegetated, with sparse understory types occurring primarily on shallow, shale soils. Stands tend to be open, so the signature varies with the geology. In the Carmel Formation in the southern portion of the mapping area, it typically has a light tan to yellow tan cast. Slope varies from level to steep. Close inspection reveals scattered tiny gray specks representing the desert shrubs with Torrey Mormon-tea being the most distinguishable shrub. The trees appear as scattered small regular dark dots. At some sites, the understory is gray tending to black from reflectance of black lava boulders and gravel. However, generally geology or soil type has little influence on the distribution of the associations in this map type. This map class may sometimes be difficult to distinguish from adjacent polygons of Pinyon-Juniper / Mesic Shrub Woodland Complex (16) at higher elevations.

Distribution/Ecology/Composition:

This map class describes open woodlands with mixed xeric shrubs in the understory or very sparse understory. It is intended as an umbrella map class that may include examples of all other 15-type map classes when they cannot be distinguished using the imagery or field data. Stands occur on drier slopes of the pinyon-juniper belt throughout the mapping area, but are most widespread in the northern portion. Most stands are very open because of the limited ability of the substrate to absorb or retain precipitation. The understory shrub composition is quite variable depending on substrate; however, all are more xeric than those communities mapped as 16. Typical shrubs include shadscale, Bigelow sagebrush, Torrey Mormon-tea, and

roundleaf buffaloberry. There are few herbaceous species in the understory, although there may be a well-developed non-vascular community on the gentlest slopes. Sparse understory in this map class can be attributed primarily to: 1) open stands on rocky slopes that have little understory because most of the ground surface is rock or pebbles (typically in Carmel Formation), or 2) open stands on sandy soils that support few shrubs or grasses.



Photo credits: NPS

15b Pinyon - Juniper / Brittle Prickly Pear Woodland (W-PJOP)

Associations:

Pinus edulis - *Juniperus osteosperma* / *Opuntia fragilis* Woodland

Common species:

Juniperus osteosperma
Pinus edulis
Opuntia fragilis
Bouteloua gracilis

Frequency = 45 total polygons
40 polygons in CARE, 5 in the environs
Total area = 150 ha / 372 acres (<1%)
139 ha / 344 acres CARE
11 ha / 28 ac environs
Average polygon size = 3.3 ha / 8.3 acres
Producer's accuracy = 80% ± 12%
User's accuracy = 60% ± 13%

Interpretation:

This map class occurs in small to medium, regular polygons. It is uncommon in the mapping area, occurring on level to gently sloping sites with deep, sandy soils. The understory appears as a uniformly smooth tan to gray-green color, except where biological soil crusts create a medium gray cast. Tree crowns are usually larger than those in adjacent polygons with shallower soils. Adjacent polygons are often mapped as Pinyon – Juniper / Mesic Shrub Woodland Complex (16) or Pinyon – Juniper / Mixed Grass Woodland Complex (14).



Distribution/Ecology/Composition:

This woodland map class is distributed primarily in the central portion of the mapping area, particularly around George Peak, Paradise Flats, north of Spring Canyon, and on Dry Bench. It is characterized by having less than 5% cover by shrubs and more than 5% cover of prickly pear and blue grama. Some stands of this association may have been mapped as Pinyon – Juniper / Sparse Understory Woodland (15d), since it is difficult to determine dominance of prickly pear from aerial imagery. Substrates are primarily sandy loam derived from the Navajo, Wingate, or Kayenta formations. Stands are usually found in small pockets surrounded by other woodland map classes. Stands tend to have an open canopy and the trees to have large crowns. Most stands are inaccessible to cattle, so this association is not a consequence of grazing. A few sites on Dry Bench and in Paradise Flats were grazed, but this does not seem to have affected the species composition.



Photo credits: NPS

15d Pinyon - Juniper / Sparse Understory Woodland (W-PJSP)

Association:

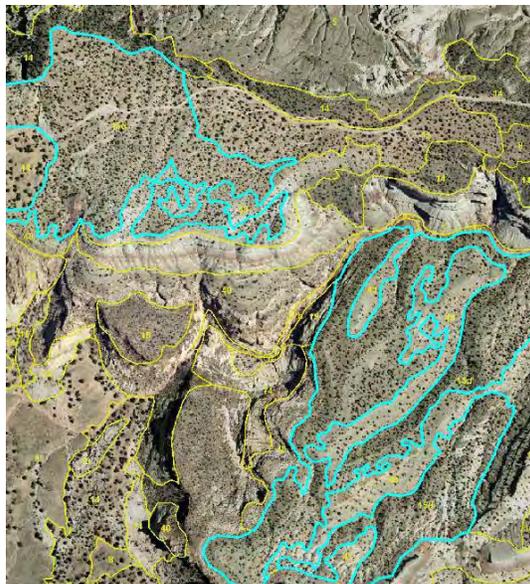
Pinus edulis - *Juniperus osteosperma* / *Artemisia pygmaea* Woodland
Pinus edulis - *Juniperus osteosperma* / *Atriplex* spp. Woodland
Pinus edulis - *Juniperus osteosperma* / Cushion Plant Woodland
Pinus edulis - *Juniperus osteosperma* / *Ephedra viridis* Woodland
Pinus edulis - *Juniperus osteosperma* / *Petradoria pumila* Woodland
Pinus edulis - *Juniperus osteosperma* / Sparse Understory Woodland

Common species:

Juniperus osteosperma
Pinus edulis
Artemisia pygmaea
Atriplex (*canescens*, *confertifolia*)
Ephedra viridis
Achnatherum hymenoides
Arenaria eastwoodiae
Enceliopsis nudicaulis
Erigeron (*compactus*, *pumilus*)
Eriogonum alatum
Frasera albomarginata
Heterotheca villosa
Hymenopappus filifolius
Paronychia sessiliflora
Petradoria pumila
Phlox (*hoodii*, *multiflora*)
Polygala subspinosa

Project Specifics:

Frequency = 505 total polygons
304 polygons in CARE, 201 in the environs
Total area = 2,913 ha / 7,199 acres (2%)
1,453 ha / 3,591 acres CARE
1,460 ha / 3,608 ac environs
Average polygon size = 5.8 ha / 14.3 acres
Producer's accuracy = 71% ± 8%
User's accuracy = 82% ± 7%



Interpretation:

This map class encompasses polygons of several pinyon-juniper woodland communities with a very sparse understory. Polygons are regularly-shaped, and are often medium to large in size. The signature of these stands varies because of the diverse reasons for a sparse understory (described below). In open canopy stands, the signature is small, regular dark green dots with a variable matrix signature depending on the substrate. Close inspection of the understory reveals a lack of the small, dark specks that signal shrubs.

Pinus edulis - *Juniperus osteosperma* / Sparse Understory Woodland is found in the northern portion of the mapping area on ridges and slopes covered with black lava boulders or gravel. Some polygons of this unit may be mapped as Pinyon-Juniper / Mixed Grass Woodland Complex (14), or may contain inclusions of that map class. If photo interpreters cannot distinguish this association on aerial photos it will be mapped as Pinyon-Juniper / Xeric Shrubs Woodland Complex (15) or Pinyon-Juniper / Mesic Shrubs Woodland Complex (16).

Pinus edulis - *Juniperus osteosperma* / Cushion Plant Woodland polygons are small to medium in size. They occur on ridge tops and mesa tops on shallow, shale-derived soils. They were mapped only where known from fieldwork. Stands tend to be open, so the signature reflects the

geology. In the Carmel Formation, the matrix typically has a light tan to yellow tan cast, unlike surrounding stands of Pinyon-Juniper / Mixed Grass Woodland Complex (14), which appear more yellow. At higher elevation exposures of the Carmel Formation along the Waterpocket Fold, this map class occurs on white soils. Polygons also occur on red Moenkopi Formation soils above the Burr Trail switchbacks.

Distribution/Ecology/Composition:

The *Pinus edulis* - *Juniperus osteosperma* / Cushion Plant Woodland association occurs primarily on ridge and hill tops with rocky, shallow soils derived from Carmel or Moenkopi shales. The rocky surface restricts total herbaceous cover; the cover of shrubs is also sparse. The understory consists primarily of a diverse mix of tiny cushion plants (listed above). The *Pinus edulis* - *Juniperus osteosperma* / *Petradoria pumila* Woodland is closely related in habitat.

The *Pinus edulis* – *Juniperus osteosperma* / *Artemisia pygmaea* Woodland association contains a few other shrub species, such as crispleaf buckwheat, cliffrose, round-leaf buffaloberry and Harriman’s yucca; however, pygmy sage is clearly the dominant understory shrub.

The *Pinus edulis* – *Juniperus osteosperma* / Sparse Understory type occurs primarily in the northern and central portions of the mapping area at medium elevations. The sparse understory results from two distinct situations: (1) Closed-canopy stands that have no understory because of shade and water competition from the mature canopy trees; and (2) Open stands on rocky slopes that have little understory because most of the ground surface is rock or pebbles. In both types, biological soil crusts are absent or rudimentary. Other than pinyon pine and juniper, there are no consistent species to signal this community.

Polygons of *Pinus edulis* – *Juniperus osteosperma* / *Atriplex* spp. are rare, restricted to the interface of the Dakota and Mancos formations in Strike Valley, and can be seen along the Notom Road near the Cedar Mesa campground. A saltbush and sagebrush comprise the understory dominants. Most stands have open canopies. Stands occur at low to moderate elevations on rapidly drained silts or sandy loam substrates.



Photo credits: NPS

15e Pinyon - Juniper / Sagebrush Woodland Complex (W-PJWS)

Associations:

Juniperus osteosperma / *Artemisia tridentata* ssp. *tridentata* Woodland

Juniperus osteosperma / *Artemisia tridentata* ssp. *wyomingensis* Woodland

Pinus edulis - *Juniperus* spp. / *Artemisia tridentata* (ssp. *wyomingensis*, ssp. *vaseyana*) Woodland

Common species:

Pinus edulis

Juniperus osteosperma

Artemisia tridentata (ssp. *tridentata*, *wyomingensis*)

Project Specifics:

Frequency = 443 total polygons

152 polygons in CARE, 291 in the environs

Total area = 1,135 ha / 2,805 acres (1%)

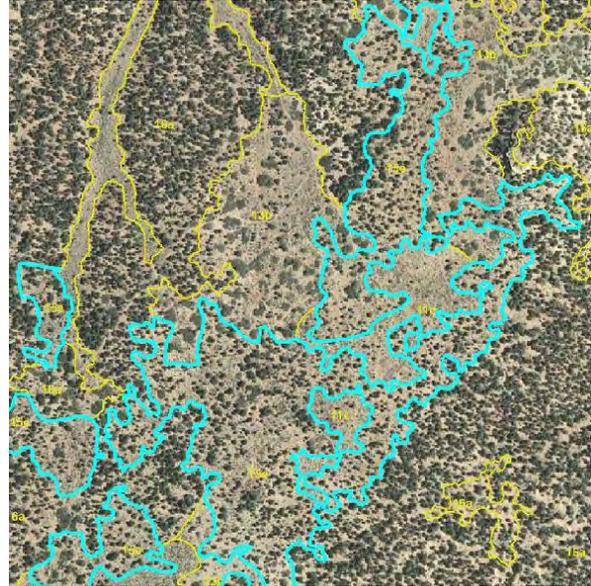
321 ha / 794 acres CARE

814 ha / 2,011 ac environs

Average polygon size = 2.6 ha / 6.3 acres

Producer's accuracy = 80% ± 12%

User's accuracy = 67% ± 13%



Interpretation:

This common map class occurs in small to very large, regular polygons located throughout the mapping area on deep residual or eolian soils. The signature is characterized by evenly spaced round dark green dots with scattered to dense gray speckles visible between tree crowns. Adjacent polygons may be mapped as Big Sagebrush Shrubland Complex (11c), Pinyon – Juniper / Sparse Understory Woodland (15d) or Mixed Grasslands Complex (8).

Distribution/Ecology/Composition:

These common woodlands occur along the central western edge (Dry Bench) and northern portions (near Baker Ranch and on Jones Bench) of the mapping area, primarily on valley floors, alluvial flats or along intermittent drainages with deep, loamy soils. The canopy may be juniper with or without pinyon pine and an understory dominated by either basin big sagebrush or Wyoming big sagebrush (minimum 5% cover). Shrubs other than sagebrush are rare. In many of the stands the sagebrush is dying due to recent severe drought.



Photo credits: NPS

15f Pinyon - Juniper / Black Sagebrush Woodland (W-PJBS)

Associations:

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

Common species:

Juniperus osteosperma
Pinus edulis
Artemisia nova
Ephedra viridis
Achnatherum hymenoides

Project Specifics:

Frequency = 48 total polygons
3 polygons in CARE, 45 in the environs
Total area = 330 ha / 815 acres (<1%)
4 ha / 11 acres CARE
326 ha / 805 ac environs
Average polygon size = 6.9 ha / 17.0 acres
Not accuracy assessed



Interpretation:

This map class occurs mostly in small to medium, regular polygons primarily on benches and rises in the northern portion of the mapping area, typically on tan, gray or white soils. The signature is characterized by evenly spaced round dark green dots with a very fine speckled gray-green texture visible between tree crowns. Adjacent polygons often include Ponderosa Pine Woodland Complex (33). Polygons may contain inclusions of map classes Juniper / Big Sagebrush Woodland Complex (15e), Pinyon – Juniper / Xeric Shrubs Woodland Complex (15) or Pinyon – Juniper / Mesic Shrubs Woodland Complex (16).

Distribution/Ecology/Composition:

This is an uncommon community occurring primarily in the northern portion of the mapping area, with a few stands located in the central portion. Canopy cover may vary from open to moderately closed. Most occurrences are at moderate elevations and gentle to moderate slopes. Many stands include green Mormon-tea and Indian ricegrass.



Photo credits: NPS

16 Pinyon - Juniper / Mesic Shrubs Woodland Complex (W-PJME)

Associations:

Juniperus osteosperma / *Cercocarpus intricatus* Woodland

Pinus edulis - *Juniperus osteosperma* / (*Shepherdia rotundifolia*, *Amelanchier utahensis*) Wooded Shrubland

Pinus edulis - *Juniperus osteosperma* / *Amelanchier utahensis* Woodland

Pinus edulis - *Juniperus osteosperma* / *Cercocarpus intricatus* Woodland

Pinus edulis - *Juniperus osteosperma* / *Ephedra viridis* Woodland

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

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

Common species:

Juniperus osteosperma

Pinus edulis

Amelanchier utahensis

Cercocarpus intricatus

Ephedra viridis

Mahonia fremontii

Purshia stansburiana

Shepherdia rotundifolia

Project Specifics:

Frequency = 5122 total polygons

3220 polygons in CARE, 1902 in the environs

Total area = 42,197 ha / 104,271 acres (29%)

27,446 ha / 67,819 acres CARE

14,751 ha / 36,452 ac environs

Average polygon size = 8.2 ha / 20.3 acres

Producer's accuracy = 79% ± 9%

User's accuracy = 53% ± 9%



Interpretation:

This map class is intended as an umbrella map class that may include examples of all other 16-type map classes when they cannot be distinguished using the imagery or field data. Most polygons of this map class are medium to large in size. It is among the most common and widely distributed woodland types in the mapping area, occurring on most aspects and slopes. In dense stands, the shrub matrix appears as a dark green, somewhat rough-textured surface containing very dark green dots that are the pinyon and juniper trees. In open stands, the shrubs appear as irregularly spaced smaller gray-green dots scattered between the trees. In the sparsest stands, the geologic substrate is visible between vegetation. This map class may sometimes be difficult to distinguish from adjacent polygons of Pinyon-Juniper / Xeric Shrub Woodland Complex (15) at mid to lower elevations.

Distribution/Ecology/Composition:

The composition and dominance of shrubs vary in these stands, but all are located in the more mesic areas of the pinyon-juniper belt. Closed canopy stands are typically found on northern facing slopes and canyon bottoms. Open to moderate canopy cover stands are found on slickrock sandstone substrates that maintain higher soil moisture content or at slightly higher elevations than map class 15. The tree canopy may be moderately closed to very open – essentially a wooded shrubland in some locations. The diagnostic tall shrub species that distinguish this complex from map class 15 are littleleaf mountain mahogany, cliffrose (especially on slickrock sites), Apache plume (in washes), Utah serviceberry and Fremont barberry. Many of the smaller shrubs common in map class 15 are also found in this map class, such as roundleaf buffaloberry, Bigelow sage, green Mormon-tea and skunkbush.



Photo credits: NPS

16a Pinyon - Juniper / Mountain Mahogany and Gambel Oak Woodland (W-PJMM)

Associations:

Pinus edulis - *Juniperus* spp. / *Cercocarpus montanus* – Mixed Shrub Woodland
Pinus edulis - *Juniperus* spp. / *Quercus gambelii* Woodland

Common species:

Juniperus osteosperma
Pinus edulis
Amelanchier utahensis
Cercocarpus montanus
Ephedra viridis
Mahonia fremontii
Quercus gambelii
Shepherdia rotundifolia
Achnatherum hymenoides

Project Specifics:

Frequency = 483 total polygons
288 polygons in CARE, 195 in the environs
Total area = 3,041 ha / 7,515 acres (2%)
2,182 ha / 5,391 acres CARE
860 ha / 2,124 ac environs
Average polygon size = 6.3 ha / 15.6 acres
Producer's accuracy = 74% ± 9%
User's accuracy = 76% ± 9%



Interpretation:

Polygons are small to medium and tend to be regularly shaped. Stands are open to moderately closed, on north-facing or otherwise cool, rocky, moderate to very steep slopes. The trees are recognizable as small, dark green dots. The shrubs appear as larger gray-brown to gray-green clumps. The shrub layer may be sparse to dense (minimum 5% cover). Stands with dense shrubs are easy to recognize. Sparse stands require magnification to see the shrubs. Adjacent stands may be mapped as Pinyon – Juniper / Mesic Shrub Woodland Complex (16), Black Sage / Mutton grass Shrubland (12c), or Douglas-fir Montane Woodland Complex (23a).

Distribution/Ecology/Composition:

The *Pinus edulis* - *Juniperus* spp. / *Cercocarpus montanus* – Mixed Shrubs Woodland component of this map class occupies colluvial slopes and canyon sides primarily in the central portion of the mapping area, mostly at moderately high elevations. The substrate is generally loamy soils derived from sandstones, or on Moenkopi or Chinle shale slopes heavily modified by sandstone boulders falling from outcrops above. The understory is generally sparse, but mountain mahogany forms a consistent shrub layer with 5-15% cover.

Upland polygons of *Pinus edulis* – *Juniperus* spp. / *Quercus gambelii* Woodland are included in this map class. They occur primarily in the central portion of the mapping area at moderate elevations and on north-facing slopes where high soil moisture content is possible. The tree canopy may be moderately closed to very open. Gambel oak is the most consistent species in the understory, but other shrubs present include Utah serviceberry, Fremont barberry and roundleaf buffaloberry.



Photo credit: NPS



Photo credit: NPS



Photo credit: NPS



Photo credit: NPS

16e Pinyon - Juniper / Oak and Manzanita Woodland (W-PJOM)

Associations:

Pinus edulis - *Juniperus osteosperma* / *Arctostaphylos patula* Woodland
Pinus edulis - *Juniperus osteosperma* / *Quercus havardii* var. *tuckeri* Woodland
Pinus edulis - *Juniperus* spp. / *Quercus gambelii* Woodland
Quercus gambelii / Sparse Understory Shrubland

Common species:

Juniperus osteosperma
Pinus edulis
Amelanchier utahensis
Arctostaphylos patula
Mahonia fremontii
Quercus gambelii
Quercus havardii var. *tuckeri*
Shepherdia rotundifolia
Symphoricarpos oreophilus
Yucca harrimaniae
Achnatherum hymenoides
Pleuraphis jamesii

Project Specifics:

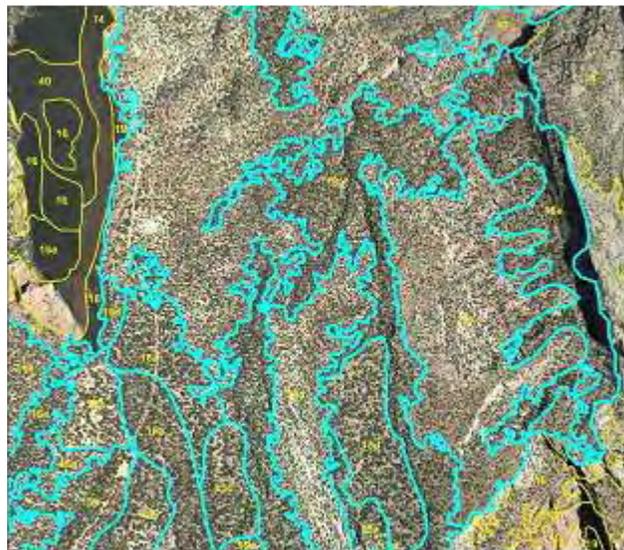
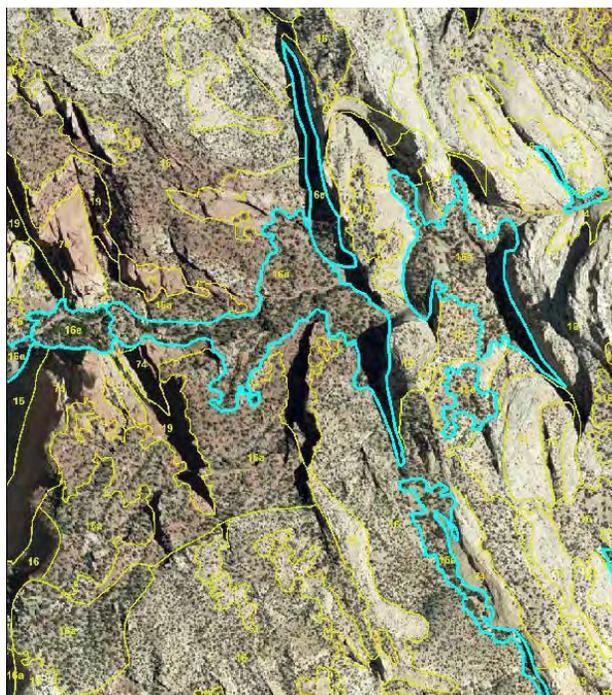
Frequency = 271 total polygons
224 polygons in CARE, 47 in the environs
Total area = 493 ha / 1,219 acres (<1%)
400 ha / 989 acres CARE
93 ha / 230 ac environs
Average polygon size = 1.8 ha / 4.5 acres
Producer's accuracy = 68% ± 10%
User's accuracy = 90% ± 8%

Interpretation:

This map class includes all oak and pinyon – juniper/ oak types except upland stands of *Pinus edulis* - *Juniperus* spp. / *Quercus gambelii* Woodland included in 16a. *Pinus edulis* – *Juniperus osteosperma* / *Arctostaphylos patula* is uncommon, occurring in small, often linear polygons. Most examples are on slopes or drainages in Navajo sandstone. The signature is predominantly the light gray of the underlying rock or sand. The trees appear as tiny black dots, with smaller scattered bright green clumps representing the greenleaf manzanita. This type often contains small inclusions of Pinyon - Juniper / Mesic Shrub Woodland Complex (16).

Polygons of pinyon – juniper woodland with an oak (Gambel and Tucker's) understory are linear. This community occurs on stream terraces and banks above the level of most floods. The shrub matrix appears as dark gray-green to deep green in color, with irregular, rough-textured dots representing pinyon and juniper trees

Most polygons of Gambel oak shrubland are small to medium in size, regular to linear in shape.



They may be on moderate to steep, north-facing slopes or in drainage bottoms. The shrubs appear as dark gray-green to deep green in color, irregular, rough-textured dots. Polygons adjacent to this map class may be mapped as Pinyon – Juniper / Mesic Shrubs Woodland Complex (16), Pinyon – Juniper / Mountain Mahogany and Gambel Oak Woodland (16a), or Douglas-fir Montane Woodland Complex (23a).

Distribution/Ecology/Composition:

The *Pinus edulis* – *Juniperus osteosperma* / *Arctostaphylos patula* Woodland association is restricted to outcrops of Navajo, Wingate or Kayenta sandstones in the Waterpocket Fold and Circle Cliffs. These areas occasionally merge with the Ponderosa Pine / Greenleaf Manzanita woodland (21) that also occurs in Navajo sandstone pockets and shelves. However, this map class tends to occur on gentler and sometimes south-facing slopes. All stands are at moderate elevations. The canopy is open and the total vegetative cover is relatively low because most plants are rooted in cracks in the sandstone and are generally dwarfed. Although greenleaf manzanita is the consistent shrub species, other shrubs commonly found in this unit include littleleaf mountain mahogany, round-leaf buffaloberry and Harriman's yucca.

Pinus edulis – *Juniperus* spp. / *Quercus gambelii* Woodland and *Quercus gambelii* / Sparse Understory Shrubland are uncommon communities which occur primarily in the central portion of the mapping area. Tree canopies may be moderately closed to very open. Most stands are at moderate elevations on north-facing slopes or canyon bottoms where high soil moisture content is maintained. Gambel oak is the most consistent species in the understory, but other shrubs present include Utah serviceberry, Fremont barberry and roundleaf buffaloberry.

Pinus edulis - *Juniperus osteosperma* / *Quercus havardii* var. *tuckeri* Woodland is an uncommon type that has only been found in on sandy substrates in Hall's Creek just south of Bitter Creek Divide. It may occur elsewhere but it is virtually impossible to distinguish from *Pinus edulis* – *Juniperus* spp. / *Quercus gambelii* Woodland on aerial photos. The tree canopy may be moderately open to very open. All known stands are on well-drained alluvial terraces.



Photo credit: NPS



Photo credit: NPS



Photo credit: NPS



Photo credit: NPS

17 Pinyon - Juniper / Blackbrush Woodland (W-PJBB)

Associations:

Juniperus osteosperma / *Coleogyne ramosissima* Woodland

Pinus edulis - *Juniperus osteosperma* / *Coleogyne ramosissima* Woodland

Common species:

Juniperus osteosperma

Pinus edulis

Coleogyne ramosissima

Ephedra viridis

Ericameria nauseosa

Pleuraphis jamesii

Project Specifics:

Frequency = 105 total polygons

32 polygons in CARE, 73 in the environs

Total area = 718 ha / 1,774 acres (<1%)

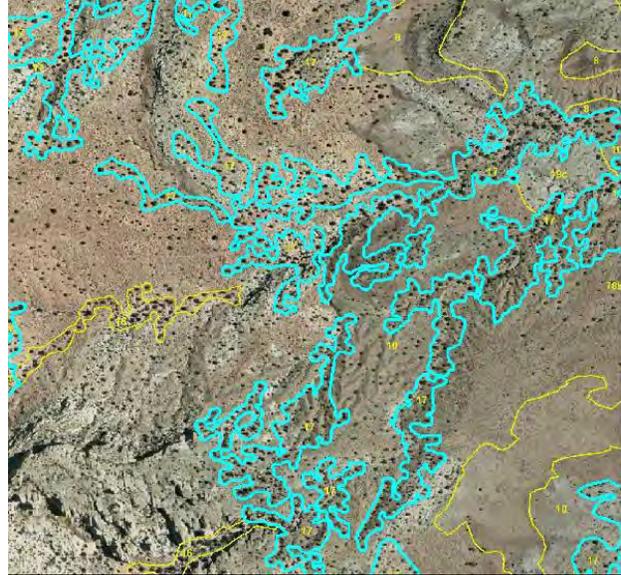
104 ha / 257 acres CARE

614 ha / 1,517 ac environs

Average polygon size = 6.8 ha / 16.9 acres

Producer's accuracy = 79% ± 15%

User's accuracy = 83% ± 15%



Interpretation:

Polygons are small to medium and regular on most surfaces. Stands are open to

moderately closed, primarily on benches or ridges. The trees are recognizable as small, dark green dots; the shrubs appear as a gray-brown to gray-green, regularly spaced to slightly clumped dots. The shrub layer may be sparse to dense (minimum 5% cover). Adjacent stands may include Blackbrush Shrubland Complex (10) or Sand Sagebrush Shrubland Complex (9).

Distribution/Ecology/Composition:

In the mapping area, this association is restricted to shallow, rocky soils developing over sandstone substrates of the Dakota, Morrison, Carmel, Navajo, and Kayenta formations or on stabilized dunes at low elevations. It is found only south of the Bitter Creek Divide. Soils are rapidly drained.



Photo credit: NPS



Photo credit: NPS

20 Bristlecone Pine Woodland (W-PILO)

Associations:

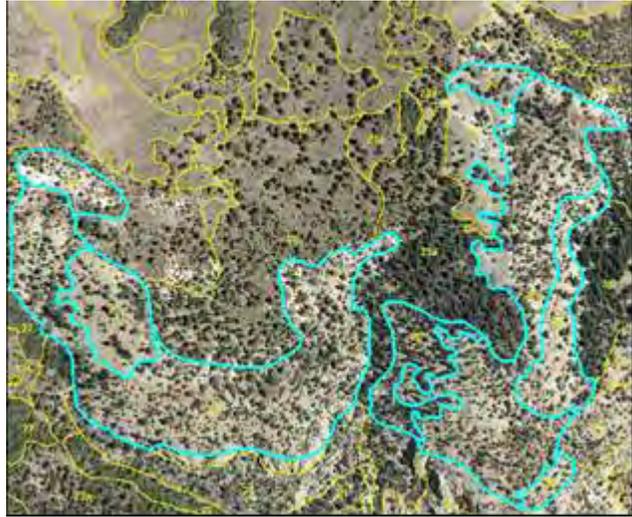
Pinus longaeva Woodland

Common species:

Juniperus (osteosperma, scopulorum)
Pinus (longaeva, edulis)
Pseudotsuga menziesii
Amelanchier utahensis
Ericameria nauseosa
Eriogonum corymbosum
Purshia tridentata

Project Specifics:

Frequency = 20 total polygons
12 polygons in CARE, 8 in the environs
Total area = 48 ha / 120 acres (<<1%)
22 ha / 56 acres CARE
26 ha / 64 ac environs
Average polygon size = 2.4 ha / 6.0 acres
Producer's accuracy = 80% ± 29%
User's accuracy = 50% ± 29%



Interpretation:

This map class is known from a few stands in the mapping area. The photo signature is a mosaic of red and white soils of the Carmel Formation. Trees are dark gray-green, ragged, irregularly spaced dots. The understory is sparse with a few scattered dark shrubs. Shadows indicate a taller tree than most pinyon-juniper stands.

Distribution/Ecology/Composition:

This association occurs in the upper elevation ranges in the northwestern part of the mapping area. A subcanopy of pinyon pine or Utah juniper is typical. There is a sparse understory of cushion plants with a few Utah serviceberry, cliffrose or buckwheat scattered throughout the polygons. The unvegetated surface has moderate cover of litter, rocks and gravel. Soils are rapidly drained sandy loam. All known sites are on Carmel Formation.



Photo credit: NPS



Photo credit: NPS

21 Ponderosa Pine / Greenleaf Manzanita Woodland (W-PPGM)

Associations:

Pinus ponderosa / *Arctostaphylos patula* Woodland

Pinus ponderosa / *Cercocarpus intricatus* - *Arctostaphylos patula* Woodland

Pinus ponderosa Slickrock Sparse Vegetation

Common species:

Juniperus (communis, scopulorum)

Pinus (ponderosa, edulis)

Amelanchier utahensis

Arctostaphylos patula

Cercocarpus intricatus

Fraxinus anomala

Purshia tridentata

Yucca harrimaniae

Project Specifics:

Frequency = 101 total polygons

63 polygons in CARE, 38 in the environs

Total area = 192 ha / 476 acres (<1%)

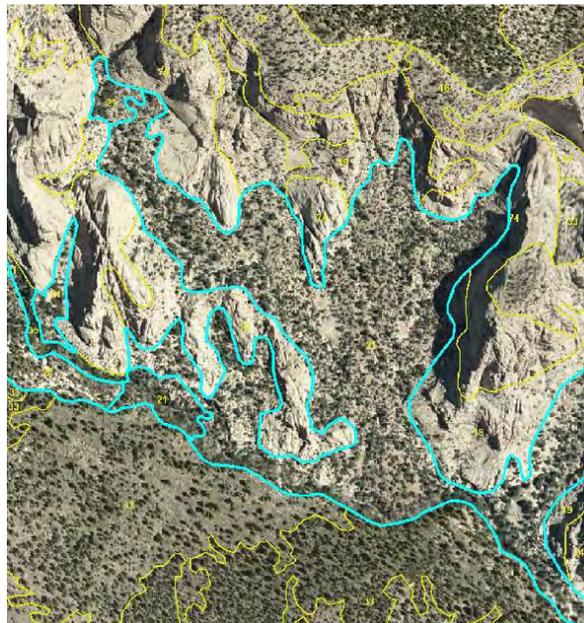
110 ha / 273 acres CARE

82 ha / 203 ac environs

Average polygon size = 1.9 ha / 4.7 acres

Producer's accuracy = 79% ± 11%

User's accuracy = 96% ± 6%



Interpretation:

This map class occurs in irregularly shaped, small to medium polygons underlain by Navajo sandstone. Slopes are gentle to moderate. Stands are generally very open, so the matrix color is usually the light gray of exposed bedrock. Individual ponderosa tree crowns appear as large black dots (shadows reveal elongated, rounded crowns). Some stands have a speckled or spotted appearance between the crowns, which represents the shrub layer, while others have no understory at all if they are rooted in cracks on the slickrock. Adjacent polygons may include Bare Exposed Rock (74), Pinyon – Juniper / Mesic Shrubs Woodland Complex (16) or Little-leaf Mountain Mahogany Slickrock Sparse Vegetation (19).

Distribution/Ecology/Composition:

This ponderosa pine woodland occurs at mid and upper elevations in the northern portion of the mapping area. It is found primarily on Navajo sandstone in the Waterpocket Fold on all aspects. Canopies are generally open with greenleaf manzanita as the dominant understory shrub, or no understory is present if trees are growing on slickrock. Parent materials are Navajo sandstone or volcanic exposures that have eroded to boulders deposited as rockfall and colluvium. Soils are well-drained sandy loam, sandy clay or clay loam.



Photo credit: NPS



Photo credit: NPS



Photo credit: NPS



Photo credit: NPS

22 Aspen / Snowberry Forest (W-ASPE)

Associations:

Populus tremuloides / *Symphoricarpos oreophilus* Forest

Common species:

Populus tremuloides

Pseudotsuga menziesii

Rosa woodsii

Symphoricarpos oreophilus

Project Specifics:

Frequency = 56 total polygons

0 polygons in CARE, 56 in the environs

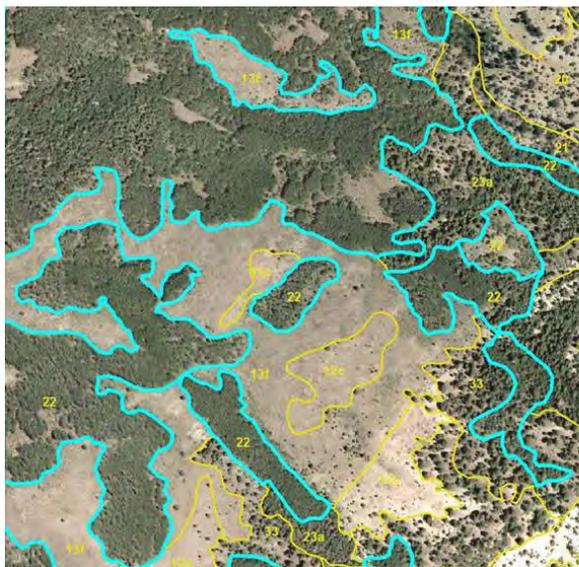
Total area = 164 ha / 405 acres (<1%)

0 ha / 0 acres CARE

164 ha / 405 ac environs

Average polygon size = 2.9 ha / 7.2 acres

Not accuracy assessed



Interpretation:

This map class occurs in small to medium, regular to elongate polygons, scattered throughout the higher elevations in the northwestern portion of the mapping area. Most stands have a closed canopy and are recognizable because of the uniform canopy height, uniform rough texture, medium green color and tall stature. This map class also occurs along some drainages. Adjacent polygons may be mapped as Vasey's Sagebrush / Snowberry Shrubland Complex (13f), Fringed Sage – Mixed Grasses – Lichens Herbaceous Vegetation (12a) or Douglas Fir Montane Woodland Complex (23a).

Distribution/Ecology/Composition:

Persistent stands of aspen occur on level to moderately steep slopes at the higher elevations in the northwestern corner of the mapping area. These stands are on east or north-facing slopes at the higher elevation ranges. The canopy may be open or closed. Douglas fir is occasionally part of the canopy and Rocky Mountain juniper and spruce may be part of the subcanopy. The unvegetated surface has moderate to high cover of litter and over 20% downed wood. The substrate is often colluvial deposits such as talus or rock fall deposits. Soils are dark because of their high organic content, suggesting that the aspen stands are persistent rather than succeeding to a conifer-dominated forest.



Photo credit: NPS



Photo credit: NPS

23a Douglas-fir Montane Woodland Complex (W-DFMO)

Associations:

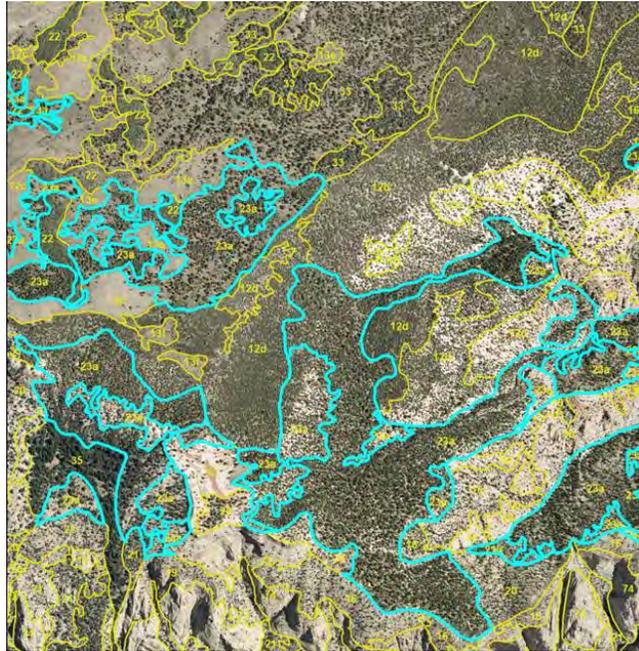
Pinus ponderosa - *Pseudotsuga menziesii* / *Purshia tridentata* Woodland
Pseudotsuga menziesii / *Cercocarpus ledifolius* Woodland
Pseudotsuga menziesii / *Cercocarpus montanus* Woodland
Pseudotsuga menziesii / *Symphoricarpos oreophilus* Forest
Pseudotsuga menziesii Scree Woodland

Common species:

Juniperus (*scopulorum*, *osteosperma*)
Pinus (*ponderosa*, *edulis*, *longaeva*)
Pinus edulis
Amelanchier utahensis
Artemisia (*tridentata*, *nova*)
Cercocarpus ledifolius
Cercocarpus montanus
Ericameria nauseosa
Mahonia repens
Pseudotsuga menziesii
Purshia tridentata
Rhus aromatica
Rosa woodsii
Shepherdia rotundifolia
Symphoricarpos oreophilus

Project Specifics:

Frequency = 104 total polygons
46 polygons in CARE, 58 in the environs
Total area = 321 ha / 794 acres (<1%)
206 ha / 508 acres CARE
115 ha / 286 ac environs
Average polygon size = 3.1 ha / 7.6 acres
Producer's accuracy = 53% ± 14%
User's accuracy = 72% ± 15%



Interpretation:

This map class appears as small to medium, irregularly shaped polygons, often on north-facing slopes or canyon bottoms mainly in the northwestern portion of the mapping area. The color is generally dark, with large black dots representing mature canopy trees. Shadows may reveal the pointed profile of the tree crown. Smaller dark dots may represent younger Douglas-fir or other conifer species. Open stands often have a gray-green mottled appearance between trees, representing the shrub layer. Closed stands appear mottled black. Adjacent polygons often are mapped as Aspen / Snowberry Forest (22), Ponderosa Pine / Greenleaf Manzanita Woodland (21), Pinyon – Juniper / Mountain Mahogany and Gambel Oak Woodland (16a), or Talus Mixed Shrubland Complex (40).

Distribution/Ecology/Composition:

This map class encompasses all Douglas-fir types, except for stands of Douglas-fir Canyon Woodlands (23c) that were documented during fieldwork. Map class 23a occurs in primarily the northwestern portion of the mapping area on colluvial deposits above 9,000 feet elevation, on steep, north and northeast-facing slopes of major canyons above 8,000 feet. Douglas-fir is generally dominant, but ponderosa pine, Rocky Mountain juniper, Utah juniper or pinyon pine may be co-dominant or form a subcanopy. Unvegetated surface area is characterized by high cover of litter and variable amounts of small rocks/ gravel, boulders, and bedrock outcrops. Soils are well drained and generally coarse-textured. Parent materials include Navajo, Kayenta, or

Wingate sandstones, Carmel shales, or boulder deposits of volcanic origin.



Photo credit: NPS



Photo credit: NPS



Photo credit: NPS

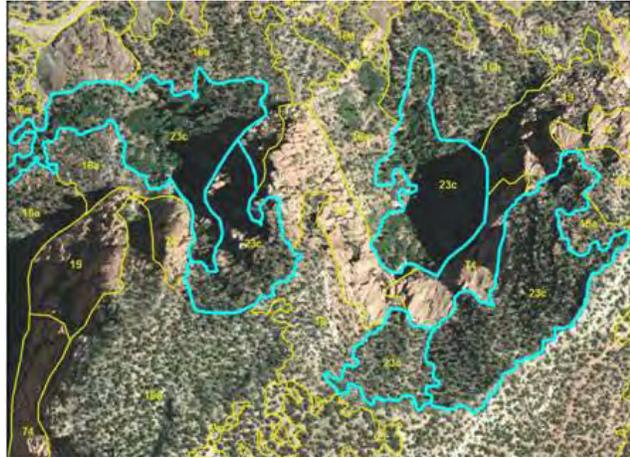
23c Douglas-fir Canyon Woodland Complex (W-DOFI)

Associations:

Pseudotsuga menziesii / *Acer glabrum* Woodland
Pseudotsuga menziesii / *Betula occidentalis* Woodland
Pseudotsuga menziesii / *Quercus gambelii* Woodland

Common species:

Pinus edulis
Populus angustifolia
Pseudotsuga menziesii
Acer (glabrum, negundo)
Amelanchier utahensis
Betula occidentalis
Cornus sericea
Ericameria nauseosa
Fraxinus anomala
Quercus gambelii
Rhus aromatica
Rosa woodsii
Salix (amygdaloides, exigua)
Shepherdia rotundifolia
Symphoricarpos oreophilus



Project Specifics:

Frequency = 110 total polygons
76 polygons in CARE, 34 in the environs
Total area = 200 ha / 493 acres (<1%)
147 ha / 363 acres CARE
53 ha / 130 ac environs
Average polygon size = 1.8 ha / 4.5 acres
Producer's accuracy = 54% ± 15%
User's accuracy = 100%

Interpretation:

This map class was mapped only where it was encountered by field crews. Douglas-fir canyon stands not verified by fieldwork are grouped into map class 23a, Douglas-fir Montane Woodland Complex. This map class appears as small to medium, linear or V-shaped polygons at the base of north facing cliffs or in the bottom of drainages. The color is generally dark, with large black dots representing mature canopy trees. Shadows may reveal the pointed profile of the tree crown. Smaller dark dots may represent a subcanopy layer of Douglas-fir or associated conifer species. Open stands often have a gray-green mottled appearance in between trees, representing the shrub layer. Adjacent polygons may be mapped as Pinyon – Juniper / Oak Woodland (16e).

Distribution/Ecology/Composition:

This map class occupies narrow slot canyons and north-facing slopes of sandstone canyons, generally between 6,000 – 7,000 feet elevation. It primarily occurs in the central portion of the mapping area. The Douglas-fir may form a dense canopy or be represented by a few trees extending high above a subcanopy of some combination of the above mentioned trees and tall shrubs. Stands tend to be small and isolated in the most mesic canyons or slopes. The unvegetated surface has a high litter cover, often with many boulders that have fallen from the cliffs above. It is primarily found in the Navajo, Wingate or Kayenta Formations.



Photo credit: NPS



Photo credit: NPS

27 Slickrock Fin Pocket (C-FINP)

Associations:

Slickrock Fin Pocket

Common species:

Pinus edulis
Pseudotsuga menziesii
Acer glabrum
Amelanchier utahensis
Cercocarpus intricatus
Ericameria nauseosa
Fraxinus anomala
Mahonia fremontii
Rhus aromatica
Shepherdia rotundifolia

Project Specifics (also mapped as points):

Frequency = 252 total polygons
222 polygons in CARE, 30 in the environs
Total area = 236 ha / 584 acres (<1%)
211 ha / 521 acres CARE
25 ha / 63 ac environs
Average polygon size = 0.9 ha / 2.3 acres
Not accuracy assessed



Interpretation:

This map class appears as small, linear or circular polygons among distinctive Kayenta Formation or Navajo Sandstone fin features. The color is generally dark green, with large black dots representing mature canopy trees. Shadows may reveal the pointed profile of the tree crown. Smaller dark dots may represent a subcanopy of Douglas-fir or other conifer species.

Distribution/Ecology/Composition:

This map class is a park special and occupies narrow slot canyons formed by sandstone fins in the Navajo Sandstone or Kayenta Formation. It primarily occurs in the central portion of the mapping area. Canopy closure is variable. Douglas-fir may form a dense canopy or be represented by a few trees extending high above a subcanopy of some combination of the above mentioned trees and tall shrubs. The stands tend to be small and isolated in these narrow but deep canyons. Soils are rapidly drained sandy loams. These areas often contain sensitive plant species.





Photo credit: NPS



Photo credit: NPS

33 Ponderosa Pine Woodland Complex (W-POPI)

Associations:

Pinus ponderosa / *Cercocarpus ledifolius* Woodland
Pinus ponderosa / *Artemisia nova* Woodland
Pinus ponderosa / *Artemisia tridentata* ssp. *vaseyana* Woodland
Pinus ponderosa / *Purshia tridentata* Woodland
Pinus ponderosa / Sparse Understory Woodland

Common species:

Juniperus scopulorum
Pinus (ponderosa, edulis)
Artemisia bigelovii
Artemisia tridentata (ssp. *vaseyana, nova*)
Cercocarpus ledifolius
Chrysothamnus viscidiflorus
Purshia tridentata
Symphoricarpos oreophilus
Tetradymia canescens
Bouteloua gracilis
Elymus elymoides
Poa fendleriana



Project Specifics:

Frequency = 207 total polygons
32 polygons in CARE, 175 in the environs
Total area = 693 ha / 1,712 acres (<1%)
92 ha / 227 acres CARE
601 ha / 1,485 ac environs
Average polygon size = 3.3 ha / 8.3 acres
Producer's accuracy = 90% ± 9%
User's accuracy = 97% ± 6%

Interpretation:

This map class occurs in regular or irregularly shaped, small to medium-sized polygons in the northwestern portion of the mapping area. Slopes are gentle to moderate. Stands have canopies that range from open to closed and occur on ridges, slopes and drainages. Individual ponderosa tree crowns appear as large black dots (shadows reveal elongated, rounded crowns). Some stands have a mossy green texture between the trees, which represents a significant shrub understory, typically dominated by sagebrush. Adjacent polygons may be mapped as Curl-leaf Mountain Mahogany Woodland Complex (12d), Black Sage – Bitterbrush / Muttongrass Shrubland (13e), or Pinyon – Juniper / Black Sage Woodland (15f). Sometimes stands are a mix of Douglas-fir and ponderosa pine, in which case they are mapped as Douglas-fir Montane Woodland Complex (23a).

Distribution/Ecology/Composition:

These ponderosa pine woodlands occur at the higher elevations of Miners Mountain and the northwestern portion of the mapping area. Canopies are generally open. There is often a subcanopy of pinyon pine and/or Rocky Mountain juniper. East of Billings Pass, this map class occurs as very open stands in a matrix of curl-leaf mountain mahogany. Ponderosa pine with a sparse understory of graminoids and brittle prickly pear occurs primarily in Paradise Flats. Some stands show evidence of repeated ground fires. The unvegetated surface has low to high cover of litter and often a moderate cover of large rocks or boulders. Downed wood is generally uncommon. Soil parent materials are Navajo sandstone or volcanic exposures that have eroded to boulders deposited as rockfall and colluvium.



Photo credit: NPS



Photo credit: NPS

33a Ponderosa Pine / Gambel Oak Woodland (W-PPQG)

Associations:

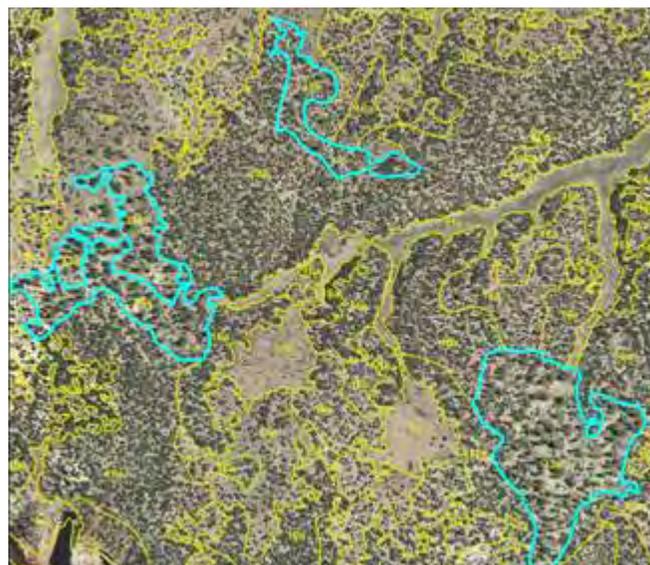
Pinus ponderosa / *Quercus gambelii* Woodland

Common species:

Pinus ponderosa
Artemisia tridentata ssp. *vaseyana*
Quercus gambelii
Poa fendleriana

Project Specifics:

Frequency = 22 total polygons
7 polygons in CARE, 15 in the environs
Total area = 41 ha / 100 acres (<<1%)
14 ha / 34 acres CARE
27 ha / 66 ac environs
Average polygon size = 1.8 ha / 4.6 acres
Producer's accuracy = 100%
User's accuracy = 83% ± 25%



Interpretation:

This map class occurs in regular or irregularly shaped, small to medium-sized polygons. Some stands have an open tree canopy with a dense understory of Gambel oak; their matrix color is usually dark green with a rough texture created by trees showing above the understory. Other stands have a light scattering of oak with bare light tan sand showing between the shrubs. Ponderosa tree crowns appear as large black dots (shadows reveal elongated, rounded crowns). Adjacent polygons may be mapped as Pinyon – Juniper / Gambel Oak Woodland (16c), Gambel Oak / Serviceberry Shrubland (13b) or Pinyon - Juniper / Mountain Mahogany Woodland (16a).

Distribution/Ecology/Composition:

This ponderosa pine woodland occurs on Dry Bench, south of Tantalus Flats, and the Onion Beds in the central portion of the mapping area. The canopy is generally open with an understory of Gambel oak and sagebrush. Some stands show evidence of ground fires. The unvegetated surface has high litter cover. Downed wood is uncommon. Parent materials are Kayenta sandstone that have eroded and been re-deposited as eolian or alluvial deposits, forming rapidly drained sandy loam soils.

Photo credit: NPS



35 Blue Spruce / Red-Osier Dogwood Woodland (W-BSRD)

Associations:

Picea pungens / *Cornus sericea* Woodland

Common species:

Picea pungens
Cornus sericea
Equisetum hyemale

Project Specifics:

Frequency = 3 total polygons
2 polygons in CARE, 1 in the environs
Total area = 7 ha / 18 acres (<<1%)
6.1 ha / 15.1 acres CARE
1.3 ha / 3.1 ac environs
Average polygon size = 2.5 ha / 6.1 acres
Not accuracy assessed

Interpretation:

This rare map class appears in small to medium shaped polygons. The color is generally dark green, with large, elongated, pointed black shadows indicating mature canopy trees. Closed stands appear mottled dark green. Adjacent polygons are often mapped as Douglas Fir Montane Woodland Complex (23a) or Ponderosa Pine / Greenleaf Manzanita Woodland (21).

Distribution/Ecology/Composition:

This map class occurs in the northwestern portion of the mapping area in upper Deep Creek. The forest canopy is typically moderate to closed. The upper polygon runs up a south facing slope where spruce generally dominates the canopy but Douglas-fir may be present in the subcanopy. The lower polygon is found in the drainage bottom in a dense mixture of spruce and dogwood.



No ground photo available

Sparsely Vegetated Badlands

1 Bentonite Badlands (S-BENT)

Associations:

Atriplex spp. Extreme Sparse Shrubland

Common species:

Atriplex corrugata

Atriplex spp. (annuals)

Eriogonum spp. (annuals)

Pleuraphis jamesii

Project Specifics:

Frequency = 169 total polygons

91 polygons in CARE, 78 in the environs

Total area = 1,285 ha / 3,176 acres (1%)

404 ha / 998 acres CARE

881 ha / 2,178 ac environs

Average polygon size = 7.6 ha / 18.8 acres

Not accuracy assessed

Interpretation:

This map class occurs in medium to large, regular polygons. It is restricted to heavy clay soils throughout the mapping area, generally on gentle slopes and lower benches. Because of the high reflectance of the geological substrate, and lack of vegetation (usually < 5%) the signature matches the geologic substrate. Polygons on the Blue Gate member of the Mancos Shale Formation are generally a smooth dark gray color, those on the Brushy Basin member of the Morrison Formation a variegated white to pink to deep red color. Adjacent polygons may be mapped as Shadscale Shrubland Complex (6), or Saltbush Badlands Complex (4).

Distribution/Ecology/Composition:

This type occurs on badland slopes and cones of the Brushy Basin member of the Morrison Formation and Blue Gate member of the Mancos Shale Formation. During high precipitation years, these areas may support numerous annuals, but during drought years they will be completely barren of vegetation. Perennial vegetative cover is generally less than 5%.



Photo credit: NPS



Photo credit: NPS

4 Saltbush Badlands Shrubland Complex (S-MATS)

Associations:

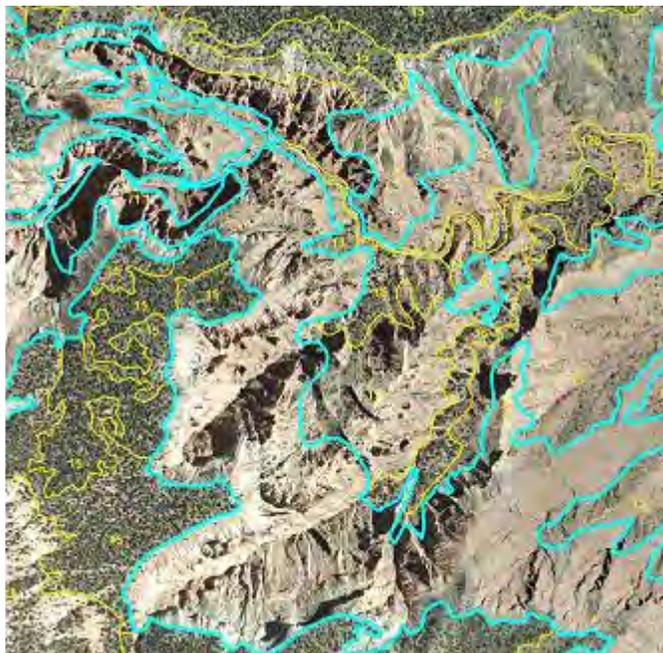
Atriplex corrugata Dwarf-shrubland
Atriplex gardneri / *Achnatherum hymenoides* Dwarf-shrubland
Atriplex gardneri / *Pleuraphis jamesii* Dwarf-shrubland
Atriplex gardneri / *Xylorhiza venusta* Dwarf-shrubland
Atriplex gardneri Dwarf-shrubland
Zuckia brandegeei Shrubland

Common species:

Atriplex (corrugata, gardneri)
Chrysothamnus viscidiflorus
Ephedra (viridis, torreyana)
Gutierrezia sarothrae
Sclerocactus parviflorus
Xylorhiza venusta
Zuckia brandegeei
Achnatherum hymenoides
Bromus tectorum
Pleuraphis jamesii

Project Specifics:

Frequency = 449 total polygons
306 polygons in CARE, 143 in the environs
Total area = 5,412 ha / 13,374 acres (4%)
3,642 ha / 8,998 acres CARE
1,771 ha / 4,376 ac environs
Average polygon size = 12.1 ha / 29.8 acres
Producer's accuracy = 69% ± 10%
User's accuracy = 74% ± 11%



Interpretation:

This map class occurs in medium to large, regular polygons. Because of the high reflectance of the geologic substrate, the minute texture provided by the shrubs is rarely visible. Polygons have generally the same smooth gray or yellowish gray signature as unvegetated shale. Adjacent polygons may include Mixed Desert Shrubland Complex (13), or Shadscale Shrubland Complex (6).

Distribution/Ecology/Composition:

This type occurs on slopes of badland soils derived from the Mancos, Morrison, Entrada, Chinle, and Moenkopi formations. It includes pure stands of Gardner saltbush, as well as mixed stands of Gardner saltbush and shadscale and/or mat saltbush. Polygons in North Blue Flats occasionally have barren areas interspersed between vegetated areas. The herbaceous layer consists of sparse tufts of bunchgrass or selenium-tolerant forbs. Total vegetative cover is generally less than 15%.

Atriplex corrugata Dwarf-shrublands occur mainly at the southern end of the mapping area or in the North Blue Flats, on gentle slopes and lower benches. The lower slopes of Mancos Shale support this community; however, the dark blue-gray Blue Gate member of the Mancos Shale is generally barren of vegetation



Photo credit: NPS



Photo credit: NPS



Photo credit: NPS



Photo credit: NPS

4a Crispleaf Buckwheat Badlands Sparse Vegetation (S-BUCK)

Associations:

Atriplex gardneri - *Eriogonum corymbosum* Dwarf Shrubland

Eriogonum corymbosum Badlands Sparse Vegetation

Common species:

Atriplex (gardneri, confertifolia)

Ephedra torreyana

Eriogonum corymbosum

Project Specifics:

Frequency = 21 total polygons

19 polygons in CARE, 2 in the environs

Total area = 200 ha / 493 acres (<1%)

193 ha / 477 acres CARE

7 ha / 16 ac environs

Average polygon size = 9.5 ha / 23.5 acres

Producer's accuracy = 82% ± 14%

User's accuracy = 78% ± 14%



Interpretation:

This map class occurs in medium sized, irregular polygons. Since the vegetation is sparse, the signature is that of the Moenkopi Formation, a deep red color with white to gray streaks through it. The gray color is alkali deposits that have risen to the soil surface. Adjacent polygons tend to be mapped as Mixed Desert Shrubland Complex (13) or Shadscale Shrubland Complex (6).

Distribution/Ecology/Composition:

This type was designed to map the badlands that occur on the Moenkopi Formation near Fruita. The association consists of nearly pure stands of crispleaf buckwheat, with few other species.



Photo credit: NPS



Photo credit: NPS

5 Gypsum Badlands Sparse Vegetation (S-GYPS)

Associations:

Ephedra torreyana – (*Atriplex* spp.) / Non-vascular Gypsum Sparse Vegetation

Common species:

Artemisia bigelovii
Atriplex confertifolia
Chrysothamnus viscidiflorus
Ephedra torreyana
Ericameria nauseosa
Eriogonum corymbosum
Achnatherum hymenoides
Pleuraphis jamesii

Project Specifics:

Frequency = 214 total polygons
168 polygons in CARE, 46 in the environs
Total area = 4,788 ha / 11,830 acres (3%)
4,288 ha / 10,595 acres CARE
500 ha / 1,235 ac environs
Average polygon size = 22.4 ha / 55.3 acres
Producer's accuracy = 77% ± 8%
User's accuracy = 83% ± 8%



Interpretation:

This map class occurs in medium to large polygons. Because the vegetation is so sparse, the signature is the color of the underlying Carmel Formation or a medium gray color due to the nearly solid coverage of biological soil crusts. Adjacent polygons tend to be mapped as Mixed Desert Shrubland Complex (13) or Shadscale Shrubland Complex (6).

Distribution/Ecology/Composition:

This association is found on the gypsiferous member of the Carmel Formation throughout the park at middle elevations. Species composition is highly variable in this community type, which is defined more by its consistently low plant cover (5-25%) and its occurrence on highly gypsiferous soils than by a list of species of high constancy.



Photo credit: NPS



Photo credit: NPS

Upland Shrublands

9 Sand Sagebrush Shrubland Complex (S-ARFI)

Associations:

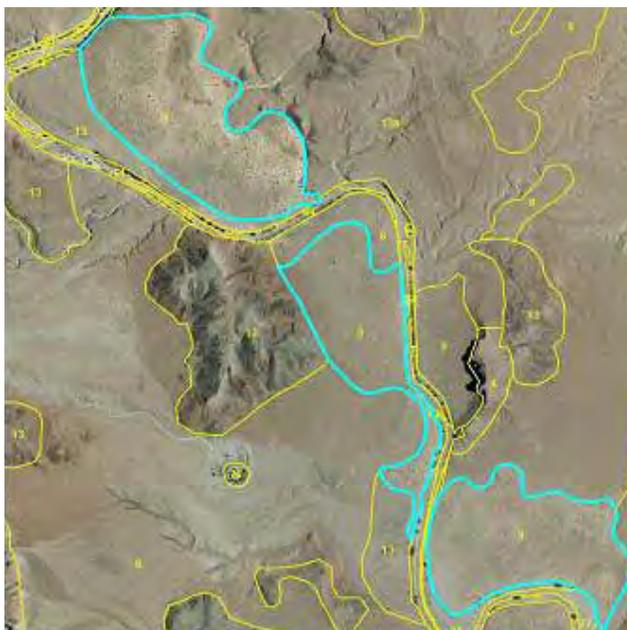
Artemisia filifolia Colorado Plateau Shrubland
Coleogyne ramosissima - *Artemisia filifolia* Shrubland
Eriogonum leptocladon / *Muhlenbergia pungens* Shrubland
Poliomintha incana - *Artemisia filifolia* – *Vanclevea stylosa* Shrubland

Common species:

Artemisia filifolia
Atriplex canescens
Coleogyne ramosissimum
Ephedra viridis
Ericameria nauseosa
Eriogonum leptocladon
Poliomintha incana
Vanclevea stylosa
Achnatherum hymenoides
Hesperostipa comata
Muhlenbergia pungens

Project Specifics:

Frequency = 62 total polygons
60 polygons in CARE, 2 in the environs
Total area = 408 ha / 1,008 acres (<1%)
401 ha / 991 acres CARE
7 ha / 17 ac environs
Average polygon size = 6.6 ha / 16.3 acres
Producer's accuracy = 69% ± 15%
User's accuracy = 72% ± 15%



Interpretation:

This map class occurs in small to medium, elongated to regular polygons on upper floodplain terraces above major drainages. The signature changes with the soil color from light tan to reddish depending on the geologic substrate. Polygons often appear as low rounded sand dunes with irregularly shaped small brownish dots or “donuts” for the open shrub canopy. Occasionally the space between the “donuts” is grayish due to an understory of grasses and forbs. Adjacent polygons tend to be mapped as Pinyon – Juniper Grassland complexes (14-), Blackbrush Shrubland Complex (10) or Desert Wash Shrubland Mosaic (11, 11a, 11c).

Distribution/Ecology/Composition:

This map class occurs on middle and upper terraces of major drainages primarily in the broader valleys of the southern portion of the mapping area and the South Desert. It is found in deep sandy soils, often derived from Quaternary sand dunes but also from fine-grained sandstones such as the Entrada Formation. The shrub canopy is generally open, and herbaceous elements occupy the spaces between shrubs. The surface may be unstable, blowing sands (usually in *Poliomintha incana* - *Artemisia filifolia* – *Vanclevea stylosa* Shrubland stands), or well protected by biological soil crusts (usually in *Coleogyne ramosissima* - *Artemisia filifolia* Shrubland stands), or in an intermediate stage. These communities are dynamic, with successional processes evident over relatively short spans of time as the soils stabilize or blow out.



Photo credit: NPS



Photo credit: NPS

6 Shadscale Shrubland Complex (S-ATCO)

Associations:

Atriplex confertifolia - *Krascheninnikovia lanata* Shrubland
Atriplex confertifolia / *Achnatherum hymenoides* Shrubland
Atriplex confertifolia / *Pleuraphis jamesii* Shrubland
Atriplex confertifolia Great Basin Shrubland
Atriplex gardneri / *Pleuraphis jamesii* Shrubland

Common species:

Atriplex (*confertifolia*, *gardneri*)
Chrysothamnus viscidiflorus
Ephedra torreyana
Eriogonum spp.
Krascheninnikovia lanata
Xylorhiza venusta
Achnatherum hymenoides
Pleuraphis jamesii

Project Specifics:

Frequency = 635 total polygons
417 polygons in CARE, 218 in the environs
Total area = 8,849 ha / 21,866 acres (6%)
6,051 ha / 14,951 acres CARE
2,798 ha / 6,915 acres environs
Average polygon size = 13.9 ha / 34.4 ac
Producer's accuracy = 69% ± 12%
User's accuracy = 60% ± 12%



Interpretation:

Most polygons of this map class are small to medium in size, regularly shaped, and occur primarily on eroding slopes of Entrada, Moenkopi, Chinle, or Morrison formations. There is no distinctive signature for these occurrences; the dominant formation color is slightly dulled by the presence of vegetation, although close inspection will reveal tiny specks of the shrubs. Using known sites of this map class in an area, subsequent polygons were delineated by recognizing similar slopes and aspects. There tend to be few if any Torrey Mormon-tea shrubs, which are usually quite visible in a signature. Adjacent map classes include the Mixed Desert Shrubland Complex (13), which is characterized by dots of Torrey Mormon-tea and other shrubs, Saltbush Badlands Complex (4,) or Pinyon-Juniper / Xeric Shrubs Woodland Complex (15).

Distribution/Ecology/Composition:

This type occurs on dry, eroding slopes of Morrison, Entrada, Chinle or Moenkopi formations throughout the mapping area. Within this sparse community, shadscale, Torrey Mormon-tea, winterfat, Gardner saltbush and occasionally mat saltbush may be present, all with low cover. Soil chemistry, poor water-holding capacity and erosion maintain these stands in a sparsely vegetated state.



Photo credit: NPS



Photo credit: NPS

12c Black Sagebrush / Muttongrass Shrubland (S-ARPO)

Associations:

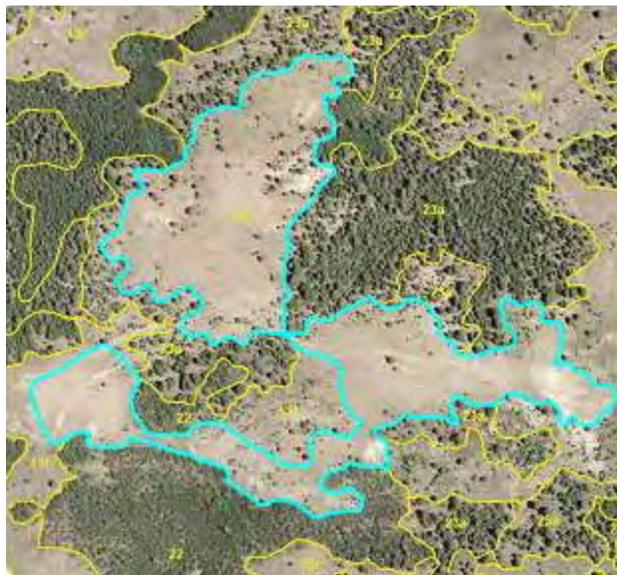
Artemisia nova / Poa fendleriana Shrubland

Common species:

Artemisia (nova, tridentata ssp. vaseyana)
Tetradymia canescens
Bouteloua gracilis
Elymus elymoides
Koeleria macrantha
Poa fendleriana

Project Specifics:

Frequency = 29 total polygons
0 polygons in CARE, 29 in the environs
Total area = 52 ha / 129 acres (<<1%)
0 ha / 0 acres CARE
52 ha / 129 ac environs
Average polygon size = 1.8 ha / 4.5 acres
Not accuracy assessed



Interpretation:

This association occurs in small to medium, irregularly shaped polygons on upper slopes and ridgelines with thin soils. The signature is a light gray-green, because of the sparse vegetation and the exposure of residual soils derived from gray-colored rocks. Magnification reveals the evenly-spaced tiny gray dots of black sagebrush shrubs. The signature is distinct from adjacent polygons of Fringed Sagebrush – Lichens Rocky Mesa Herbaceous Vegetation (12a), which is a smoother, brighter light gray color. Other adjacent polygons include Mountain Sagebrush – Snowberry Shrubland Complex (13f), or Aspen Forest (22). This association may blend with Black Sage - Bitterbrush / Muttongrass Shrubland (13e); however, the bitterbrush tends to be visible in the signature and generally occurs at lower elevations.

Distribution/Ecology/Composition:

This map class occurs primarily on windswept slopes with thin or rocky soils between aspen forests and ponderosa pine woodlands in the northwestern corner of the mapping area. Black sagebrush is often the only shrub, but sometimes Wyoming or mountain big sagebrush is a minor component. The understory is diverse but may be sparse.



Photo credit: NPS



Photo credit: NPS

10 Blackbrush Shrubland Complex (S-BLAC)

Associations:

Coleogyne ramosissima / *Pleuraphis jamesii* Shrubland
Coleogyne ramosissima Shrubland

Common species:

Coleogyne ramosissima
Ephedra (*viridis*, *torreyana*)
Achnatherum hymenoides
Bromus tectorum
Pleuraphis jamesii
Vulpia octoflora

Project Specifics:

Frequency = 270 total polygons
125 polygons in CARE, 145 in the environs
Total area = 2,611 ha / 6,453 acres (2%)
1,002 ha / 2,476 acres CARE
1,609 ha / 3,977 ac environs
Average polygon size = 9.7 ha / 23.9 acres
Producer's accuracy = 93% ± 9%
User's accuracy = 86% ± 10%

Interpretation:

This map class is found in the southern portion of mapping area. Polygons are generally medium to large on terraces or benches. The signature is of regularly spaced brown-gray speckled dots generally in a reddish tan matrix. Where this map class blends into Green Mormon-tea / *Galleta* Shrubland Complex (13x), a few gray-green “donut” dots of the Mormon-tea are visible.

Distribution/Ecology/Composition:

This unit is limited to low elevations in the area south of Bitter Creek Divide. It occurs on either shallow, rocky soils developing over sandstone substrates in the Morrison and Dakota Formations or in deep, sandy soils of the Carmel, Navajo and Kayenta Formations. It is a stable community type, often with well-developed biological soil crusts. Green Mormon-tea is often a major component of this complex near Hall Mesa.



Photo credit: NPS



Photo credit: NPS

10a Tucker Oak Shrubland (S-QUHA)

Associations:

Quercus havardii var. *tuckeri* Shrubland

Common species:

Quercus havardii var. *tuckeri*

Coleogyne ramosissima

Ephedra viridis

Gutierrezia sarothrae

Shepherdia rotundifolia

Achnatherum hymenoides

Muhlenbergia pungens

Pleuraphis jamesii

Project Specifics:

Frequency = 15 total polygons

13 polygons in CARE, 2 in the environs

Total area = 36 ha / 90 acres (<<1%)

34 ha / 84 acres CARE

2 ha / 6 ac environs

Average polygon size = 2.4 ha / 6.0 acres

Producer's accuracy = 50% ± 34%

User's accuracy = 100%



Interpretation:

Polygons of this map class are small in size and tend to follow a ridgeline that has collected sand to form a small dune. The photo signature is similar to the Sand Sage Shrubland Complex (9), with the addition of dark gray-green to deep green, irregular, rough-textured dots of Tucker oak. Blackbrush may be a strong component of the community, but if Tucker oak is dominant or co-dominant, then map class 10a is correct. Adjacent polygons include Blackbrush Shrubland Complex (10), or Mixed Desert Shrubland Complex (13). One polygon of this unit was mapped from plot data collected on Hall Mesa at Burt Spring. It has a different photo signature of dark green closely spaced blotches for the dense Tucker oak and other shrubs.

Distribution/Ecology/Composition:

This uncommon shrubland occurs primarily south of the Post in the Hall's Creek drainage on ridgeline sand dunes. However, one area where a plot was sampled on Hall Mesa was classified to this association, even though it is found growing in cracks and among boulders in the Dakota Formation. The shrub species composition of these two different habitats is slightly different. The site on Hall Mesa has single-leaf ash, cliffrose, skunkbush, Fremont barberry, and Anderson wolfberry.



Photo credit: NPS



Photo credit: NPS

11 Desert Wash Shrubland Mosaic (S-WASH)

Associations (not assigned to other map classes in the 11- series):

Atriplex canescens / *Bouteloua gracilis* Shrubland
Atriplex canescens / *Pleuraphis jamesii* Shrubland
Atriplex canescens / *Sporobolus airoides* Shrubland
Atriplex canescens Desert Wash Shrubland
Atriplex canescens Shrubland
Ericameria nauseosa / *Bromus tectorum* Semi-natural Shrubland
Ericameria nauseosa / *Sporobolus airoides* Shrubland
Ericameria nauseosa Desert Wash Shrubland
Ericameria nauseosa Sand Deposit Sparse Shrubland
Krascheninnikovia lanata – *Pleuraphis jamesii* Dwarf-shrubland
Krascheninnikovia lanata Dwarf-shrubland
Sarcobatus vermiculatus - *Atriplex canescens* Shrubland
Sarcobatus vermiculatus / *Artemisia tridentata* Shrubland

Common species:

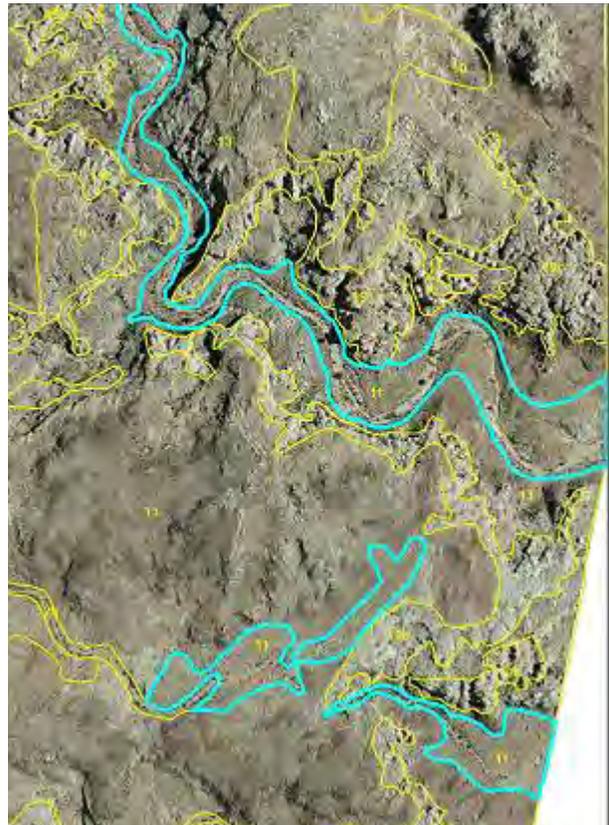
Artemisa bigelovii
Atriplex (*confertifolia*, *canescens*)
Ephedra viridis
Ericameria nauseosa
Gutierrezia sarothrae
Sarcobatus vermiculatus
Achnatherum hymenoides
Bouteloua gracilis
Bromus tectorum
Distichlis spicata
Elymus elymoides
Pleuraphis jamesii
Sporobolus airoides

Project Specifics:

Frequency = 413 total polygons
235 polygons in CARE, 178 in the environs
Total area = 1,175 ha / 2,903 acres (1%)
714 ha / 1,765 acres CARE
461 ha / 1138 ac environs
Average polygon size = 2.8 ha / 7.0 acres
Producer's accuracy = 77% ± 8%
User's accuracy = 86% ± 8%

Interpretation:

This map class occurs in small to large, linear to elongated polygons. It is found on middle and upper terraces of major drainages with a developed floodplain. It is a mosaic of many associations as they shift and blend from one to the other along the length of the polygon. The signature changes with the soil color from light tan to brown or gray, with a speckled matrix representing the open canopy of shrubs. In areas with rubber rabbitbrush, the individual shrubs appear a brighter green under magnification. In areas with basin big sagebrush, the individual shrubs appear a dark gray green under magnification. In areas along the Notom-Bullfrog Road, the color shifts to tan with a yellow tint supplied by cheatgrass. This map class generally occurs in a complex with black greasewood and big sagebrush shrublands (11a, 11c). Adjacent polygons may also be mapped as Shadscale Shrubland Complex (6). This map class looks very similar to map class 11, but polygons lack the bright green dots of rabbitbrush.



Distribution/Ecology/Composition:

This mosaic of associations occupies large patches on middle and upper terraces of the major drainages throughout the lower and middle elevation ranges of the mapping area. It also occurs in disturbed areas such as along roads and eroded wash channels. Some of these areas have saline alluvium that tends to favor black greasewood, while areas with a deeper water table support sagebrush and rabbitbrush. There may be an alkaline crust on the soil surface. These sites rarely flood. They tend to be found on deep alluvial deposits along ephemeral streams and washes, often in broad valleys. Canopies are open to moderately closed and dominated by four-wing saltbush, rubber rabbitbrush or black greasewood and often are a mixture of these species. Stands may merge with the Grassland Complex (8) in some areas, with a broad ecotone in which the shrubs become gradually less abundant and the grasses more abundant. These shrub-herbaceous associations can contain a large component of graminoid species.



Photo credit: NPS



Photo credit: NPS



Photo credit: NPS



Photo credit: NPS

11a Black Greasewood Shrubland Complex (S-BLGR)

Associations:

Atriplex confertifolia - *Sarcobatus vermiculatus* Shrubland
Bromus tectorum Semi-natural Herbaceous Vegetation
Sarcobatus vermiculatus / *Distichlis spicata* Shrubland
Sarcobatus vermiculatus Disturbed Shrubland
Sarcobatus vermiculatus / *Atriplex confertifolia* – (*Picrothamnus desertorum*, *Suaeda moquinii*) Shrubland
Sarcobatus vermiculatus / *Sporobolus airoides* Shrubland

Common species:

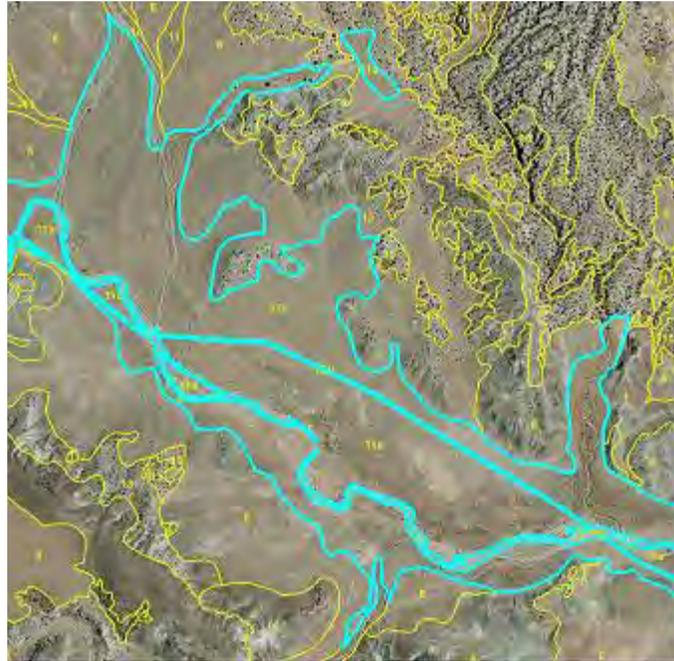
Atriplex confertifolia
Ericameria nauseosa
Sarcobatus vermiculatus
Suaeda moquinii
Sporobolus airoides
Distichlis spicata

Project Specifics:

Frequency = 284 total polygons
214 polygons in CARE, 70 in the environs
Total area = 2,107 ha / 5,207 acres (1.5%)
1,545 ha / 3,818 acres CARE
562 ha / 1,390 ac environs
Average polygon size = 7.4 ha / 18.3 acres
Producer's accuracy = 74% ± 13%
User's accuracy = 81% ± 12%

Interpretation:

This map class occurs in small or medium, linear or elongated polygons on upper floodplain terraces along the major drainages. The signature changes with the soil color from light tan to brown or gray, with a speckled matrix for the open canopy of shrubs. Along the Notom-Bullfrog Road, the color shifts to tan with a yellow tint supplied by cheatgrass. This map class often occurs in a complex with fourwing saltbush, and rubber rabbitbrush shrublands and big sagebrush map classes (11, 11c).



Distribution/Ecology/Composition:

This map class occupies large patches on middle and upper terraces of the major drainages throughout the lower and middle elevation ranges of the mapping area. These associations occur in areas that may flood but where a clay pan elevates both the salinity and the water table in the soil. Hartnet Draw has a good example of this complex. The canopy is open to moderately closed and dominated by black greasewood, sometimes with a significant component of rubber rabbitbrush or fourwing saltbush. The elevated salinity of the soil is indicated by a white crust on the soil surface, and there is usually very little herbaceous understory, although saltgrass or alkali sacaton may be present with low cover.



Photo credit: NPS



Photo credit: NPS



Photo credit: NPS



Photo credit: NPS

11c Big Sagebrush Shrubland Complex (S-ARTR)

Associations:

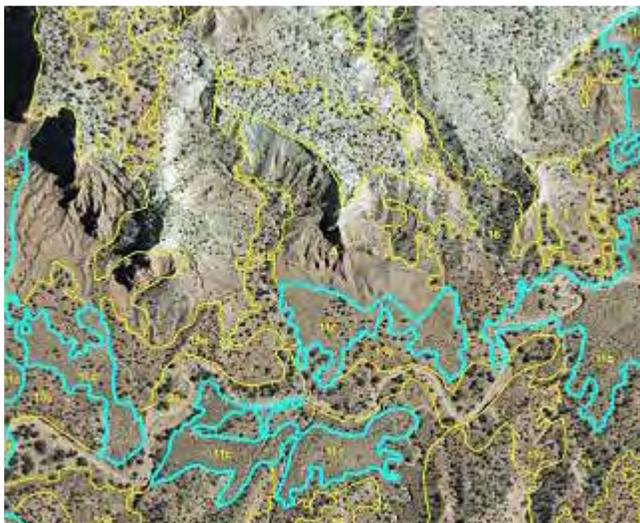
Artemisia tridentata - (*Ericameria nauseosa*) / *Bromus tectorum* Semi-natural Shrubland
Artemisia tridentata / *Achnatherum hymenoides* Shrubland
Artemisia tridentata Shrubland
Artemisia tridentata ssp. *tridentata* / *Pleuraphis jamesii* Shrubland
Artemisia tridentata ssp. *tridentata* / *Sporobolus airoides* Shrubland
Artemisia tridentata ssp. *wyomingensis* / (*Agropyron cristatum*, *Psathyrostachys juncea*) Seeded Grasses Semi-natural Shrubland
Artemisia tridentata ssp. *wyomingensis* / Disturbed Understory Semi-natural Shrubland
Artemisia tridentata ssp. *wyomingensis* / *Leymus salinus* Shrubland
Artemisia tridentata ssp. *wyomingensis* / Sparse Understory Shrubland

Common species:

Artemisia tridentata (ssp. *tridentata*, ssp. *wyomingensis*)
Achnatherum hymenoides
Bouteloua gracilis
Leymus salinus
Pleuraphis jamesii
Psathyrostachys juncea
Sporobolus airoides

Project Specifics:

Frequency = 345 total polygons
160 polygons in CARE, 185 in the environs
Total area = 2,025 ha / 5,005 acres (1.5%)
696 ha / 1,719 acres CARE
1,330 ha / 3,286 ac environs
Average polygon size = 5.9 ha / 14.5 acres
Producer's accuracy = 69% ± 15%
User's accuracy = 95% ± 9%



Interpretation:

This type occurs in small to medium linear to elongated polygons on upper floodplain terraces along the major drainages. Dense stands appear as a solid, rough-textured dark gray, but lack the speckles and patches of green that characterize Black Greasewood Shrubland Complex (11a). Open stands have dark gray speckles in a light gray matrix, similar to open map class 11a, but close inspection reveals that the shrubs are grayer. The yellow tint of cheatgrass is absent. All of these sagebrush types may occur in a mosaic on the larger floodplains with Black Greasewood, Four-wing Saltbush or Rubber Rabbitbrush shrublands (11, 11a).

Distribution/Ecology/Composition:

This map class occurs on upper terraces along the Fremont River and other major drainages in the mapping area. It also occurs on the broad floodplains and valley floors around Sandy Ranch and the Onion Beds. Soils are a fine textured alluvium, but the white surface deposits indicating a high, fluctuating water table are usually absent. Mature stands indicate a long interval since fire last burned the area. Basin big sagebrush may be mixed with Wyoming big sagebrush, but the former is clearly dominant. The understory may be sparse, or blue grama, Indian ricegrass or galleta are present. These latter stands represent high quality, undisturbed examples of this community type. Cheatgrass, if present, is a minor component of the understory.



Photo credit: NPS



Photo credit: NPS

12a Fringed Sagebrush – Lichens Rocky Mesa Herbaceous Vegetation (H-ROME)

Associations:

Artemisia frigida – (*Bouteloua gracilis* – *Achnatherum hymenoides* - *Poa secunda*) – Lichens Rocky Mesa Dwarf-shrubland

Common species:

Artemisia (frigida, nova)
Chrysothamnus viscidiflorus
Tetradymia canescens
Achnatherum hymenoides
Bouteloua gracilis
Elymus (elymoides, lanceolatus)
Festuca ovina
Poa fendleriana

Project Specifics:

Frequency = 9 total polygons
0 polygons in CARE, 9 in the environs
Total area = 24 ha / 59 acres (<<1%)
0 ha / 0 acres CARE
24 ha / 59 ac environs
Average polygon size = 2.7 ha / 6.6 acres
Not accuracy assessed



Interpretation:

This association occurs in small to medium, regularly shaped polygons on upper slopes and ridges with thin soils. The signature is a smooth, light gray-green, because of the sparse vegetation and the exposure of residual soils derived from light gray-colored rocks. The signature is distinct from nearby polygons of Black Sagebrush / Muttongrass Shrubland (12c) that are darker gray green in color with tiny dots for the black sagebrush. Adjacent polygons include Mountain Sagebrush – Snowberry Shrubland Complex (13f), or Aspen Forest (22).

Distribution/Ecology/Composition:

This map class occurs primarily on windswept slopes with thin soils or rocky basaltic substrates within aspen forests and ponderosa pine woodlands in the northwestern corner of the mapping area. Slopes range from fairly level to moderately steep. Fringed sagebrush is clearly the dominant shrub, although black sagebrush and viscid rabbitbrush may be present. The understory is diverse but is often sparse. Crustose and fruticose ground lichens cover most of the ground surface.



Photo credit: NPS



Photo credit: NPS

12b Mesic Canyon Bottom Shrubland Complex (S-MESI)

Associations:

Atriplex canescens Desert Wash Shrubland
Ericameria nauseosa Desert Wash Shrubland
Fallugia paradoxa Desert Wash Shrubland
Fraxinus anomala Woodland
Mesic Canyon Bottom Shrubland Complex

Common species:

Juniperus osteosperma
Pinus edulis
Pseudotsuga menziesii
Amelanchier utahensis
Cercocarpus intricatus
Chrysothamnus viscidiflorus
Ephedra viridis
Ericameria nauseosa
Fallugia paradoxa
Fraxinus anomala
Gutierrezia sarothrae
Mahonia fremontii
Purshia stansburiana
Quercus gambelii
Rhus trilobata
Shepherdia rotundifolia
Symphoricarpos longiflorus
Achnatherum hymenoides
Bromus tectorum

Project Specifics:

Frequency = 165 total polygons
145 polygons in CARE, 20 in the environs
Total area = 321 ha / 793 acres (<1%)
697 ha / 1,719 acres CARE
26 ha / 65 ac environs
Average polygon size = 1.9 ha / 4.8 acres
Producer's accuracy = 80% ± 12%
User's accuracy = 75% ± 13%

Interpretation:

This map class occurs in small to medium, linear to elongated polygons. It is restricted to canyon and drainage bottoms throughout the mapping area. The signature is one of large dark green dots irregularly scattered along drainages usually with much open tan color between the dots. There are occasional pinyons or junipers with less than 8% cover; these show up as large, very dark green dots. Polygons in the southern portion of the mapping area tend to have denser vegetation, so the signature appears a bit darker in color. They are often located in steep canyons in the Waterpocket Fold.

Distribution/Ecology/Composition:

This mapping unit is found in the intermittent washes in narrow canyons and ravines throughout the mapping area. These associations are highly variable in species composition and the dominant shrubs will vary from one canyon to the next. Some areas are very diverse with many species, and others contain only a few species, but all represent the more mesic regime in these ephemeral washes. No single species is a consistent dominant because of small variations in exposure, slope, soil depth, chemistry, and rockiness.

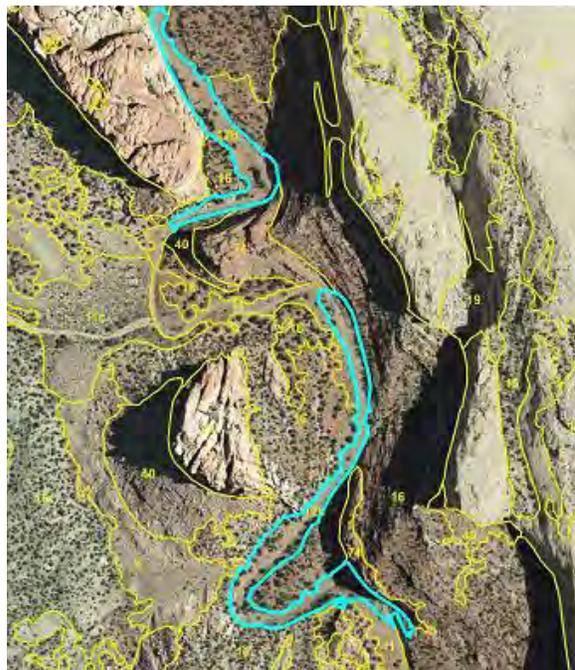




Photo credit: NPS



Photo credit: NPS



Photo credit: NPS

13 Mixed Desert Shrubland Complex (S-MXDD)

Associations (not assigned to other map classes in the 13- series):

Artemisia bigelovii Shrubland

Ephedra torreyana – *Artemisia bigelovii* Sparse Vegetation

Common species:

Artemisia bigelovii

Atriplex confertifolia

Chrysothamnus viscidiflorus

Ephedra (*torreyana*, *viridis*)

Ericameria nauseosa

Eriogonum corymbosum

Eriogonum leptocladon

Gutierrezia sarothrae

Shepherdia rotundifolia

Achnatherum hymenoides

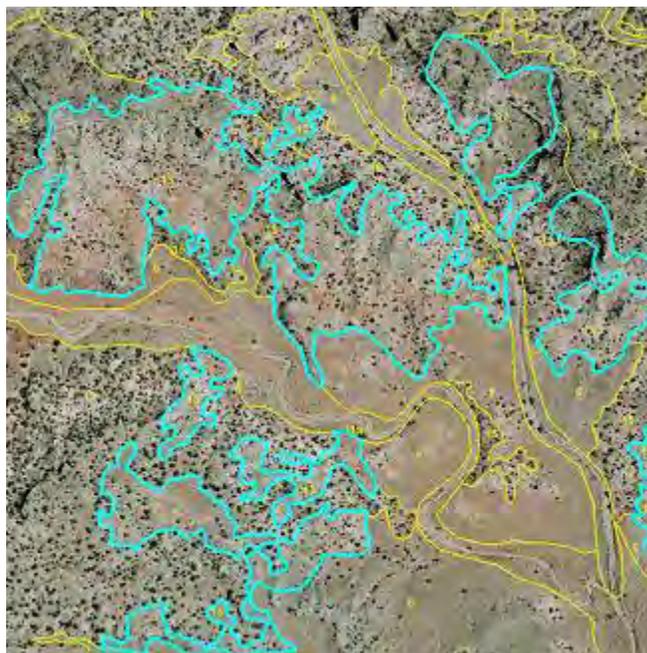
Aristida purpurea

Bouteloua gracilis

Hesperostipa comata

Muhlenbergia pungens

Pleuraphis jamesii



Project Specifics:

Frequency = 1129 total polygons

759 polygons in CARE, 370 in the environs

Total area = 13,507 ha / 33,376 acres (9%)

9,941 ha / 24,565 acres CARE

3,566 ha / 8,811 ac environs

Average polygon size = 12.0 ha / 29.6 acres

Producer's accuracy = 82% ± 9%

User's accuracy = 86% ± 8%

Interpretation:

This map class is an umbrella type meant to cover mixed desert shrublands when it could not be determined that polygons were specifically 13a (Torrey Mormon Tea Shrubland Complex), 13h (Torrey Mormon Tea / Blue Grama – Galleta Shrubland), 13x (Torrey Mormon Tea / Galleta - Cheatgrass Shrubland), or 13y (Green Mormon Tea / Indian Ricegrass – Needle-and-Thread Shrubland). Some polygons are one of the more specific types and may also include undifferentiated mixed desert shrublands dominated by either species of *Ephedra*. Most polygons of this map class are medium to large in size, and regularly shaped. There is no distinctive signature for these occurrences; the signature matrix varies depending on the underlying soils and geologic formations. This color is slightly dulled by the vegetation, and close inspection will reveal tiny specks of the shrubs. Pinyon and juniper cover, visible as larger dark green rounded dots, may be as high as 8%. This unit differs from Shadscale Shrubland Complex (6) because it has dark tiny scattered dots of Torrey Mormon-tea and other shrubs. Adjacent polygons include Shadscale Shrubland Complex (6) or Pinyon-Juniper / Xeric Shrubs Woodland Complex (15).

Distribution/Ecology/Composition:

This type occurs primarily on eroding slopes of Summerville, Entrada, Curtis, Chinle, Moenkopi, Carmel, Salt Wash (Morrison), and Emery formations throughout the mapping area. These areas tend to be covered with a fine alluvial gravel coating and are generally characterized by shallow, coarse-textured soils developing over unfractured sandstone bedrock or a hardpan. Areas supporting this unit are drier than areas of map class 15 (Pinyon - Juniper / Xeric Shrubs Woodland Complex), although the two groups of associations appear very similar and overlap

almost completely in geological substrate and elevation. This map class may have up to 8% tree cover, whereas map class 15 has usually higher tree cover. This unit is found on a wide variety of moderately xeric sites over a broad range of elevations. Shrub species diversity in this unit is highly variable. It is one of the most variable map classes in terms of species composition of any in the mapping area.



Photo credit: NPS



Photo credit: NPS



Photo credit: NPS



Photo credit: NPS

13a Torrey Mormon Tea Shrubland Complex (S-EPTO)

Associations:

Ephedra torreyana / *Achnatherum hymenoides* – *Pleuraphis jamesii* Shrubland
Ephedra torreyana Sparse Vegetation
Eriogonum leptocladon Sparse Vegetation

Common species:

Atriplex confertifolia
Ephedra torreyana
Ericameria nauseosa
Eriogonum leptocladon
Gutierrezia sarothrae
Achnatherum hymenoides
Pleuraphis jamesii

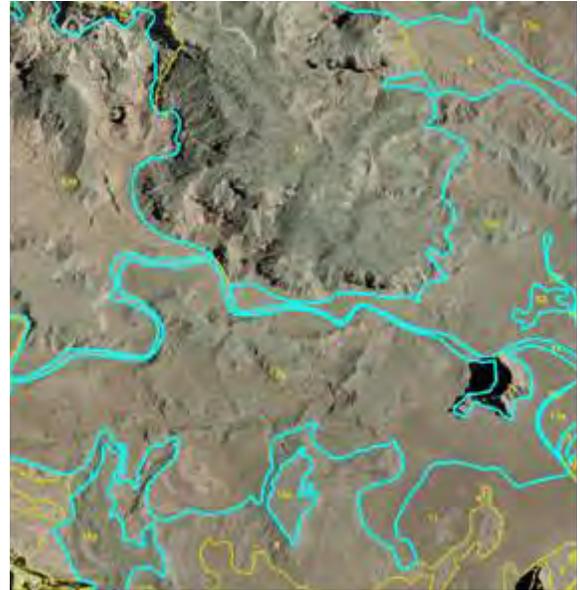
Project Specifics:

Frequency = 143 total polygons
67 polygons in CARE, 76 in the environs
Total area = 6,631 ha / 15,643 acres (4%)
2,496 ha / 6,167 acres CARE
3,835 ha / 9,476 ac environs
Average polygon size = 44.3 ha / 109.4 acres
Producer's accuracy = 70% ± 14%
User's accuracy = 78% ± 13%



Interpretation:

Most polygons of this map class are medium to large in size and regularly shaped. There is no distinctive signature for these occurrences; the signature matrix varies from red to gray depending on the underlying soils and geologic formations. This color is slightly dulled by the vegetation, and close inspection reveals tiny specks of the shrubs. This unit differs from Shadscale Shrubland Complex (6) by having numerous tiny dark scattered dots of Torrey Mormon-tea, and/or Bigelow sage. Adjacent map classes include map class 6, Mixed Desert Shrubland Complex (13), or Pinyon-Juniper / Xeric Shrubs Woodland Complex (15).



Distribution/Ecology/Composition:

This type occurs throughout the mapping area, primarily on eroding slopes of Summerville, Entrada, Curtis, and Carmel formations. These areas may be covered with fine alluvial gravel and are generally characterized by deep, fine-textured soils. Areas supporting this unit are drier than those supporting the Pinyon - Juniper / Xeric Shrub Woodlands Complex (15), although the two groups of associations can appear very similar and overlap almost completely in geological substrate and elevation. This unit is found on a wide variety of moderately xeric sites over a broad range of elevations. The dominant shrub tends to be Torrey Mormon-tea, with crispleaf buckwheat often sub-dominant. There are two phases of this unit; one on the deeper sandy soils that support an understory of native bunchgrasses, and another phase that occurs on the heavier clay soils that typically has little to no understory of grasses.



Photo credit: NPS



Photo credit: NPS

13b Gambel Oak / Serviceberry Shrubland (S-GOSB)

Associations:

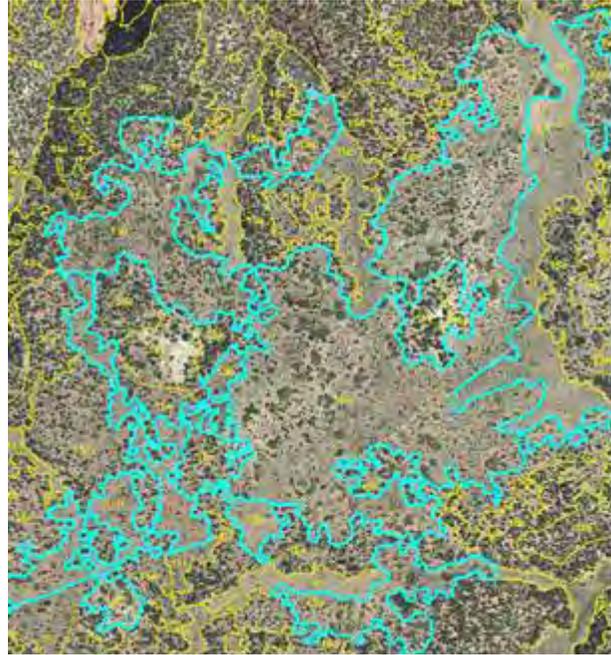
Quercus gambelii / *Amelanchier utahensis* Shrubland

Common species:

Amelanchier utahensis
Artemisia tridentata (ssp. *tridentata*, *wyomingensis*,
vaseyana)
Ephedra viridis
Purshia tridentata
Quercus gambelii
Achnatherum hymenoides
Bouteloua gracilis
Hesperostipa comata
Poa fendleriana

Project Specifics:

Frequency = 38 total polygons
15 polygons in CARE, 23 in the environs
Total area = 169 ha / 417 acres (<1%)
67 ha / 166 acres CARE
102 ha / 251 ac environs
Average polygon size = 4.4 ha / 10.9 acres
Producer's accuracy = 64% ± 17%
User's accuracy = 100%



Interpretation:

This type occurs in medium-sized, regular polygons on level areas of Dry Bench. This map class was used for both burned and unburned areas of basin big sagebrush with Gambel oak and serviceberry. The burned areas are lighter in appearance, typically without the gray green color of sagebrush and fewer irregular green splotches of oak. The unburned areas contain an irregular scattering of the green oak splotches with a denser gray green signature of sagebrush between the oaks. Adjacent polygons include Mixed Grasslands Complex (8) and Pinyon – Juniper / Mountain Mahogany Woodland (16a).

Distribution/Ecology/Composition:

This map class occurs on Dry Bench along the central western edge of the mapping area, primarily on deeper, fine-textured alluvial soils. The understory may be sparse or may include blue grama, Indian ricegrass or galleta. These latter stands represent high quality, undisturbed examples of this association. Many areas have mountain big sagebrush or Wyoming big sagebrush, with Gambel oak irregularly scattered throughout the sage and only a few Utah serviceberry along the margins of the trees or rock outcroppings. There are also pockets in the sagebrush openings that are codominated by Gambel oak and Utah serviceberry; however, the majority of the unburned openings on Dry Bench are dominated by oak and sagebrush. The herbaceous layer is diverse in terms of species composition but typically provides less than 10% cover.



Photo credit: NPS



Photo credit: NPS

13d Wyoming Sagebrush / Blue Grama Shrubland (S-WYSA)

Associations:

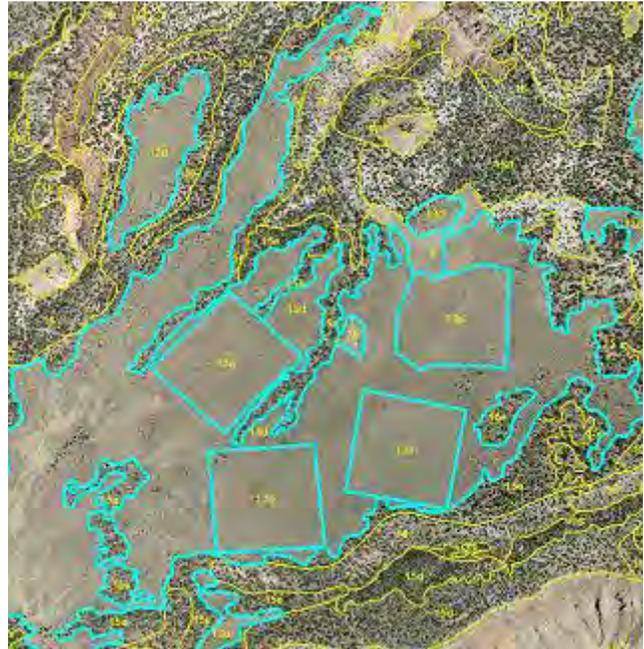
Artemisia tridentata (ssp. *vaseyana*, ssp. *wyomingensis*) - *Amelanchier utahensis* Shrubland
Artemisia tridentata ssp. *wyomingensis* / *Bouteloua gracilis* Shrubland

Common species:

Amelanchier utahensis
Artemisia tridentata ssp. *wyomingensis*
Bouteloua gracilis
Elymus elymoides
Pleuraphis jamesii

Project Specifics:

Frequency = 22 total polygons
14 polygons in CARE, 8 in the environs
Total area = 164 ha / 406 acres (<1%)
96 ha / 236 acres CARE
68 ha / 170 ac environs
Average polygon size = 7.5 ha / 18.5 acres
Producer's accuracy = 100%
User's accuracy = 92% ± 9%



Interpretation:

This association occurs in medium to large, regularly shaped polygons on benches and flats. The signature is a light gray-green color with evenly spaced dots of sagebrush. Adjacent polygons may be mapped as Pinyon – Juniper / Sagebrush Woodland Complex (15e).

Distribution/Ecology/Composition:

This map class occurs primarily on Jones Bench in the northern portion of the mapping area. This area was treated by various methods to remove sagebrush, so there are old roads and straight lines visible in the signature. Wyoming big sagebrush is often the only shrub, but the understory varies depending on grazing pressure and disturbance history.



Photo credit: NPS



Photo credit: NPS

13e Black Sagebrush – Bitterbrush / Muttongrass Shrubland (S-BSCU)

Associations:

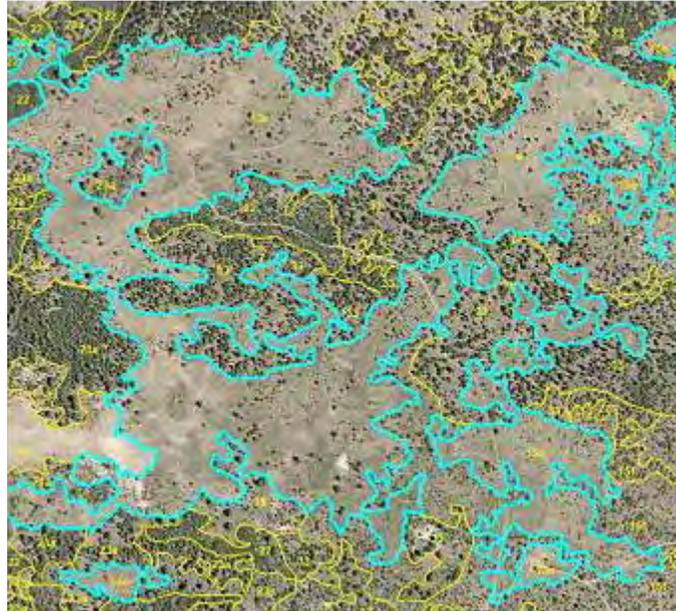
Artemisia nova - *Purshia tridentata* Shrubland / *Poa fendleriana* Shrubland

Common species:

Artemisia (nova, frigida)
Chrysothamnus viscidiflorus
Purshia tridentata
Symphoricarpos oreophilus
Tetradymia canescens
Carex rossii
Elymus (elymoides, lanceolatus)
Poa fendleriana

Project Specifics:

Frequency = 38 total polygons
2 polygons in CARE, 36 in the environs
Total area = 152 ha / 376 acres (<1%)
3 ha / 8 acres CARE
149 ha / 368 ac environs
Average polygon size = 4.0 ha / 9.9 acres
Producer's accuracy = 100%
User's accuracy = 100%



Interpretation:

This map class occurs in small to medium, regular to irregular polygons on upper slopes and ridgelines with thin soils. The signature is irregularly mottled gray-green patches of bitterbrush with smooth tan-gray spaces in between. Tree cover may be up to 8% in these stands. Magnification reveals the evenly spaced tiny gray dots of black sagebrush shrubs. Adjacent polygons include Fringed Sagebrush – Lichens Rocky Mesa Herbaceous Vegetation (12a) and Pinyon – Juniper / Black Sagebrush Woodland (15f).

Distribution/Ecology/Composition:

This map class occurs on the windswept slopes and thin or rocky conglomerate soils at high elevations in the northwestern portion of the mapping area. Slopes range from level to moderate. Black sagebrush and bitterbrush are often the only shrubs, but sometimes mountain big sagebrush is a minor component. Tree cover may be up to 8%. The understory is diverse but may be sparse.



Photo credit: NPS



Photo credit: NPS

13f Mountain Sagebrush – Snowberry Shrubland Complex (S-MSSN)

Associations:

Artemisia tridentata ssp. *vaseyana* / *Poa fendleriana*
Shrubland
Symphoricarpos oreophilus Shrubland

Common species:

Artemisia tridentata (ssp. *vaseyana*, *nova*)
Chrysothamnus viscidiflorus
Purshia tridentata
Symphoricarpos oreophilus
Tetradymia canescens
Bouteloua gracilis
Carex stenophylla
Elymus elymoides
Koeleria macrantha
Poa fendleriana

Project Specifics:

Frequency = 25 total polygons
0 polygons in CARE, 25 in the environs
Total area = 74 ha / 182 acres (<<1%)
0 ha / 0 acres CARE
74 ha / 182 ac environs
Average polygon size = 2.9 ha / 7.3 acres
Not accuracy assessed



Interpretation:

This map class occurs in small to medium polygons in the northwestern portion of the mapping area. Most examples are on gentle to moderate slopes. The matrix color is similar to Black Sagebrush - Bitterbrush Shrubland (13e), but this unit has a more uniform, smooth gray green appearance. Adjacent polygons generally include Black Sagebrush - Bitterbrush Shrubland (13e), Pinyon-Juniper / Black Sagebrush Woodland (15f), or Aspen Forest (22).

Distribution/Ecology/Composition:

This map class only occurs in the upper elevations of the northern portion of the mapping area. It occupies windswept ridges and basins with gentle to moderately steep slopes. Black sagebrush and snowberry generally grow intermixed in a dense shrub canopy. The herbaceous understory is diverse and generally has high cover.



Photo credit: NPS



Photo credit: NPS

13h Torrey Mormon Tea / Blue Grama – Galleta Shrubland (S-ETGG)

Associations:

Ephedra torreyana - *Atriplex confertifolia* / *Hesperostipa comata* - *Pleuraphis jamesii* - *Bouteloua gracilis* Shrub Herbaceous Vegetation

Ephedra torreyana / *Bouteloua gracilis* – *Pleuraphis jamesii* Shrubland

Ephedra torreyana / *Hesperostipa comata* - *Pleuraphis jamesii* - *Bouteloua gracilis* Shrub Herbaceous Vegetation

Common species:

Atriplex confertifolia

Echinocereus triglochidiatus

Ephedra torreyana

Gutierrezia sarothrae

Opuntia polyacantha

Yucca harrimaniae

Bouteloua gracilis

Pleuraphis jamesii

Project Specifics:

Frequency = 3 total polygons

3 polygons in CARE, 0 in the environs

Total area = 82.5 ha / 203.8 acres (<<1%)

82.5 ha / 203.8 acres CARE

0 ha / 0 ac environs

Average polygon size = 27.5 ha / 67.9 acres

Producer's accuracy = 75% ± 16%

User's accuracy = 100%



Interpretation:

Polygons of this rare map class are small to medium in size. It has only been documented from Johnson Mesa and similar sites near Fruita. The signature matrix varies somewhat from whitish to gray depending on the underlying soils, although most of Johnson Mesa is covered with black volcanic boulders and gravel giving the signature a dark gray appearance. This color is slightly dulled by the presence of vegetation and close inspection reveals tiny specks of the Mormon-tea. The overall general appearance is smooth in texture. Adjacent map classes include Black Grama – Galleta Grassland (8b), or Pinyon-Juniper / Xeric Shrubs Woodland Complex (15).

Distribution/Ecology/Composition:

This type occurs primarily on Johnson Mesa near Fruita. The mesa is the remnant of a massive landslide that deposited black volcanic boulders and a coating of gravel across the entire surface. Torrey Mormon-tea is clearly the dominant shrub, although shadscale and prickly pear are common. Needle-and-thread may be common to co-dominant in some stands, especially near the margins of the mesa where the volcanic boulder coating is thinner.



Photo credit: NPS

13x Green Mormon Tea / Galleta – Cheatgrass Shrubland Complex (S-EVGC)

Associations:

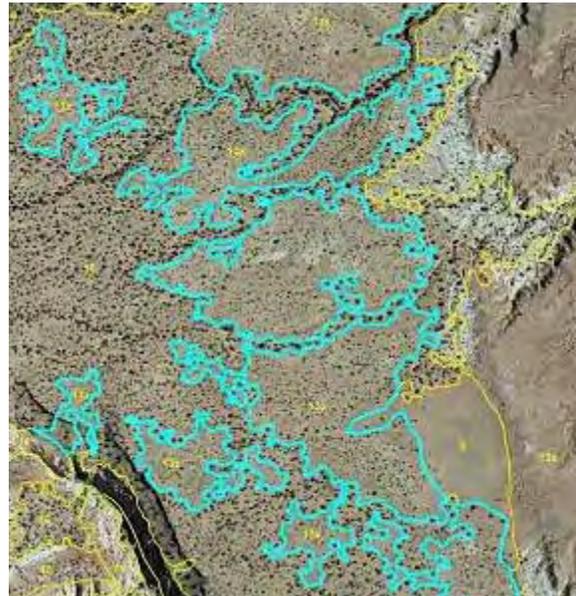
Ephedra viridis / *Bromus tectorum* Semi-Natural Shrubland
Ephedra viridis / *Pleuraphis jamesii* Shrubland

Common species:

Ephedra viridis
Gutierrezia sarothrae
Opuntia polyacantha
Bromus tectorum
Pleuraphis jamesii

Project Specifics:

Frequency = 106 total polygons
23 polygons in CARE, 83 in the environs
Total area = 939 ha / 2,321 acres (1%)
17 ha / 43 acres CARE
922 ha / 2,278 ac environs
Average polygon size = 8.9 ha / 21.9 acres
Producer's accuracy = 100%
User's accuracy = 100%



Interpretation:

This map class is found in the central and southern portions of the mapping area in medium to large, regular polygons. The matrix signature varies from tan to gray depending on the underlying soils. It has a smooth to moderately textured background with small dark green specks for the Mormon-tea and other shrubs. Polygons on Hall Mesa tend to have “donut” shaped clumps of Mormon-tea where they have grown into clones. Polygons around Oak Creek and along the Waterpocket Fold south of Jailhouse Rock have a more yellow tan base color and dark specks for the Mormon-tea, but these shrubs have not formed clones, so they do not have the “donut” appearance. Adjacent polygons may be mapped as Blackbrush Shrubland Complex (10) or Pinyon-Juniper / Mesic Shrubs Woodland Complex (16).



Distribution/Ecology/Composition:

This map class is found on Hall Mesa and the slopes draining away from the Waterpocket Fold around Oak Creek and Jailhouse Rock. Green Mormon-tea is clearly the dominant shrub, although prickly pear is common. Some of the areas on Hall Mesa have been heavily grazed for decades and the understory between shrubs now consists of cheatgrass. Areas less disturbed by grazing still have good cover of galleta. The green Mormon-tea on Hall Mesa has also been impacted by grazing and usually grows in a low sprawling shape, while the shrubs in others areas have the tall, irregular shape typical of green Mormon-tea. This type tends to occur on finer-textured soils than does Green Mormon Tea / Indian Ricegrass – Needle and Thread Grass Shrubland (13y).



Photo credit: NPS



Photo credit: NPS

13y Green Mormon-Tea / Indian Ricegrass – Needle-and-Thread Shrubland (S-EVRN)

Associations:

Ephedra viridis / (*Achnatherum hymenoides* – *Hesperostipa comata*) Shrubland

Common species:

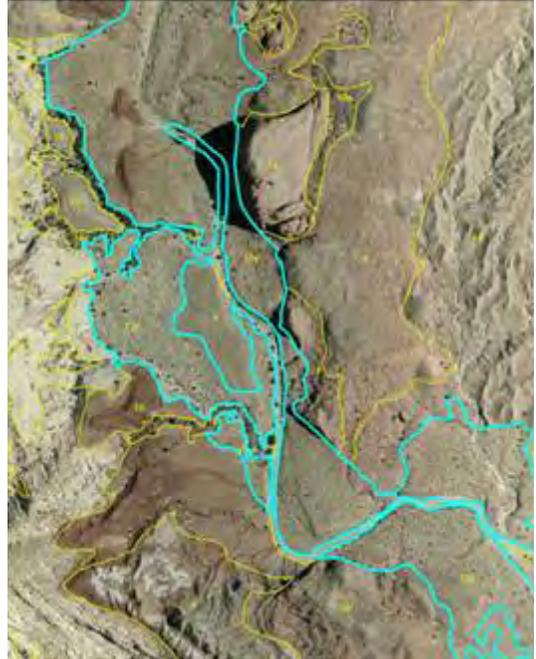
Atriplex canescens
Ephedra viridis
Opuntia polyacantha
Achnatherum hymenoides
Hesperostipa comata
Salsola tragus

Project Specifics:

Frequency = 24 total polygons
12 polygons in CARE, 12 in the environs
Total area = 219 ha / 542 acres (<1%)
146 ha / 361 acres CARE
73 ha / 181 ac environs
Average polygon size = 9.1 ha / 22.6 acres
Producer's accuracy = 73% ± 15%
User's accuracy = 84% ± 14%

Interpretation:

This map class is found in the southern part of the mapping area in medium to large polygons. The matrix signature varies from tan to grayish depending on the underlying soils. It typically has a smooth to moderately textured background with small medium green specks for the Mormon-tea and other shrubs. Polygons in Hall's Creek drainage tend to have "donut" shaped clumps of Mormon-tea where they have grown into clones. These also appear on sandier soils. Polygons around Tarantula Mesa area have a more gray base color with dark specks for the Mormon-tea, but these shrubs haven't formed clones, so do not have the "donut" appearance.



Distribution/Ecology/Composition:

This map class is found on Tarantula Mesa, near Sandy Ranch, and in lower Hall's Creek (north of the Narrows). Green Mormon-tea is clearly the dominant shrub, although prickly pear and Russian thistle are common. In Hall's Creek it is found on sandy alluvial soils on terraces above the drainage. On Tarantula Mesa it is found in swales of deep soils between Pinyon-Juniper / Mesic Shrubs Woodland Complex (16).



Photo credit: NPS



Photo credit: NPS

13z Rubber Rabbitbrush / Blue Grama Shrub Herbaceous Vegetation (S-RURA)

Associations:

Ericameria nauseosa / *Bouteloua gracilis* Shrub Herbaceous Vegetation

Common species:

Ericameria nauseosa
Gutierrezia sarothrae
Opuntia polyacantha
Achnatherum hymenoides
Bouteloua gracilis
Muhlenbergia pungens

Project Specifics:

Frequency = 7 total polygons
3 polygons in CARE, 4 in the environs
Total area = 193 ha / 478 acres (<1%)
68 ha / 167 acres CARE
126 ha / 311 ac environs
Average polygon size = 27.6 ha / 68.3 acres
Producer's accuracy = 90% ± 11%
User's accuracy = 90% ± 11%

Interpretation:

This map class occurs in regularly shaped polygons located in the northern end of the mapping area. The signature is predominantly a smooth gray green, but close inspection reveals scattered green specks of rabbitbrush. It looks similar to Wyoming Sagebrush / Blue Grama Shrubland (13d) but the green rabbitbrush specks are brighter than sagebrush specks.



Distribution/Ecology/Composition:

This type occurs on sandy upper floodplain terraces or in broad sandy washes. The rabbitbrush canopy is generally open, with a high cover of blue grama interspersed between the shrubs. Slopes are usually gentle, and the substrate is usually a deep eolian or alluvial sand.



Photo credit: NPS



Photo credit: NPS

41 Greenleaf Manzanita Shrubland (S-MANZ)

Associations:

Arctostaphylos patula Shrubland

Common species:

Amelanchier utahensis

Arctostaphylos patula

Project Specifics:

Frequency = 2 total polygons

2 polygons in CARE, 0 in the environs

Total area = 18 ha / 44 acres (<<1%)

18 ha / 44 acres CARE

0 ha / 0 ac environs

Average polygon size = 8.9 ha / 22.0 acres

Not accuracy assessed



Interpretation:

This rare map class is restricted to ridge tops. The two mapped polygons are small to medium in size and regular in shape. The signature is distinctive - the shrubs form tight, dense clones and appear as solid medium green polygons with a slightly rough texture and distinct edges. Adjacent polygons include Pinyon – Juniper / Greenleaf Oak and Manzanita Woodland (16e) and Pinyon – Juniper / Mountain Mahogany Woodland (16a).

Distribution/Ecology/Composition:

This park special is limited to the ridge tops near VABM Bitter in the southwestern portion of the mapping area. The community consists of dense, thigh-high mats of greenleaf manzanita with few other species except possibly green Mormon-tea. Manzanita shrubs are long-lived, clonal, and resprout freely following fire, so these communities should persist over time. This area was not sampled during the field work phases of the mapping project, so detailed ecological and composition information is not available.

No ground photo available

18c Spiny Hopsage Shrubland (S-GRSP)

Associations:

Grayia spinosa Shrubland

Common species:

Grayia spinosa
Purshia stansburiana
Achnatherum hymenoides
Bromus tectorum
Hesperostipa comata

Project Specifics:

Frequency = 2 total polygons
1 polygons in CARE, 1 in the environs
Total area = 3 ha / 7.7 acres (<<1%)
3 ha / 7.5 acres CARE
0.1 ha / 0.25 ac environs
Average polygon size = 1.5 ha / 3.8 acres
Not accuracy assessed

Interpretation:

This rare map class has only been found in one canyon in the southern portion of the mapping area. The one polygon is medium in size and irregularly shaped. The signature is similar to Big Sagebrush Shrubland Complex (11c), but is more even in texture and slightly greener. Adjacent polygons are mapped as Pinyon - Juniper / Mesic Shrubs Woodland Complex (16), and Pinyon - Juniper / Mixed Grass Woodland Complex (14).

Distribution/Ecology/Composition:

This type has only been found in one location in a protected bowl of sandstone near the top of the Waterpocket Fold. It consists of a stand of nearly pure spiny hopsage, with a few cliffrose shrubs in a small drainage running through the center of the stand. The understory includes a dense layer of native bunch grasses.

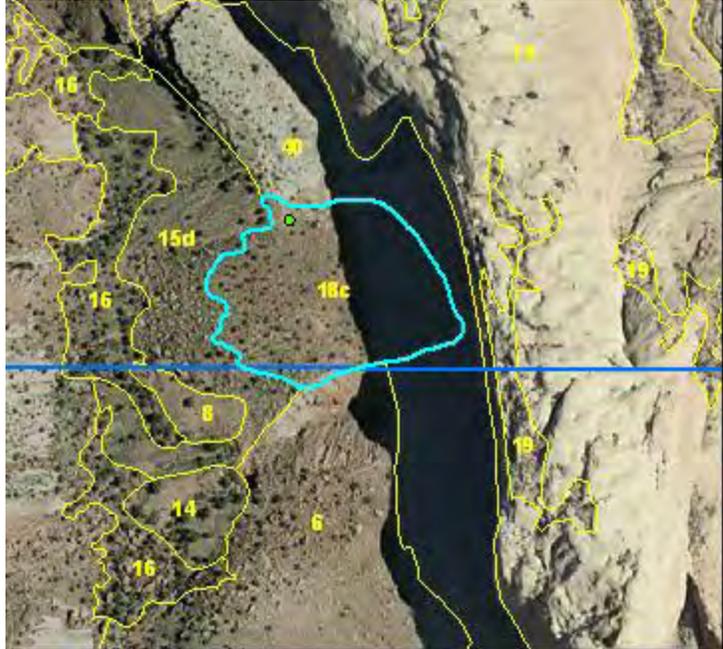


Photo credit: NPS



Photo credit: NPS

19 Little-leaf Mountain Mahogany Slickrock Sparse Vegetation (S-LLMM)

Associations:

Cercocarpus intricatus Slickrock Sparse Vegetation

Juniperus osteosperma / *Cercocarpus intricatus* Woodland

Pinus edulis – *Juniperus osteosperma* / *Cercocarpus intricatus* Woodland

Common species:

Juniperus osteosperma

Pinus edulis

Amelanchier utahensis

Cercocarpus intricatus

Fraxinus anomala

Rhus trilobata

Project Specifics:

Frequency = 1,577 total polygons

1,330 polygons in CARE, 247 in the environs

Total area = 10,765 ha / 26,600 acres (7%)

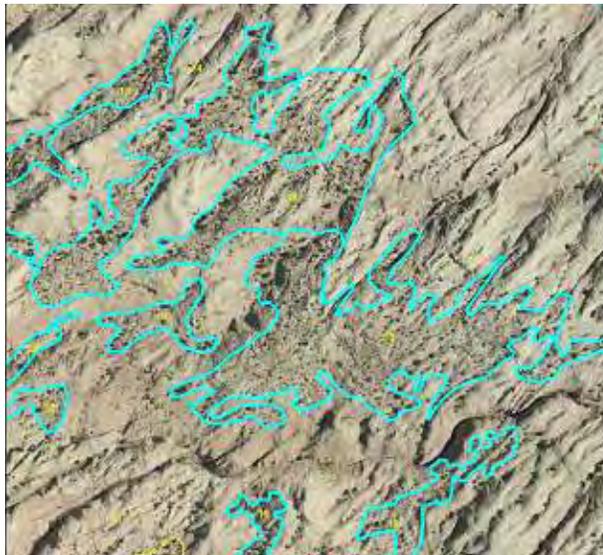
10,264 ha / 25,362 acres CARE

501 ha / 1,238 ac environs

Average polygon size = 6.8 ha / 16.9 acres

Producer's accuracy = 83% ± 14%

User's accuracy = 94% ± 10%



Interpretation:

This map class occurs in small to large, irregularly shaped polygons. Most are inclusions within larger polygons of unvegetated Navajo or Wingate sandstone (74) or Pinyon-Juniper / Mesic Shrubs Woodland Complex (16). Shrubs appear as tiny irregular black specks on a mostly white or red background. A few larger black dots (representing trees) are evident; in some polygons these may be enough to consider the community a sparse woodland.

Distribution/Ecology/Composition:

This type occurs in small to large areas on exposures of Navajo or Wingate sandstones where crevices are large enough to support the growth of shrubs, and some pinyon and juniper. Elevation is not as important as the availability of the proper substrate. Cover is open to sparse. Littleleaf mountain mahogany is clearly dominant, although other shrubs such as skunkbush, Utah serviceberry and Mormon-tea are often present. Pinyon and juniper occur in some polygons as a sparse woodland.



Photo credit: NPS



Photo credit: NPS

19c Pinyon - Juniper / Blackbrush – Cliffrose – Tucker Oak Wooded Shrubland (W-PJBC)

Associations:

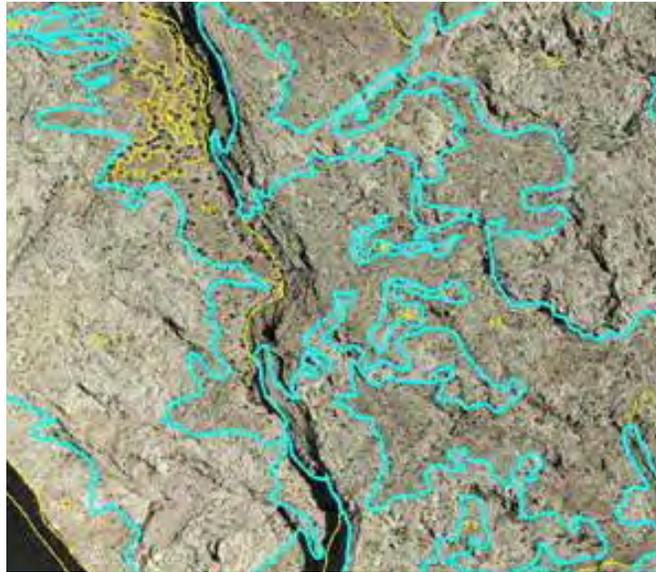
Juniperus osteosperma – (*Pinus edulis*) / *Coleogyne ramosissima* – *Purshia stansburiana* – *Quercus havardii* var. *tuckeri* Wooded Shrubland

Common species:

Amelanchier utahensis
Coleogyne ramosissima
Ephedra torreyana
Fraxinus anomala
Purshia stansburiana
Quercus havardii var. *tuckeri*
Rhus trilobata

Project Specifics:

Frequency = 127 total polygons
18 polygons in CARE, 109 in the environs
Total area = 450 ha / 1,112 acres (<1%)
33 ha / 81 acres CARE
417 ha / 1,031 ac environs
Average polygon size = 3.5 ha / 8.8 acres
Producer's accuracy = 100%
User's accuracy = 71% ± 29%



Interpretation:

This map class occurs as small to medium sized, irregularly shaped polygons. All polygons are on fractured Salt Wash sandstone of the Morrison Formation with vegetation growing in the cracks and crevices. Shrubs appear as tiny dark green specks scattered irregularly on a white to light gray background of sandstone. A few larger black dots (representing pinyon and/or juniper) are evident, but this association is mainly a wooded shrubland.

Distribution/Ecology/Composition:

This type occurs on exposed Salt Wash sandstones in the Morrison Formation where crevices are only large enough to support the growth of shrubs and a few trees. All locations are in the southern end of the mapping area at lower elevations. Cover is open to sparse. The dominant shrubs vary from one outcrop to the next. Some areas are very diverse with many species and others contain only a few species, but stands will have some combination of at least two out of three of the shrubs named in this association.



Photo credit: NPS



Photo credit: NPS

19d Blackbrush – Cliffrose – Tucker Oak Shrubland (S-BCTO)

Associations:

Coleogyne ramosissima – *Purshia stansburiana* – *Quercus havardii* var. *tuckeri* Shrubland

Common species:

Coleogyne ramosissima
Ephedra torreyana
Gutierrezia sarothrae
Purshia stansburiana
Quercus havardii var. *tuckeri*
Achnatherum hymenoides
Rumex hymenosepalus

Project Specifics:

Frequency = 6 total polygons
0 polygons in CARE, 6 in the environs
Total area = 19 ha / 46 acres (<<1%)
0 ha / 0 acres CARE
19 ha / 46 ac environs
Average polygon size = 3.1 ha / 7.7 acres
Not accuracy assessed



Interpretation:

This map class occurs in small to medium, irregularly shaped polygons. All polygons are on deep eolian sands that lie on fractured Salt Wash sandstone of the Morrison Formation. Shrubs appear as tiny dark green specks scattered irregularly against the bright sand signature. Larger black dots (representing pinyon and/or juniper) are rare.

Distribution/Ecology/Composition:

This rare type occurs on sand sheets in the southern end of the mapping area (mainly outside the park) at lower elevations. Cover is generally open, with a variable amount of herbaceous cover in the understory. Sand loving species (such as *Rumex hymenosepalus*, Indian ricegrass, and the mot form of Torrey Mormon-tea) are usually present. Associated shrubs may be diverse, but should always include at least two of the three species in the map class and association name.



Photo credit: NPS



Photo credit: NPS

40 Talus Mixed Shrubland Complex (S-TALM)

Associations:

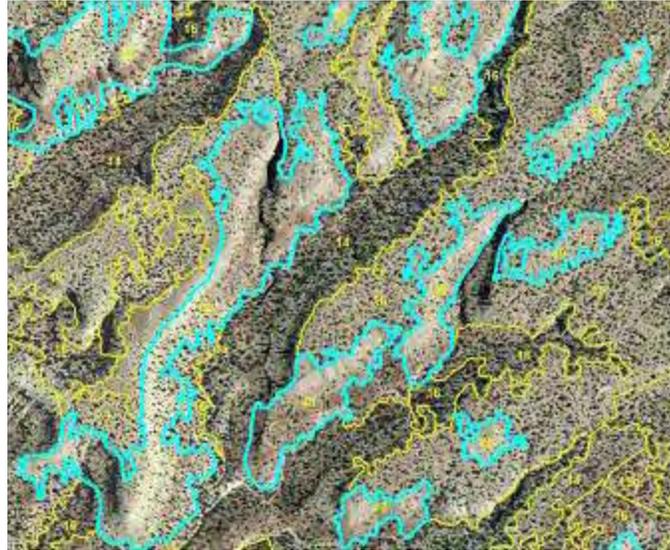
Amelanchier utahensis Shrubland
Atriplex canescens – *Ephedra viridis* Talus Shrubland
Chrysothamnus viscidiflorus Talus Shrubland
Juniperus osteosperma / *Shepherdia rotundifolia* Woodland
Pinus edulis – *Juniperus osteosperma* / *Ephedra viridis* Woodland

Common species:

Juniperus osteosperma
Amelanchier utahensis
Artemisia bigelovii
Atriplex canescens
Chrysothamnus viscidiflorus
Ephedra viridis
Ericameria nauseosa
Fraxinus anomala
Mahonia fremontii
Shepherdia rotundifolia

Project Specifics:

Frequency = 490 total polygons
372 polygons in CARE, 118 in the environs
Total area = 3,169 ha / 7,832 acres (2%)
2,754 ha / 6,804 acres CARE
416 ha / 1,028 ac environs
Average polygon size = 6.5 ha / 16.0 acres
Producer's accuracy = 90% ± 16%
User's accuracy = 53% ± 20%



Interpretation:

This map class consists of medium to large, regular to elongated polygons on moderate to steep talus slopes throughout the mapping area. The signature varies depending on shrub canopy cover. Some stands are a mix of several tall shrub species; these have a speckled appearance. Other areas are quite sparse, and the dominant signature is the color of the underlying geology. Scattered juniper trees appear as larger dark dots.

Distribution/Ecology/Composition:

These shrublands and wooded shrublands primarily occupy steep, south-and west- facing talus slopes below cliffs of Kayenta or Wingate sandstone. Stands are highly variable in species composition but have either no trees or very low cover of trees. Juniper has less than 8% cover in denser stands, in sparse stands it has less than half the cover of shrubs, so stands cannot be classified as woodlands. The dominant shrubs vary from one area to the next; some areas are very diverse with many species (including rubber rabbitbrush, Utah serviceberry, single-leaf ash, viscid rabbitbrush, Fremont barberry, roundleaf buffaloberry, fourwing saltbush, and Bigelow sagebrush); others contain only a few species. This map class was designed to encompass these non-wooded or sparsely-treed mixed shrublands on talus slopes until more data are available.



Photo credit: NPS



Photo credit: NPS

Upland Herbaceous Communities

8 Mixed Grasslands Complex (H-GRAS)

Associations:

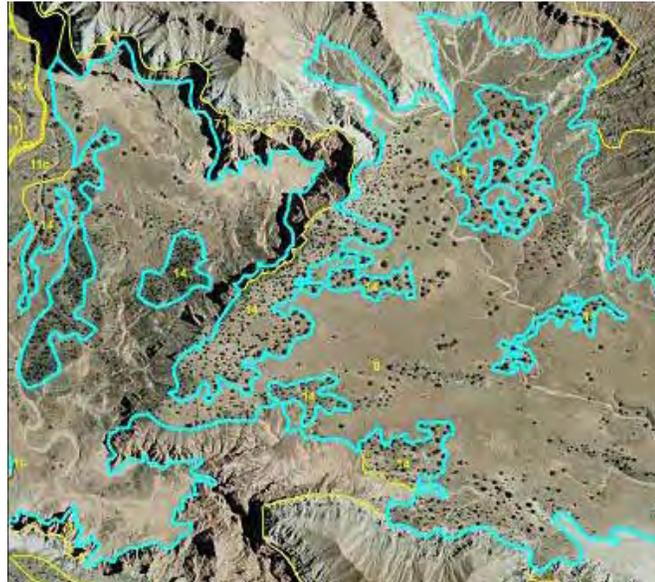
Achnatherum hymenoides Colorado Plateau Herbaceous Vegetation
Achnatherum hymenoides Shrub Herbaceous Alliance
Bouteloua gracilis - *Hesperostipa comata* Herbaceous Vegetation
Bouteloua gracilis - *Pleuraphis jamesii* Herbaceous Vegetation
Hesperostipa comata Great Basin Herbaceous Vegetation
Muhlenbergia pungens Herbaceous Vegetation
Pleuraphis jamesii - *Sporobolus airoides* Herbaceous Vegetation
Pleuraphis jamesii Herbaceous Vegetation
Sporobolus airoides Southern Plains Herbaceous Vegetation
Sporobolus flexuosus Herbaceous Alliance

Common species:

Achnatherum hymenoides
Hesperostipa comata
Muhlenbergia pungens
Pleuraphis jamesii
Sporobolus (flexuosus, airoides)

Project Specifics:

Frequency = 783 total polygons
566 polygons in CARE, 217 in the environs
Total area = 4,553 ha / 11,250 acres (3%)
3,147 ha / 7,776 acres CARE
1,406 ha / 3,475 ac environs
Average polygon size = 5.8 ha / 14.3 acres
Producer's accuracy = 77% ± 13%
User's accuracy = 57% ± 13%
Producer's accuracy = 77% ± 13%
User's accuracy = 57% ± 13%



Interpretation:

Polygons of this map class occur throughout the mapping area, in many different landscape positions and geologic substrates. Polygons are small to large, and most are regularly shaped. This map class is easily recognized by its smooth texture and generally uniform tan or gray color.

Distribution/Ecology/Composition:

This unit includes areas dominated by native bunchgrasses such as James' galleta, sand dropseed, needle-and-thread, Indian ricegrass, and/or sandhill muhly. Most of these grasslands contain scattered short shrubs, including shadscale, Torrey Mormon-tea, Bigelow sagebrush, snakeweed or rabbitbrush. Most stands are substrate-controlled, and soils are generally deep. Substrates are variable, and this unit occurs on level to moderately steep slopes on nearly every landform found in the mapping area, from floodplains and valley floors to ridges, hills and mountain slopes. Some examples include burned pinyon-juniper woodlands or sagebrush shrublands; these grasslands are generally seral and will remain grasslands only if burned more often than woody plants can become established.



Photo credit: NPS



Photo credit: NPS



Photo credit: NPS



Photo credit: NPS

8a Salina Wildrye Shale Sparse Grassland (H-LESA)

Associations:

Leymus salinus Shale Sparse Vegetation

Common species:

Atriplex confertifolia
Chrysothamnus viscidiflorus
Achnatherum hymenoides
Bromus tectorum
Hesperostipa comata
Leymus salinus

Project Specifics:

Frequency = 10 total polygons
7 polygon in CARE, 9 in the environs
Total area = 33 ha / 80 acres (<<1%)
1.3 ha / 3.3 acres CARE
31 ha / 77 ac environs
Average polygon size = 3.3 ha / 8.0 acres
Not accuracy assessed



Interpretation:

This map class occurs in very small patches on moderately steep north-facing slopes, primarily in the southern portion of the mapping area. Polygons tend to be regular in shape. They appear as gray polygons with a mostly smooth texture – although most stands contain some shrubs that appear as scattered small speckles. This map class is used where stands are known from fieldwork, otherwise polygons are assigned the map code for Mixed Grasslands Complex (8). Adjacent polygons are mapped either as Shadscale Shrubland Complex (6) or Mixed Desert Shrubland Complex (13).

Distribution/Ecology/Composition:

This map class is restricted to north and east facing slopes, primarily on Mancos Shale outcrops in the southern part of the mapping area. Salina wildrye is the dominant herbaceous species in this association; however, needle-and-thread and Indian ricegrass are often present. These communities tend to occur on slopes steep enough to discourage cattle grazing, so they are generally in better condition than adjacent areas on flatter slopes.



Photo credit: NPS

8b Black Grama – Galleta Herbaceous Vegetation (H-BGPL)

Associations:

Bouteloua eriopoda – *Bouteloua gracilis* Herbaceous Vegetation

Bouteloua eriopoda – *Pleuraphis jamesii* Herbaceous Vegetation

Common species:

Ephedra viridis

Bouteloua eriopoda

Pleuraphis jamesii

Project Specifics:

Frequency = 1 total polygons

1 polygon in CARE, 0 in the environs

Total area = 16 ha / 39.4 acres (<<1%)

16 ha / 39.4 acres CARE

0 ha / 0 ac environs

Average polygon size = 16 ha / 39.4 acres

Producer's accuracy = 0%

User's accuracy = 0%



Interpretation:

This rare map class was found and mapped on Johnson Mesa near Fruita.

It occurs on a moderately steep south-facing slope. It is indistinguishable from the grassland association on top of the mesa, which appears as gray polygons with a mostly smooth texture. Therefore, it was only mapped when known from field data.

Distribution/Ecology/Composition:

This map class is only known from a few locations in the mapping project area. Most polygons are smaller than the minimum mapping unit, so they were mapped with adjacent polygons of Mixed Grasslands Complex (8) or Mixed Desert Shrubland Complex (13). Johnson Mesa is a landslide feature that is covered with black lava boulders.



Photo credit: NPS



Photo credit: NPS

8c Muttongrass / Non-Vascular Herbaceous Vegetation (H-POFE)

Associations:

Poa fendleriana / Non-vascular Herbaceous Vegetation

Common species:

Artemisa (nova, frigida)
Chrysothamnus viscidiflorus
Poa fendleriana
Foliose lichens

Project Specifics:

Frequency = 1 total polygon
0 polygons in CARE, 1 in the environs
Total area = 5 ha / 12.4 acres (<<1%)
0 ha / 0 acres CARE
5 ha / 12.4 ac environs
Average polygon size = 5.0 ha / 12.4 acres
Not accuracy assessed



Interpretation:

This rare map class occurs in very small patches at higher elevations in the northwestern corner of the mapping area. Only one polygon was mapped. It appears as a smooth gray area surrounded by Douglas Fir Montane Woodland Complex (23a). This association cannot be distinguished from *Artemisia nova* – *Poa fendleriana* Shrubland (12c), so it will be mapped with that association unless fieldwork identifies separate polygons.

Distribution/Ecology/Composition:

This community is found in the northwestern corner of the mapping area at higher elevations. It occurs in openings within ponderosa pine woodlands and black sagebrush shrublands. These areas are highly diverse, often with a large number of annual forbs scattered among the grass clumps. Most of the ground is covered by foliose ground lichens.



Photo credit: NPS

43 Sparse Cushion Plant Herbaceous Vegetation (H-CUSH)

Associations:

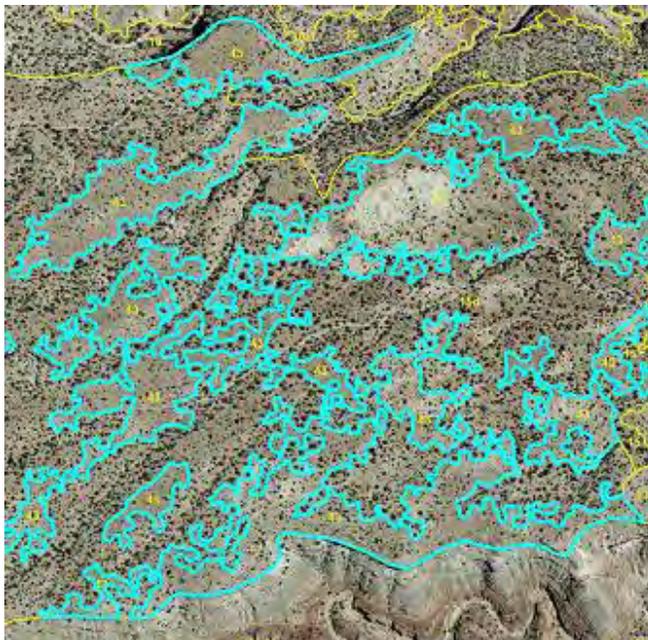
Sparse Cushion Plant Herbaceous Vegetation

Common species:

Arenaria eastwoodiae
Artemisia pygmaea
Enceliopsis nudicaulis
Erigeron (compactus, pumilus)
Eriogonum alatum
Eriogonum corymbosum
Frasera albomarginata
Heterotheca villosa
Hymenopappus filifolius
Paronychia sessiliflora
Petradoria pumila
Phlox (hoodii, multiflora)
Polygala subspinosa
Stenotus armerioides
Tetraneuris (acaulis, depressa)

Project Specifics:

Frequency = 79 total polygons
77 polygons in CARE, 2 in the environs
Total area = 213 ha / 526 acres (<1%)
210 ha / 518 acres CARE
3 ha / 8 ac environs
Average polygon size = 2.7 ha / 6.7 acres
Not accuracy assessed



Interpretation:

This map class is known from a few stands mostly located in the northwestern corner of the park. The vegetation is sparse with primarily cushion plants in the understory, so the signature is a white, gray, or pink color defined by variations in the underlying Carmel Formation. Where the vegetation is mainly pygmy sage, the substrate is the red of the Moenkopi Formation. This map class was mapped where known from fieldwork or when the tree cover of Bristlecone Pine Woodland (20) or Pinyon – Juniper / Sparse Understory (15d) was less than 8%.

Distribution/Ecology/Composition:

This park special is generally found among polygons of map classes 20 and 15d. It primarily occurs in the upper elevation ranges on ridge tops between major canyons draining east into the South Desert. It also occurs above the Burr Trail Switchbacks and on Horse Mesa. The vegetation consists of a few bristlecone pine, Utah juniper, Utah serviceberry, cliffrose or buckwheat scattered through the polygons with a sparse understory of cushion plants. All known sites are on Carmel or Moenkopi Formations.



63 Abandoned Fields (H-FIEL)

Associations:

Abandoned Fields

Common species:

Atriplex spp. (annuals)
Bromus tectorum
Halogeton glomeratus
Plantago patagonica
Salsola spp.

Project Specifics:

Frequency = 11 total polygons
6 polygons in CARE, 5 in the environs
Total area = 23 ha / 58 acres (<<1%)
16 ha / 40 acres CARE
7 ha / 18 ac environs
Average polygon size = 2.1 ha / 5.3 acres
Not accuracy assessed



Interpretation:

Some polygons of this map class are easy to delineate due to their rectangular shape and the abrupt change in vegetation reflected in their photo signature. These areas tend to be light-colored from the high percentage of bare ground and dead annual vegetation. Since this type is otherwise indistinguishable from Mixed Grasslands Complex (8), it was only mapped when known from fieldwork.

Distribution/Ecology/Composition:

Abandoned fields were mapped in the South Desert around an old homestead and adjacent to Sleeping Rainbow Ranch. Old fields support weedy annual herbaceous vegetation, as noted above. No plots were sampled in polygons of this map class.

No ground photo available

65 Halogeton Semi-Natural Herbaceous Vegetation (H-HAGL)

Associations:

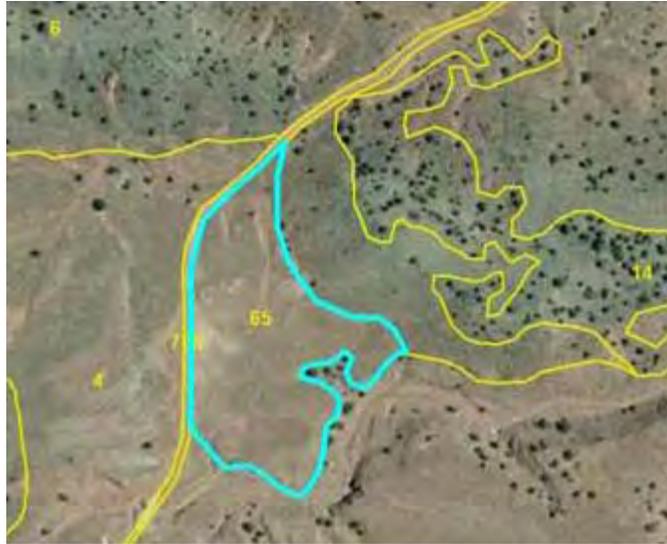
Halogeton glomeratus Semi-Natural Herbaceous Vegetation

Common species:

Halogeton glomeratus
Salsola spp.

Project Specifics (also mapped as points):

Frequency = 1 total polygon
1 polygon in CARE, 0 in the environs
Total area = 1.5 ha / 3.6 acres (<<1%)
1.5 ha / 3.6 acres CARE
0 ha / 0 ac environs
Average polygon size = 1.5 ha / 3.6 acres
Not accuracy assessed



Interpretation:

Most examples of this map class are recorded as point data; only one small polygon was mapped. They occur on valley floors and basins, appearing light-colored and smooth-textured from the high percentage of bare ground and dead annual vegetation. Since this type is often indistinguishable from Mixed Grasslands Complex (8), it was only mapped where known from fieldwork.

Distribution/Ecology/Composition:

Stands of halogeton and other salt-tolerant exotic annual plants are distributed throughout the mid and lower level elevations in the mapping area. Old fields, corrals and other sites with a history of frequent disturbance within the mapping area support weedy annual herbaceous vegetation. Roadsides often support a community that keys to this map class, but most roadside examples are too small and narrow to be mapped as polygons.

No ground photo available

Riparian Forest and Woodland

24 Fremont Cottonwood Woodland Complex (W-POFR)

Associations:

Populus fremontii / *Acer negundo* Forest
Populus fremontii / *Ericameria nauseosa* Woodland
Populus fremontii / Mesic Forbs Woodland
Populus fremontii / Mesic Graminoids Woodland
Populus fremontii / *Salix exigua* Woodland
Populus fremontii / *Salix gooddingii* Woodland
Salix gooddingii Temporarily Flooded
Woodland Alliance

Common species:

Acer negundo
Populus fremontii
Salix (gooddingii, exigua)
Artemisia tridentata ssp. *tridentata*
Brickellia longifolia
Ericameria nauseosa
Rhus trilobata
Juncus balticus
Phragmites australis
Schoenoplectus americanus

Project Specifics (also mapped as points):

Frequency = 277 total polygons
187 polygons in CARE, 90 in the environs
Total area = 364 ha / 898 acres (<1%)
254 ha / 628 acres CARE
109 ha / 270 ac environs
Average polygon size = 1.3 ha / 3.2 acres
Producer's accuracy = 88% ± 9%
User's accuracy = 86% ± 10%



Interpretation:

Most examples of this map class are elongated to linear polygons located along drainages. The photo signature varies from dark lush green to gray-brown depending on the age, height, density and health of the trees. The trees are tall, flat-crowned, and appear irregularly shaped. They are set in a matrix that is tan to gray, depending on the amount of vegetation in the understory. This map class is often intermixed with Tamarisk Temporarily Flooded Shrubland (64).

Distribution/Ecology/Composition:

This map class occurs primarily along the Fremont River, Pleasant Creek and Halls Creek drainage. Stands of Fremont cottonwood and box elder forest were mapped as encountered during fieldwork in Spring Canyon. Most cottonwood stands in the mapping area are decadent and on high terraces above the current stream bed. A few are on the margins of abandoned channels. The understory in mature stands generally includes or is dominated by upland species, including basin big sagebrush and rubber rabbitbrush. Young stands retain clumps of sandbar willow in the subcanopy. Canopy cover does not usually exceed 40%.



Photo credit: NPS



Photo credit: NPS



Photo credit: NPS



Photo credit: NPS

24a Narrowleaf Cottonwood Woodland (W-PORH)

Associations:

Populus angustifolia / Disturbed Understory Woodland
Populus angustifolia / *Rhus trilobata* Woodland

Common species:

Juniperus osteosperma
Pinus edulis
Populus angustifolia
Cornus sericea
Rhus trilobata
Rosa woodsii
Symphoricarpos oreophilus

Project Specifics:

Frequency = 3 total polygons
0 polygons in CARE, 3 in the environs
Total area = 6 ha / 15 acres (<<1%)
0 ha / 0 acres CARE
6 ha / 15 ac environs
Average polygon size = 2.1 ha / 5.1 acres
Not accuracy assessed



Interpretation:

Examples of this map class are very small, in linear to regular polygons. All known occurrences are in cold, narrow tributary canyons. The large, rounded tree crowns are light green and distinct from the surrounding darker green pinyon-juniper woodlands. The understory is variable and has no consistent signature. This map class has the same signature as Aspen / Snowberry Forest (22), so stands were mapped where encountered during field work.

Distribution/Ecology/Composition:

This association is found only at middle elevations along Polk Creek in the northern portion of the mapping area. It is restricted to the upper reaches of cold (north-south oriented) narrow tributary canyons. The understory is diverse and usually dense. The canopy of most stands is closed.



Photo credit: NPS



Photo credit: NPS

26d Netleaf Hackberry Slickrock Canyon Woodland (W-HACK)

Associations:

Celtis laevigata var. *reticulata* Slickrock Canyon Woodland

Common species:

Acer negundo
Celtis laevigata var. *reticulata*
Juniperus osteosperma
Salix gooddingii
Fraxinus anomala
Mahonia fremontii
Quercus gambelii
Rhamnus betulifolia

Project Specifics:

Frequency = 32 total polygons
30 polygons in CARE, 2 in the environs
Total area = 30 ha / 73 acres (<1%)
29 ha / 71 acres CARE
1 ha / 2 ac environs
Average polygon size = 0.9 ha / 2.3 acres
Not accuracy assessed



Interpretation:

This uncommon map class occurs in small, linear polygons in Navajo slickrock canyons in the southern portion of the mapping area. The signature is bright green irregular clumps of shrubs and trees in a matrix of light-colored Navajo sandstone.

Distribution/Ecology/Composition:

This woodland is found primarily in the southern portion of the mapping area in Navajo slickrock canyons coming out of the Waterpocket Fold. It is restricted to deep, narrow canyons or the base of north-facing cliffs where water seeps out of the sandstone walls. Most of these canyons have not been surveyed, so a complete vegetation description is not available. Some canyons have stands consisting primarily of netleaf hackberry, but others may lack hackberry and have only a combination of the other species listed above. This association name was selected as a placeholder for the slickrock canyons in the southern Waterpocket Fold until additional data can be gathered.



Photo credit: NPS



Photo credit: NPS

30 Box Elder Woodland Complex (W-BOEL)

Associations:

Acer negundo – *Ostrya knowltonii* Woodland
Acer negundo / *Quercus gambelii* Woodland
Acer negundo / *Rhus trilobata* Woodland
Acer negundo – Mixed Shrub Woodland
Acer negundo – *Betula occidentalis* Woodland

Common species:

Acer negundo
Celtis laevigata var. *reticulata*
Ostrya knowltonii
Quercus gambelii
Rhamnus betulifolia
Toxicodendron rydbergii

Project Specifics:

Frequency = 6 total polygons
6 polygons in CARE, 0 in the environs
Total area = 12 ha / 29 acres (<<1%)
12 ha / 29 acres CARE
0 ha / 0 ac environs
Average polygon size = 1.9 ha / 4.8 acres
Not accuracy assessed



Interpretation:

Most of the small, elongated polygons of this rare map class occur at the very southern end of the mapping area. This type was mapped only where known, since the bright green signature is the same as other closed riparian woodlands in similar canyon habitats.

Distribution/Ecology/Composition:

This woodland is characterized by a dense canopy cover of box elder and variable cover of hop hornbeam. Occurrences are restricted to Hall's Creek Narrows and similar narrow slot canyons. Stands grow on perennial stream banks or at the base of north-facing cliffs where water permanently seeps out of the sandstone walls. These stands rarely, if ever, flood. The understory is dominated by Gambel oak, hackberry, poison ivy and alder. Because this association is indistinguishable from Hackberry Slickrock Canyon (26d), it was mapped only where it was observed in the field.



Photo credit: NPS



Photo credit: NPS

Riparian / Wetland Shrubland

26b Red-osier Dogwood Shrubland (S-COSE)

Associations:

Cornus sericea Shrubland

Common species:

Juniperus scopulorum

Acer glabrum

Cercocarpus ledifolius

Project Specifics:

Frequency = 1 total polygon

1 polygon in CARE, 0 in the environs

Total area = 0.2 ha / 0.5 acres (<<1%)

0.2 ha / 0.5 acres CARE

0 ha / 0 ac environs

Average polygon size = 0.2 ha / 0.5 acres

Not accuracy assessed



Interpretation:

This rare map class occurs in small, linear polygons. The signature is dark green with a smooth texture. It was mapped only in one known location.

Distribution/Ecology/Composition:

This shrubland is characterized by a dense thicket of red-osier dogwood and is restricted to one location in upper Deep Creek. It was mapped only where known from field work.

No ground photo available

26c River Birch Shrubland (S-BEOC)

Associations:

Betula occidentalis Shrubland

Common species:

Juniperus scopulorum

Pinus edulis

Amelanchier utahensis

Artemisia tridentata

Betula occidentalis

Ericameria nauseosa

Rhus trilobata

Ribes (aureum, inerme)

Rosa woodsii

Salix (exigua, boothii)

Shepherdia argentea

Carex microptera

Juncus balticus

Poa (fendleriana, pratensis)



Project Specifics:

Frequency = 6 total polygons

1 polygon in CARE, 5 in the environs

Total area = 20 ha / 49 acres (<<1%)

9.5 ha / 23 acres CARE

10.5 ha / 26 ac environs

Average polygon size = 3.3 ha / 8.1 acres

Not accuracy assessed

Interpretation:

This rare map class occurs in very narrow polygons on the floors of deep canyons. The signature is light green, irregularly shaped clumps, with scattered openings of light gray between the taller shrub crowns. Polygons are usually surrounded by stands of Pinyon – Juniper Black Sage Woodland (15f).

Distribution/Ecology/Composition:

This type is restricted to perennial drainages and ditches in the northwestern corner of the mapping area and in the Fremont River Gorge. Most are in areas with a fluctuating, but generally high water table and have a diverse understory of wetland species.



Photo credit: NPS



Photo credit: NPS

32 Willow Shrubland Complex (S-WILL)

Associations:

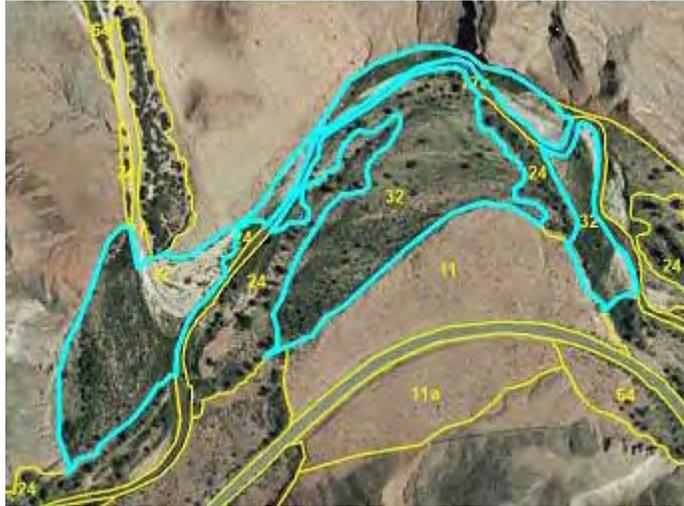
Rhus trilobata Intermittently Flooded Shrubland
Salix exigua / Mesic Graminoids Shrubland
Salix exigua / Barren Shrubland
Salix gooddingii Temporarily Flooded Woodland Alliance

Common species:

Rhus trilobata
Salix (exigua, gooddingii)
Scirpus pungens
Tamarix chinensis
Achnatherum hymenoides
Carex nebrascensis
Equisetum laevigatum
Euthamia occidentalis
Juncus balticus
Typha latifolia

Project Specifics (also mapped as points):

Frequency = 44 total polygons
24 polygons in CARE, 20 in the environs
Total area = 55 ha / 135 acres (<1%)
35 ha / 87 acres CARE
19 ha / 48 ac environs
Average polygon size = 1.2 ha / 3.1 acres
Producer's accuracy = 40% ± 36%
User's accuracy = 100%



Interpretation:

This map class occurs in small, linear or elongate polygons that may include terrace and upland communities above the narrow band of willow. Many stands are close to the minimum mapping unit in size. The signature is a smooth medium green. It is difficult to distinguish this map class from stands of young tamarisk growing in the same habitat; therefore, many stands may contain Tamarisk Temporarily Flooded Shrubland (64).

Distribution/Ecology/Composition:

This is an uncommon riparian shrubland complex in the mapping area. It occurs on the banks, point bars, lowest terraces, abandoned channels and islands of the Fremont River, Pleasant Creek, Divide Canyon and Swap Canyon. Stands subject to frequent flooding typically have a barren understory. Stands raised slightly above the annual flood level may have a rich mixture of forbs and/or graminoids in the understory. As these stands dry out, they are generally replaced either by map class 64 (Tamarisk) or Fremont Cottonwood Woodland Complex (24).



Photo credit: NPS



Photo credit: NPS

64 Tamarisk Temporarily Flooded Shrubland (S-TARU)

Associations:

Tamarix spp. Temporarily Flooded Semi-natural Shrubland
Tamarix spp. / *Sporobolus airoides* Shrubland

Common species:

Tamarix chinensis
Muhlenbergia pungens
Phragmites australis
Schoenoplectus pungens

Project Specifics (also mapped as points):

Frequency = 285 total polygons
199 polygons in CARE, 86 in the environs
Total area = 334 ha / 824 acres (<1%)
105 ha / 260 acres CARE
228 ha / 564 ac environs
Average polygon size = 1.2 ha / 2.9 acres
Producer's accuracy = 80% ± 12%
User's accuracy = 96% ± 6%



Interpretation:

This map class occurs in small to medium, linear to elongated polygons in floodplains of the major drainages. Many polygons are smaller than the minimum mapping unit; these stands and individual plants outside polygons were mapped as point data. The rough texture and dark green of mature tamarisk crowns distinguish these stands. They are often embedded in larger polygons of Fremont Cottonwood Woodland Complex (24).

Distribution/Ecology/Composition:

This map class is found throughout the mid and lower elevations of the mapping area in the major drainages, and occasionally in small pockets along minor drainages and at seeps. In many areas, tamarisk are invading Fremont Cottonwood Woodland Complex (24).

Photo credit: NPS



Riparian / Wetland Herbaceous

25 Springs and Seeps Mosaic (H-SEEP)

Associations:

Eleocharis palustris Herbaceous Vegetation

Juncus balticus Herbaceous Vegetation

Phragmites australis Western North America Temperate Semi-natural Herbaceous Vegetation

Schoenoplectus pungens Herbaceous Vegetation

Typha (latifolia, angustifolia) Western Herbaceous Vegetation

Waterpocket Community

Common species:

Carex spp.

Distichlis spicata

Eleocharis palustris

Juncus spp.

Phragmites australis

Schoenoplectus spp.

Typha latifolia

Project Specifics (also mapped as points):

Frequency = 77 total polygons

41 polygons in CARE, 36 in the environs

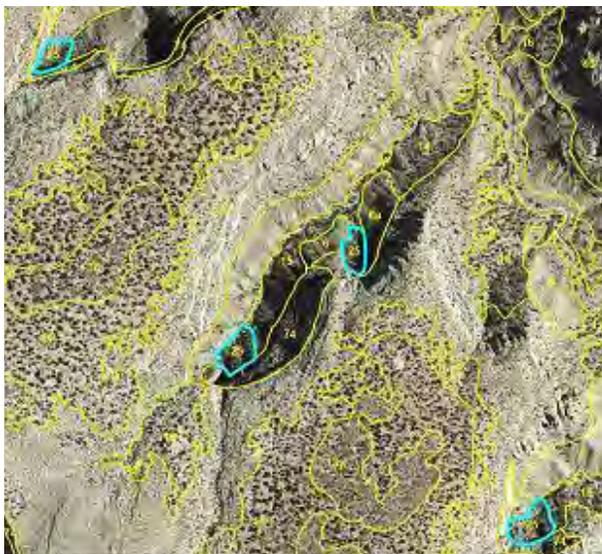
Total area = 23 ha / 57 acres (<1%)

13 ha / 32 acres CARE

10 ha / 25 ac environs

Average polygon size = 0.3 ha / 0.7 acres

Not accuracy assessed



Interpretation:

Most polygons of this map class are linear to elongate. Stands smaller than the minimum mapping unit are mapped as points. Many are located along the banks of the larger streams and their major tributaries, but others occur in isolated wetlands away from the rivers. The signature is a medium to dark, smooth green.

Distribution/Ecology/Composition:

This map class occurs where the water table is high and ground salts are low to moderate. The largest examples are on the lowest terraces of the Hall's Creek drainage in the southern portion of the mapping area. A few polygons occur around upland springs and seeps. Graminoid species such as *Juncus*, *Eleocharis*, *Typha* or *Schoenoplectus* are the usual dominants.



Photo credits: NPS

31 Hanging Gardens Herbaceous Vegetation (H-HANG)

Associations:

Aquilegia micrantha - *Mimulus eastwoodiae* Herbaceous Vegetation

Common species:

Adiantum capillus-veneris

Aquilegia micrantha

Carex spp.

Cirsium calcareum

Juncus spp.

Maianthemum stellatum

Mimulus eastwoodiae

Project Specifics (also mapped as points):

Frequency = 1 polygon

1 polygons in CARE, 0 in the environs

Total area = 0.1 ha / 0.2 acres (<<1%)

0.1 ha / 0.2 acres CARE

0 ha / 0 ac environs

Average polygon size = 0.1 ha / 0.2 acres

Not accuracy assessed



Interpretation:

This map class contains a variety of herbaceous wetland vegetation found in hanging gardens and seeps in sandstone cliffs. They are usually smaller than the minimum mapping unit, so most occurrences are mapped as points, not polygons. Most examples are isolated wet areas not associated with the major drainages. Their appearance is a bright green clump in the midst of light gray sandstone.

Distribution/Ecology/Composition:

There are a few hanging gardens emerging from sandstone cliff faces or alcoves in the central and southern portions of the mapping area. These areas contain a variety of herbaceous and wetland vegetation that may or may not include the key species mentioned in the association name.



Photo credits: NPS

36 Wet Meadow Herbaceous Vegetation (C-MXDW)

Associations:

Wet Meadow Herbaceous Vegetation (Park Special)

Common species:

Agrostis spp.
Carex spp.
Juncus spp.
Schoenoplectus spp.

Project Specifics:

Frequency = 5 total polygons
0 polygons in CARE, 5 in the environs
Total area = 1.9 ha / 4.7 acres (<<1%)
0 ha / 0 acres CARE
1.9 ha / 4.7 ac environs
Average polygon size = 0.4 ha / 0.9 acres
Not accuracy assessed



Interpretation:

This is a rare vegetation type, occurring in a few small polygons in the northwestern corner of the mapping area. All stands are located along the banks of ditches or perennial creeks. The signature is a medium to dark, smooth green, or smooth yellow-tan in color depending on soil moisture in each meadow.

Distribution/Ecology/Composition:

This map class occurs where the water table is high and ground salts are low to moderate. Graminoid species make up the majority of species. No plots were sampled at these small isolated wet meadows, so this map class is a placeholder for these areas until more data can be gathered.



Photo credit: NPS

Index to the Map Classes Defined for Capitol Reef National Park

1	Bentonite Badlands (S-BENT)	799
4	Saltbush Badlands Shrubland Complex (S-MATS)	800
4a	Crispleaf Buckwheat Badlands Sparse Vegetation (S-BUCK)	802
5	Gypsum Badlands Sparse Vegetation (S-GYPS)	803
6	Shadscale Shrubland Complex (S-ATCO)	806
8	Mixed Grasslands Complex (H-GRAS)	843
8a	Salina Wildrye Shale Sparse Grassland (H-LESA)	845
8b	Black Grama – Galleta Herbaceous Vegetation (H-BGPL)	846
8c	Muttongrass / Non-vascular Herbaceous Vegetation (H-POFE)	847
9	Sand Sage Shrubland Complex (S-ARFI)	804
10	Blackbrush Shrubland Complex (S-BLAC)	809
10a	Tucker Oak Shrubland (S-QUHA)	810
11	Desert Wash Shrubland Mosaic (S-WASH)	811
11a	Black Greasewood Shrubland Complex (S-BLGR)	813
11c	Big Sagebrush Shrubland Complex (S-ARTR)	815
12a	Fringed Sagebrush – Lichens Rocky Mesa Herbaceous Vegetation (H-ROME)	817
12b	Mesic Canyon Bottom Shrubland Complex (S-MESI)	818
12c	Black Sagebrush / Muttongrass Shrubland (S-ARPO)	808
12d	Curl-leaf Mountain Mahogany Woodland Complex (W-CELE)	764
13	Mixed Desert Shrubland Complex (S-MXDD)	820
13a	Torrey Mormon Tea Shrubland Complex (S-EPTO)	822
13b	Gambel Oak / Serviceberry Shrubland (S-GOSB)	824
13d	Wyoming Sagebrush / Blue Grama Shrubland (S-WYSA)	826
13e	Black Sagebrush – Bitterbrush / Muttongrass Shrubland (S-BSCU)	827
13f	Mountain Sagebrush – Snowberry Shrubland Complex (S-MSSN)	828
13h	Torrey Mormon Tea / Blue Grama – Galleta Shrubland (S-ETGG)	829
13x	Green Mormon Tea / Galleta – Cheatgrass Shrubland Complex (S-EVGC)	831
13y	Green Mormon Tea / Indian Ricegrass – Needle and Thread Shrubland (S-EVRN)	833
13z	Rubber Rabbitbrush / Blue Grama Shrub Herbaceous Vegetation (S-RURA)	835
14	Pinyon - Juniper / Mixed Grass Woodland Complex (W-PJMG)	765
14b	Pinyon - Juniper / Cheatgrass Semi-natural Woodland (W-PJCH)	767
14c	Pinyon - Juniper / Russian Wildrye Semi-natural Woodland (W-PJPJ)	768
15	Pinyon - Juniper / Xeric Shrubs Woodland Complex (W-PJXE)	769
15b	Pinyon - Juniper / Brittle Prickly Pear Woodland (W-PJOP)	771
15d	Pinyon - Juniper / Sparse Understory Woodland (W-PJSP)	773
15e	Pinyon - Juniper / Sagebrush Woodland Complex (W-PJWS)	775
15f	Pinyon - Juniper / Black Sagebrush Woodland (W-PJBS)	776
16	Pinyon - Juniper / Mesic Shrubs Woodland Complex (W-PJME)	777
16a	Pinyon - Juniper / Mountain Mahogany and Gambel Oak Woodland (W-PJMM)	779
16e	Pinyon - Juniper / Oak and Manzanita Woodland (W-PJOM)	781
17	Pinyon - Juniper / Blackbrush Woodland (W-PJBB)	784
18c	Spiny Hopsage Shrubland (S-GRSP)	837
19	Little-leaf Mountain Mahogany Slickrock Sparse Vegetation (S-LLMM)	838
19c	Pinyon - Juniper / Blackbrush – Cliffrose – Tucker Oak Wooded Shrubland (W-PJBC)	839
19d	Blackbrush – Cliffrose – Tucker Oak Shrubland (S-BCTO)	840
20	Bristlecone Pine Woodland (W-PILO)	785

21	Ponderosa Pine / Greenleaf Manzanita Woodland (W-PPGM)	786
22	Aspen / Snowberry Forest (W-ASPE)	788
23a	Douglas-fir Montane Woodland Complex (W-DFMO)	789
23c	Douglas-fir Canyon Woodland Complex (W-DOFI).....	791
24	Fremont Cottonwood Woodland Complex (W-POFR)	851
24a	Narrowleaf Cottonwood Woodland (W-POAN).....	853
25	Springs and Seeps Mosaic (H-SEEP)	862
26b	Red-osier Dogwood Shrubland (S-COSE)	857
26c	River Birch Shrubland (S-BEOC)	858
26d	Netleaf Hackberry Slickrock Canyon Woodland (W-HACK)	854
27	Slickrock Fin Pocket (C-FINP)	793
30	Box Elder Woodland Complex (W-BOEL)	855
31	Hanging Gardens Herbaceous Vegetation (H-HANG)	863
32	Willow Shrubland Complex (S-WILL)	859
33	Ponderosa Pine Woodland Complex (W-POPI)	795
33a	Ponderosa Pine / Gambel Oak Woodland (W-PPQG)	797
35	Blue Spruce / Red-Osier Dogwood Woodland (W-BSRD)	798
36	Wet Meadow Herbaceous Vegetation (C-MXDW)	864
40	Talus Mixed Shrubland Complex (S-TALM)	841
41	Greenleaf Manzanita Shrubland (S-MANZ).....	836
43	Sparse Cushion Plant Herbaceous Vegetation (H-CUSH).....	848
63	Abandoned Fields (H-FIEL)	849
64	Tamarisk Temporarily Flooded Shrubland (S-TARU).....	861
65	Halogeton Semi-Natural Herbaceous Vegetation (H-HAGL).....	850

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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National Park Service
U.S. Department of the Interior



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