National Park Service
U.S. Department of the Interior

Natural Resource Program Center

Vegetation Classification and Mapping Project Report, Dinosaur National Monument

Natural Resource Technical Report NPS/NCPN/NRTR—2008/112



ON THE COVER
Yampa River Canyon, Dinosaur National Monument (Photograph by Janet Coles)

Vegetation Classification and Mapping Project Report, Dinosaur National Monument

Natural Resource Report NPS/NCPN/NRTR—2008/112

Janet Coles
Northern Colorado Plateau Network
National Park Service
Moab, Utah

Dan Cogan / David Salas
Remote Sensing and Geographic Information Group
Bureau of Reclamation
Denver, Colorado

Aneth Wight / Gery Wakefield
Southeast Utah Group / Northern Colorado Plateau Network
National Park Service
Moab, Utah

Jim Von Loh
engineering-environmental Management, Inc.
Englewood, Colorado

Dr. Angela Evenden
Northern Colorado Plateau Network
National Park Service
Moab, Utah

July, 2008

U.S. Department of the Interior
National Park Service
Natural Resource Program Center
Fort Collins, Colorado

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

The Natural Resource Technical Report series is used to disseminate the peer-reviewed results of scientific studies in the physical, biological, and social sciences for both the advancement of science and the achievement of the NPS mission. The reports provide contributors with a forum for displaying comprehensive data that are often deleted from journals because of page limitations. Current examples of such reports include the results of research that addresses natural resource management issues; natural resource inventory and monitoring activities; resource assessment reports; scientific literature reviews; and peer reviewed proceedings of technical workshops, conferences, or symposia.

Views, statements, findings, conclusions, recommendations and data in this report are solely those of the authors and do not necessarily reflect policies of the U.S. Department of the Interior, NPS. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the NPS.

Printed copies of reports in these series may be produced in a limited quantity and they are only available as long as the supply lasts. This report is available from the Northern Colorado Plateau I&M Network website (http://www.nature.nps.gov/im/units/NCPN) or the Natural Resource Publications Management Web site (http://www.nature.nps.gov/publications/NRPM) on the Internet.

Please cite this publication as:

Coles, J., D. Cogan, D. Salas, A. Wight, G. Wakefield, J. Von Loh, and A. Evenden. 2008. Vegetation classification and mapping project report, Dinosaur National Monument. Natural Resource Technical Report NPS/NCPN/NRTR—2008/112. National Park Service, Fort Collins, Colorado.

NPS D-240, July 2008

Contents

SUMMARY ..... **XI**
ACKNOWLEDGEMENTS ..... **XIII**
INTRODUCTION **1**
Vegetation Classification and Mapping Project, Dinosaur National Monument 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 8
Geology and Vegetation 9
Soils 21
Hydrology and Water Resources 23
Land Use and Settlement History 25
Previous Vegetation Studies 26
OVERVIEW **29**
General Approach and Timeline 29
Primary Partners and Project Roles 30
Aerial Photography 32
Stereoscopic Aerial Photo Coverage 32
Digital Orthophotos 33
Project Boundary and Map Extent 35
Minimum Mapping Unit 36
Ecological System Classification 36
VEGETATION CLASSIFICATION AND DESCRIPTION **38**
Pre-Field Methods 38
Preliminary Classification List 38
Legacy Data Review 38
Field Methods 38

Field Sampling Approach 38
Plot Data Collection 39
Data Processing and Analysis 41
Observation Points 42
Classification Data Analysis 43
Classification Results 46
Plant Community Descriptions 57
Upland Forest and Woodland Associations 57
Upland Shrubland Associations 58
Upland Herbaceous Associations 60
Riparian and Wetland Forest and Woodland Associations 61
Riparian and Wetland Shrubland Associations 61
Riparian and Wetland Herbaceous Associations 62
Field Key Preparation 63
Assessment of Global Rarity 63
FUELS DATA COLLECTION 65
Fuels Data 65
VEGETATION MAPPING 66
Methods 66
Field Reconnaissance 66
Map Class and Polygon Attribute Development 66
Park Specials 69
Mapping 69
Spatial Database Development 70
Map Classes 70
Results 71
Map Class Descriptions 80
Map Polygons 80
Discussion 87
ACCURACY ASSESSMENT 89
Methods 89
Introduction 89
Sampling Design 89
Field Data Collection 90
Data Analysis 91
Results and Discussion 94
REFERENCES 97

APPENDIX A: ECOLOGICAL SYSTEMS OF DINOSAUR NATIONAL MONUMENT 103

APPENDIX B: PLOT, OBSERVATION POINT, ACCURACY ASSESSMENT POINT INSTRUCTIONS AND DATA FORMS 118

Appendix B.1. Plot and Observation Point Field Sampling Manual 119

Appendix B.2. Accuracy Assessment Point Field Sampling Manual 144

Appendix B.3. Example of a Vegetation Plot Data Form 157

Appendix B.4. Example of an Observation Point Data Form 161

Appendix B.5. Example of an Accuracy Assessment Data Form 163

APPENDIX C: DATABASE DOCUMENTATION 165

C.1. Plots Database Documentation 165

C.2. Geodatabase Documentation 182

APPENDIX D: PLANT SPECIES LIST AND CROSSWALK 191

APPENDIX E: FIELD PLOT CROSSWALK TO NVC ASSOCIATIONS 208

APPENDIX F: PLANT ASSOCIATION DESCRIPTIONS FOR DINOSAUR NATIONAL MONUMENT 219

APPENDIX G: ILLUSTRATED KEYS TO THE PLANT ASSOCIATIONS OF DINOSAUR NATIONAL MONUMENT 627

KEY I: MAJOR PHYSIOGNOMIC GROUPS OF DINOSAUR NATIONAL MONUMENT 629

KEY II: FOREST AND WOODLAND ASSOCIATIONS OF DINOSAUR NATIONAL MONUMENT 630

Key III: SHRUBLAND ASSOCIATIONS OF DINOSAUR NATIONAL MONUMENT 663

KEY IV: HERBACEOUS ASSOCIATIONS OF DINOSAUR NATIONAL MONUMENT 699

APPENDIX H: MODIFIED ANDERSON LAND USE-LAND COVER CLASSIFICATION 724

APPENDIX I: SOILS SERIES OF DINOSAUR NATIONAL MONUMENT 732

APPENDIX J: MAP CLASS DESCRIPTIONS FOR DINOSAUR NATIONAL MONUMENT 735

Figures

Figure 1. Location of DINO within the Northern Colorado Plateau network of parks 6
Figure 2. Map of the DINO vegetation mapping project area boundary showing adjacent land ownership. 7
Figure 3. Climate data for DINO (Western Regional Climate Center 2008) 8
Figure 4. Bedrock geology map of Dinosaur National Monument and vicinity 10
Figure 5. Characteristic plant communities of Precambrian (top) and Cambrian (bottom) geologic strata. 11
Figure 6. Characteristic plant communities of Mississippian geologic strata 12
Figure 7. Characteristic plant communities of Pennsylvanian geologic strata 13
Figure 8. Characteristic sparsely vegetated exposures of tilted Permian and Triassic geologic strata at the mouth of Split Mountain Canyon 14
Figure 9. Characteristic plant communities of Triassic geologic strata 15
Figure 10. Characteristic plant communities of Jurassic geologic strata 16
Figure 11. Characteristic plant communities of Cretaceous geologic strata 17
Figure 12. Characteristic plant communities of Oligocene (L) or Miocene (R) geologic strata 18
Figure 13. Characteristic plant communities of unconsolidated geologic strata: eolian (top), alluvial (middle), and colluvial (bottom) 21
Figure 14. Example of well-developed biological soil crusts on the Colorado Plateau (l) and in Dinosaur National Monument (r) 25
Figure 15. Flight lines for 2001 stereo aerial photograph coverage ofDINO 33
Figure 16. Example of a 9” x 9” stereo aerial photograph taken for the DINO vegetation classification and mapping project 34
Figure 17. Flight lines for 2002 orthophotography coverage of DINO 35
Figure 18. Vegetation plot and observation point locations in the DINO mapping project area 42
Figure 19. Results of Indicator Species Analysis of the full DINO plots dataset. The data were divided into two groups (using cluster analysis) and analyzed for the number of significant indicator species and the p value of species in each group. The analysis was repeated for 3, 4, 5 and so on up to24 groups. Arrows indicate the three points within the analysis that meet the criteria of localmaximum number of indicators and local minimum p-value 44
Figure 20. Bray-Curtis ordination of the 727 vegetation plots sampled at DINO. The different symbols and colors represent the twelve main groups identified through ISA and cluster analysis. The data were square root transformed to reduce the “dust bunny” effect of a data set that is mostly zeroes (McCune and Grace 2002 45
Figure 21. The globally imperiled Pseudoroegneria spicata Herbaceous Vegetation association at DINO 64
Figure 22. General structure of the DINO geodatabase 71
Figure 23. The DINO vegetation map based on ecological system groups of map classes 88
Figure 24. Location of accuracy assessment points sampled within DINO. The accuracy of the mapoutside of the park boundary was not assessed 91

Tables

Table 1. National Vegetation Classification System hierarchy for terrestrial vegetation (FGDC 1997)..... 3
Table 2. Vegetation types identified and mapped for Dinosaur National Monument by Wathen and Friedlander (1983). Species names have been updated to Kartesz (1999)..... 27
Table 3. Timeline for DINO vegetation mapping project tasks 29
Table 4. Plot sizes used for vegetation classification sampling at DINO..... 39
Table 5. General plot data categories and specific data components collected at each vegetation classification plot..... 40
Table 6. Vegetation cover and height classes used in the DINO vegetation mapping project..... 41
Table 7. A summary of the twelve groups of communities revealed by cluster analysis and ISA of the entire plot data set. Significant indicator species had an indicator value >25 and p < .05..... 44
Table 8. Plant associations identified within the DINO vegetation mapping project area*..... 47
Table 9. Physiognomic attributes assigned to polygons during mapping. When appropriate, these attributes were assigned to individual polygons. Otherwise they were assigned to an entire map class..... 67
Table 10. Modifiers used to provide additional information for map polygons in the DINO vegetation mapping project area..... 68
Table 11. Map classes used in the final (post-AA) DINO vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. DINO vegetation map classes are arranged using the NatureServe ecological systems classification (shaded boxes) 72
Table 12. Summary statistics for polygons of each map class developed for the DINO vegetation mapping project 81
Table 13. Final contingency table for the map classes used at DINO. This table represents the 34 map classes retained following the accuracy assessment and revision process1. 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 81% (Kappa statistic = 79%). User's and producer's accuracy values for each map class appear in Tables 11 and 12..... 93
Table 14. Final DINO vegetation map classes that met or exceeded the 80% program standard for both user's and producer's accuracy..... 94
Table 15. DINO vegetation map classes where either the user's or producer's accuracy did not meet the 80% program standard 94
Table 16. DINO vegetation map classes where neither the user's nor producer's accuracy met the 80% program standard..... 95

Acronyms and Abbreviations

AA	Accuracy Assessment
APFO	Aerial Photography Field Office (USDA)
BLM	United States Bureau of Land Management
BOR	United States Bureau of Reclamation
BPU	Biophysical Unit
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
DINO	Dinosaur National Monument
DRC	Diameter at Root Crown
e^2M	engineering-environmental Management, Inc.
ES	Ecological System
ESRI	Environmental Systems Research Institute
FGDC	Federal Geographic Data Committee
GIS	Geographic Information System(s)
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
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 System
QA/QC	Quality Assurance/Quality Control
RSGIG	Remote Sensing and Geographic Information Group
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

The Northern Colorado Plateau Inventory and Monitoring Network worked with the support of the U.S. Geological Survey - National Park Service Vegetation Mapping Program to describe and map vegetation at Dinosaur National Monument (DINO). This collaborative effort involved many project partners, particularly the Remote Sensing and Geographic Information Group of the U.S. Bureau of Reclamation, the Western Region office of NatureServe, engineering-environmental Management, Inc., and their cooperators.

The mapping area is 161,169 hectares (398,258 acres), encompassing the entire Monument as well as an environs of adjacent public and private lands. Ecologists and photointerpreters worked together to identify plant associations for DINO 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 727 vegetation classification plots and 217 observation points. Supplemental fuels data were collected during the project in sagebrush, pinyon-juniper, ponderosa pine, and Douglas-fir communities. Assessment of map accuracy entailed sampling of another 1,543 data points. Fieldwork and mapping were completed between 2002 and 2005.

Analysis of the plot data revealed 174 National Vegetation Classification plant associations, alliances, or park special vegetation types within the Monument and environs. Eighteen associations were documented from accuracy assessment data, the remainder from vegetation plots, observation points, and 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 Mylar overlays on paper plots of the orthophotographs and transferred to a spatial database. The project used the program standard minimum mapping unit of 0.5 ha with few exceptions.

The DINO vegetation mapping project area was 161,169 ha (398,258 acres) divided into 31,384 polygons. A total of 28,915 map polygons represent 37 natural and semi-natural vegetation map classes. Nine land use map classes describe 372 other polygons within the mapping area. An additional 2,097 polygons represent exposures of unvegetated geological formations. Average polygon size across all map classes is 5.1 ha (12.7 acres). Natural and semi-natural vegetation classes cover 153,963 ha (380,449 acres; 95.5% of the project area). Map classes representing unvegetated bedrock, talus or washes total 5,672 ha (14,015 acres; 3.5% of the project area). Land use/land cover polygons, including roads, ranch developments and NPS facilities, total 1,536 ha (3,794 acres; 1% of the project area). The most frequent vegetation mapping unit is the Sagebrush - Rabbitbrush Shrubland (S-SAGE, #31) with 5,368 polygons covering 31,695 ha (78,320 acres) or 19.7% of the project area.

Map accuracy was assessed within the DINO boundary only. Results from a thematic accuracy assessment of 37 vegetation map classes remaining after accuracy assessment analysis indicated an estimate of 81% overall map accuracy (Kappa statistic = 79%). Seven 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 Monument managers. These map classes are described in the

Accuracy Assessment section of this report, along with the justification for retaining them.

Products resulting from the DINO vegetation mapping project include:

Available in this report:

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

Available elsewhere[1]:

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

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

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

Acknowledgements

This project was completed through the effort and dedication of numerous individuals and organizations. Details of the role of each person mentioned here is described in more detail in the Project Overview section. Angela Evenden (National Park Service), Mike Story and Tammy Hamer (NPS), Karl Brown (USGS/NPS) and Mike Mulligan (USGS) provided project oversight and coordination with support from Mike Pucherelli of the Bureau of Reclamation Remote Sensing and Geographic Information Group (RSGIG). 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, Matt Bare, Rita Berberian, Kathy Carsey, Janet Coles, Bruce Condie, Karin Edwards, Lisa Hahn, Matt Smith, Amy Schwarzbach, Stephanie Shoemaker, Amy Tendick, Lisa Tasker, Julie Thompson, Sarah Topp, Jim Von Loh, and Pete Williams.

Janet Coles completed both the preliminary and final vegetation classifications, with assistance from Marion Reid and Gwen Kittel of NatureServe. Janet also created the original map class concepts and completed most of the mapping. Marion Reid developed the local association description template used in this report. David Salas and Dan Cogan of the Bureau of Reclamation helped complete the photointerpretation and accuracy analysis. Jim Von Loh helped write the final report.

Database management support and development were skillfully performed by Margaret Beer and Helen Thomas (NPS) and Jack Doria (e²M). Their preparation of a project MS Access database for plot, observation point, and accuracy assessment data simplified entry and analysis. Gery Wakefield and Aneth Wight (NPS) worked closely with Dan Cogan (then of BOR-RSGIG) to produce the final vegetation map coverage.

Special thanks to Tamara Naumann of Dinosaur National Monument, who made us welcome whenever we arrived to check the map or collect field data, and provided helpful advice as to the best way to access different parts of the Monument. Pete Williams also deserves special mention, for his skill as a boatman, his profound understanding of the park, his talents as an editor, and his fabulous cooking.

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

Introduction

Vegetation Classification and Mapping Project, Dinosaur National Monument

The Dinosaur National Monument (DINO) Vegetation Mapping Project was organized and coordinated by the Northern Colorado Plateau Network (NCPN) Inventory and Monitoring (I&M) Program between 2001 and 2007, with assistance from several project cooperators. The purpose of this project was to describe and map existing plant associations on 161,169 hectares (398,258 acres) within DINO and its environs, and to provide this information in written, tabular, digital, and spatial formats useful to monument resource managers, the NCPN I&M Program, and others. The basic project components consist of a classification and description of the monument'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 DINO Vegetation Classification and Mapping Project was initiated by the NCPN, the Bureau of Reclamation Remote Sensing and Geographic Information Group (RSGIG) and NatureServe. Project work was coordinated with the USGS-NPS Vegetation Mapping Program. Vegetation plot and observation point data collection occurred between 2002 and 2004. 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 DINO 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 DINO. 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 DINO vegetation mapping project is the fourth of the network-coordinated projects to be completed.

Vegetation Mapping Program Standards

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

Protocols

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

Standards

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

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

National Vegetation Classification Standard

The National Vegetation Classification (NVC) is the system used in NCPN vegetation mapping projects (TNC and ESRI 1994a), and is based on the National Vegetation Classification Standard adopted by the Federal Geographic Data Committee (FGDC 1997). The NVC evolved from work conducted primarily by The Nature Conservancy (TNC), NatureServe, and the Natural Heritage Program network over more than two decades (Grossman et al. 1998). The structure of the NVC is based in part on an earlier international vegetation classification developed by the United Nations Educational, Cultural, and Scientific Organization (UNESCO 1973, Driscoll et al. 1984). Use of a standardized classification system helps to ensure data compatibility throughout the 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) 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**
Group	Leaf morphology (broad leaf, microphyllous, xeromorphic), leaf phenology, and climatic conditions	Temperate or subpolar needle-leaved evergreen woodland

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

Dinosaur National Monument (DINO) was created in 1915 by proclamation of President Woodrow Wilson (NPS 2008). The original monument boundary included 33 ha (80 acres) surrounding a rich Jurassic fossil quarry adjacent to the Green River. The monument boundary was expanded by proclamation of President Franklin D. Roosevelt in 1938 to include approximately 80,937 ha (200,000 acres) of spectacular canyons cut by the Green and Yampa rivers. Further adjustments to the boundary resulted in the current configuration of 85,096 ha (210,278 acres). About two-thirds of DINO is in northwestern Colorado; the remainder, including the Quarry, is in adjacent eastern Utah (Figure 1).

DINO is located approximately 32 km (20 miles) east of Vernal, UT and approximately 80 km (50 miles) west of Craig, CO. Vernal (population 7,900) is the county seat of Uintah County. Craig (population 9,200) is the county seat of Moffat County. Both Uintah and Moffat counties have very low population densities of six and three people per square mile, respectively. Except for a few parcels of state-owned lands, most lands adjacent to DINO are administered by the Bureau of Land Management (BLM) or are privately owned. Browns Park National Wildlife Refuge abuts a small part of the northern boundary of DINO (Figure 2). The monument may be accessed from several points along US Highway 40 in Colorado and Utah; the Gates of Lodore can be reached from State Highway 318 northwest of Maybell, Colorado.

DINO is in the northeast corner of the Northern Colorado Plateau Network (Figure 1). The vegetation mapping area includes the entire 85,096 ha / 210,278 acres of the monument and approximately 76,073 ha (187,980 acres) of adjacent public lands. The project mapping area totals 161,169 ha (398,258 acres).

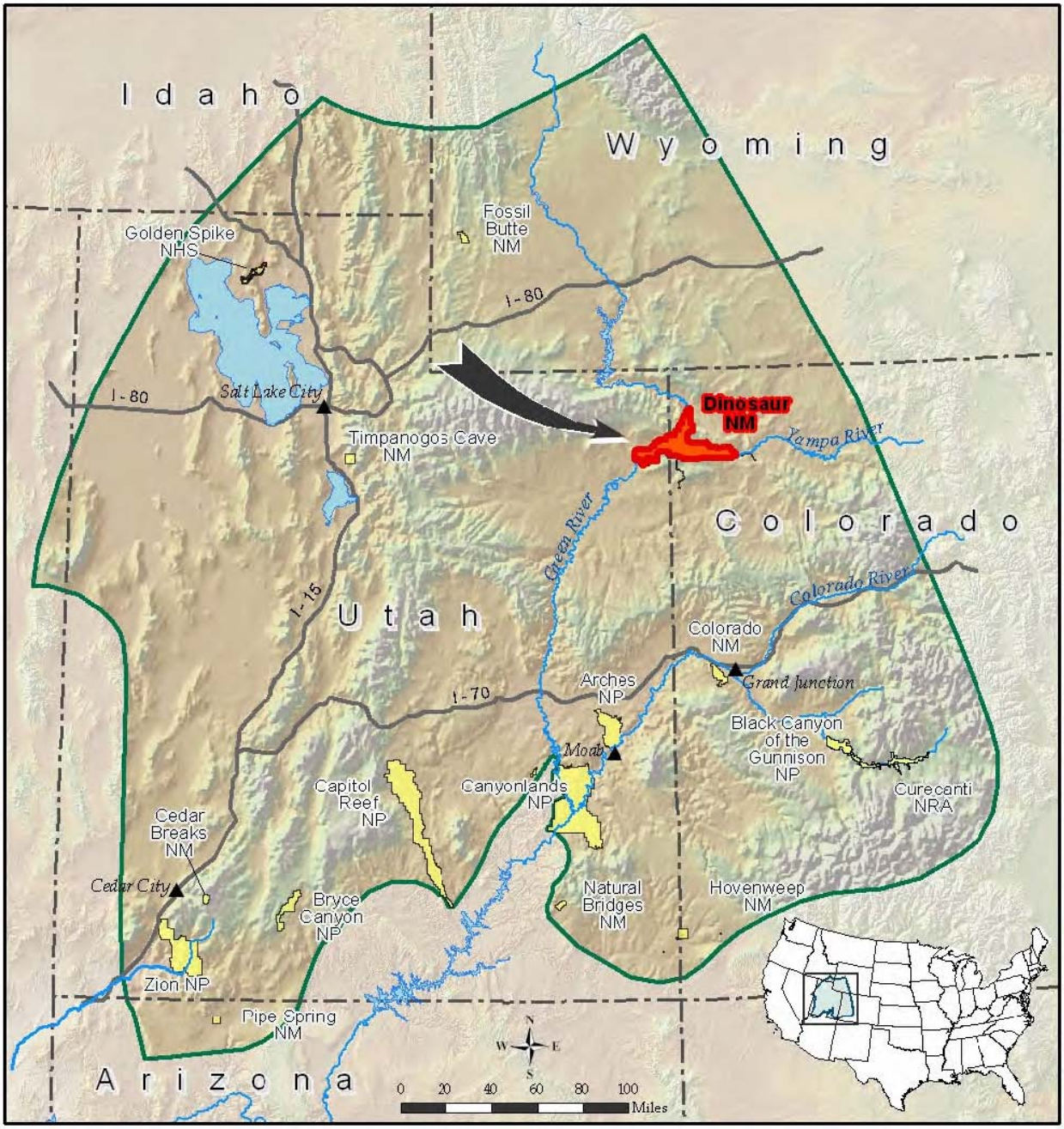


Figure 1. Location of DINO within the Northern Colorado Plateau network of parks.

Topography

DINO occupies the eastern margin of the Uinta Mountain uplift within the Uinta Basin Section of the Colorado Plateaus physiographic province (Fenneman and Johnson 1946, Foos and Hannibal 2000). The Colorado Plateau is 33.5 million ha (130,000 mi^2) in area, ringed by highlands and dissected by deep canyons (Cogan et al. 2004). The Uinta Mountains are a fault

bounded uplift formed by compressional forces. Unlike other similar Laramide uplifts that are north-south oriented, the Uinta Mountains are aligned along an east-west axis.

The geologic description of DINO is that of a complex faulted and dissected anticline. Landscapes within the monument are characterized by rolling plateaus and structural benches deeply incised by canyons carved by the Green and Yampa rivers and their tributaries. Prominent uplands include Split Mountain, Diamond Peak, Douglas Mountain, Blue Mountain, Zenobia Peak, the Yampa Plateau, and the Yampa Bench. The outer limbs of the anticline are marked in many parts of the monument by striking flatirons of Weber Sandstone.

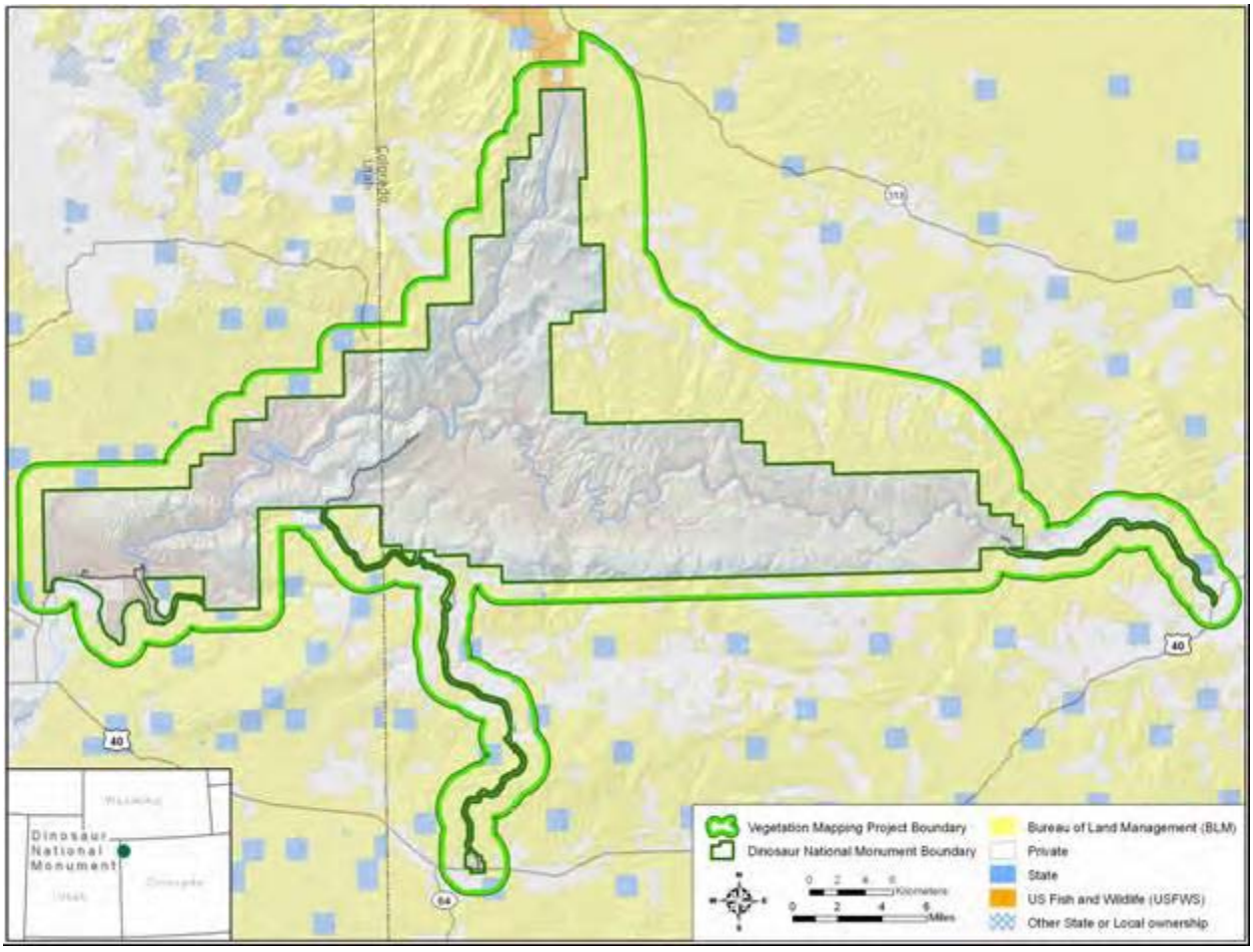


Figure 2. Map of the DINO vegetation mapping project area boundary showing adjacent land ownership.

The forces of wind and water erosion combined to carve sedimentary layers exposed at DINO into the present topography, as well as redistributing surficial deposits of sand and silt. The Yampa River winds for 46 miles from Deerlodge Park to its confluence with the Green River in the middle of the monument. The Green River flows 45 miles from the Gates of Lodore to the mouth of Split Mountain Canyon. The spectacular canyons carved by these rivers are up to 915 m (3,000 ft.) deep in several locations. Elevations within DINO range from 1,442 m (4,730 ft.)

where the Green River exits the southwestern corner of the monument to 2,745 m (9,005 ft.) atop Zenobia Peak. The tremendous elevation differences over short linear distances result in widely varying climatic conditions and diverse plant communities occurring in close proximity.

Climate

Records of climatic conditions have been maintained continuously at the DINO visitor center since 1965 (Western Regional Climate Center 2008). DINO is characterized by a semiarid climate, averaging 29.5 cm (11.6 inches) of annual precipitation (Figure 3). Precipitation is roughly evenly distributed throughout the year with minor peaks during the spring and fall. Total annual snowfall averages approximately 101.6 cm (40 inches) with December and January being the snowiest months.

Conditions within the monument are typical of high-elevation plateaus in the continental interior. Summers are long with hot days averaging 32.6 °C (90.6 °F) and warm nights averaging 13.8 °C (56.8 °F) in July. Hot days typically approach 38 °C (100 °F) and the hottest day on record is 39 °C (103 °F). Winters are cold, with an average maximum temperature of 0.4 °C (32.8 °F) and an average minimum temperature of -11.8 °C (10.7 °F) occurring in January. On the coldest day on record the thermometer fell to -34 °C (-29 °F). The sun shines 78% of the time during the summer and 60% of the time during winter. Prevailing winds are from the west and average wind speed is at its highest (approximately 16 km per hour [10 mph]) between April and July (NRCS 2007).

Weather conditions at the monument can change significantly within a single day, as well. Summer thunderstorms associated with cold fronts can lower temperatures several tens of degrees while dropping more than an inch of rain or hail in less than half an hour.

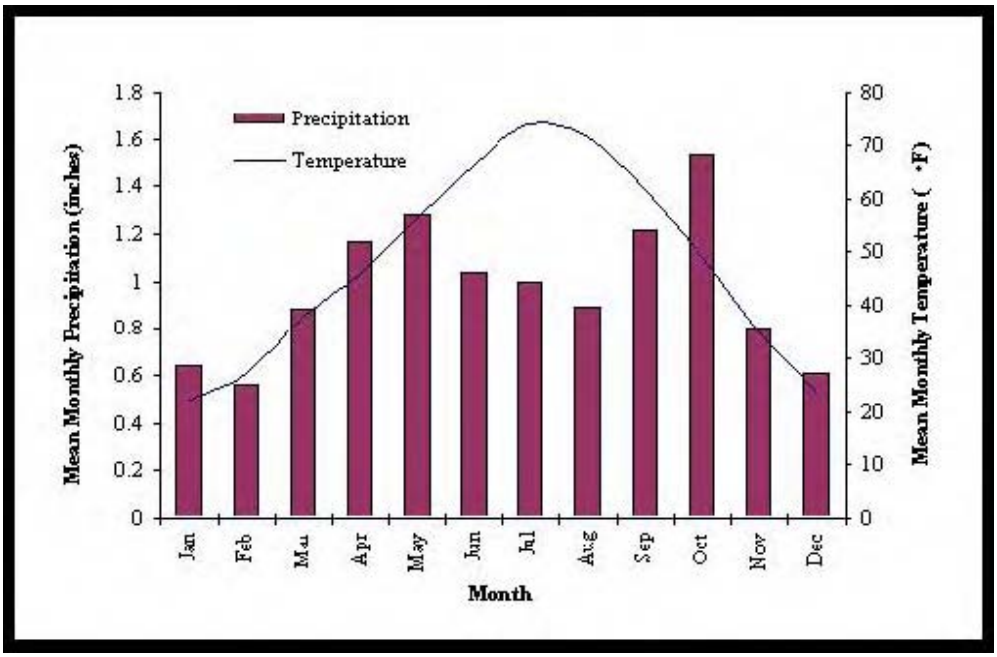


Figure 3. Climate data for DINO (Western Regional Climate Center 2008).

Geology and Vegetation

The original justification for establishing DINO was to protect the sauropod fossils exposed at the Dinosaur Quarry. This quarry has yielded significant fossils of many species of dinosaurs and upper Jurassic reptilians, plants, and invertebrates (West and Chure 1984). The 1938 boundary expansion was intended to protect the deep, scenic canyons formed by the Green and Yampa rivers, as well as exposures of faults and folds of the southeastern Uinta arch. The Uinta arch is an enigmatic east- and northeast-trending structure that formed during a major mountain-building event approximately 70 to 40 million years ago (Gregson and Chure 2003).

The Green and Yampa river canyons also illustrate outstanding examples of superposed streams (waterways that cut through landscape features instead of flowing around them). There has been some debate concerning the explanation of the canyons' origin (Foos and Hannibal 2000). John Wesley Powell's hypothesis was based on the concept of the "antecedent stream," where streams established their courses prior to the uplift of the mountains and eroded through them as the ranges rose. A later hypothesis suggested that the major drainages are "superimposed streams" that established their courses on a sediment-filled plain, then eroded through and exhumed older, buried mountain structures. A third hypothesis is that of "stream piracy," as described by Foos and Hannibal (2000):

> "Initially we had a system of streams that flowed away from the Uinta Mountains. The ancestral Upper Green river flowed east, probably into the Mississippi Basin, and the Lower Green and Yampa Rivers flowed southwest into the Colorado Basin. The Lower Green River eroded northward toward a low point in the crest of the Uinta Mountains. It eventually breached this point and intersected the drainage of the ancestral Upper Green River. Because the base level of the Lower Green was lower than the Upper Green it was able to "capture" its drainage. Once the two rivers combined the drainage system was reinvigorated, with more water and erosive power, resulting in rapid down cutting of the canyons."

The following summary of the geologic history of DINO is derived from McCormick (2003) and Gregson and Chure (2003). DINO contains one of the most complete stratigraphic columns exposed within any NPS unit; geologic processes created the strata and structures visible within DINO cover nearly one billion years (Figure 4). Over the last 270 million years, the rocks have been eroded and buried, tilted and folded, then exhumed and eroded again into the current plateau and canyon landscape. Almost all of the rocks exposed in DINO are sedimentary in origin, ranging in age from late Precambrian Uinta Mountain Group quartzite (800 to 750 million years before present) to Miocene Browns Park Formation conglomerate (5 to 15 MYBP). The lone igneous rock within DINO is an Ordovician dike exposed near Pot Creek. In some parts of the monument, the bedrock is obscured by unconsolidated surficial deposits laid down in the past few millennia by wind, water, or gravity. With the exception of the Silurian and Devonian, rocks representing all of the major periods of the geologic time scale are visible within DINO.

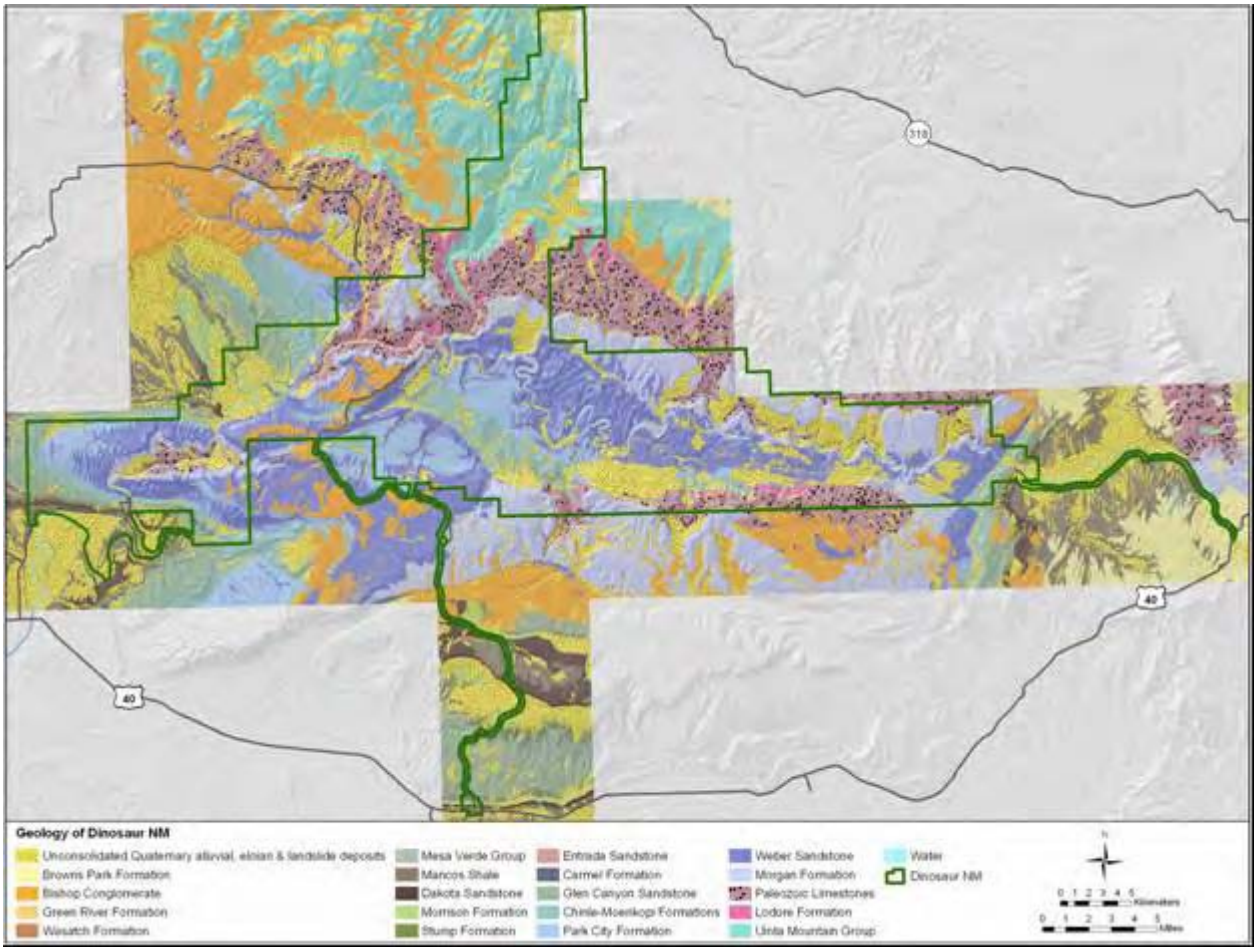


Figure 4. Bedrock geology map of Dinosaur National Monument and vicinity.

DINO lies within the Semiarid Benchlands and Canyonlands section of the Colorado Plateaus Ecoregion (Omernik 1987), also called the Uinta Mountains Section within the Temperate Steppe Regime Mountains Division by Bailey (2001). Regardless of its ecoregional classification, the vegetation can be broadly classified as temperate or semi-desert (West 1988). Although woodlands dominate the landscape, a variety of shrublands and grasslands occupy deeper soils and drier sites. The distribution of vegetation is driven by elevation, substrate (geology and soils), and to a lesser extent, aspect and fire history.

The remainder of this section is a summary of the general distribution of vegetation in relation to geology across the DINO mapping area, organized from oldest to youngest rocks.

Uinta Mountain Group (Late Precambrian). These quartzites and shales were deposited approximately 765 million years ago (Fanning and Dehler 2005) and represent the oldest rocks exposed at DINO. This formation forms the steep walls of Lodore Canyon from the Gates of Lodore to Limestone Draw. It also underlies most of the uplands in the northern third of the monument. Much of this upland area burned in the past five decades; burned slopes have been slow to recover and are now dominated by grasses, forbs, and disturbance-tolerant shrubs such as

rubber rabbitbrush. Unburned areas tend to support pinyon-juniper (*Pinus* spp.-*Juniperus* spp.) woodlands with a grassy or sparse understory on slopes, and a sparse ponderosa pine (*Pinus ponderosa*) community on the exposed bedrock of summits (Figure 5). Canyon walls support sparse mixed shrublands and pinyon-juniper woodlands with little understory. The quartzite is extremely hard and does not lend itself to the development of soil. This probably also contributes to the slow recovery of burned landscapes to the original woodland community.

Lodore Formation (Upper Cambrian). This assemblage of slightly metamorphosed sandstones and shales was deposited between 505 and 525 million years ago. The formation is best exposed in the lower part of Lodore Canyon (below Limestone Draw) and in Whirlpool Canyon. Lodore Formation sandstones are sometimes unvegetated cliffs. More often, slopes and ledges support mixed mountain shrublands and sagebrush (*Artemisia* spp.) shrublands, while ridge tops support pinyon-juniper woodlands and a few ponderosa pine woodlands (Figure 5).



Photo credits: NCPN

Figure 5. Characteristic plant communities of Precambrian (top) and Cambrian (bottom) geologic strata.

Madison Limestone (Lower Mississippian). This formation is 350 to 340 million years old and ranges from 180 to 200 m (600 to 680 ft.) in thickness. It forms a distinctive cliff in Whirlpool Canyon and underlies some highland surfaces in the eastern half of the monument. The characteristic communities found on this formation include pinyon-juniper woodlands with either a grass or a black sagebrush (*Artemisia nova*)-dominated understory, black sagebrush

shrublands, cushion-plant-rich grasslands, or big sagebrush (*Artemisia tridentata*) shrublands in swales where deep soils have developed.

Humbug Formation and Doughnut Shale (Upper Mississippian). These formations represent near-shore and shallow-water depositional environments that existed 340 to 320 million years ago. Each formation ranges from 75 to 90 m (250 to 300 ft.) thick. The Humbug Formation forms ledgy slopes that truncate the underlying Madison Limestone. Humbug and Doughnut outcrops are rare in the monument; for the most part, they are obscured by sediments derived from neighboring formations and vegetated by diverse woodlands of two-needle pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*).



Photo credits: NCPN

Figure 6. Characteristic plant communities of Mississippian geologic strata.

Round Valley Limestone (Lower Pennsylvanian). This formation was deposited approximately 310 million years ago in a shallow sea. Today, it is well-exposed within the monument as gray ledgy slopes and/or multi-tiered cliffs from 65 to 120 m (200 to 400 ft.) thick. The limestone is best seen in the walls of Whirlpool Canyon and capping the southern flank of Douglas Mountain. Canyon wall exposures tend to support pinyon-juniper woodlands with a sparse understory. Upland ridges and slopes more often support black sagebrush shrublands, pinyon-juniper woodlands with a grass or big sagebrush understory, and big sagebrush shrublands (Figure 7).

Morgan Formation (Middle Pennsylvanian). These layered sandstone and limestone rocks were deposited in a shallow, intermittently marine environment approximately 300 million years ago. The formation is 190 to 265 m (600 to 900 ft.) thick and is best exposed in Split Mountain Canyon, the Yampa river canyon above Big Joe rapid, and Whirlpool Canyon. It underlies ridges and slopes on the Yampa Plateau, Wild Mountain, and Douglas Mountain. The massive landslide blocks that form much of the north wall of the Yampa Canyon failed in part because the river undercut a weak shale layer at the base of the formation. This formation supports a range of plant communities, including black sagebrush and cushion-plant barrens on windswept ridgelines, pinyon-juniper woodlands with a variety of understory components, mixed mountain shrublands on steep slopes, and big sagebrush shrublands on moderate slopes (Figure 7).

Weber Sandstone (Middle Pennsylvanian to Lower Permian). This massive, white sandstone was deposited in a Saharan-type sand sea between 300 and 275 million years ago. Exposures may be

as much as 450 m (1,500 ft.) thick and the formation is among the most recognizable in the region in the outer slopes of Split Mountain (Figure, 8) and Cliff Ridge, as well as the near-vertical walls of the Yampa river canyon below Big Joe rapid. Cliffs and barren exposures near the canyon rims are unvegetated or sparsely vegetated by littleleaf mountain mahogany (*Cercocarpus intricatus*), two-needle pinyon pine, and Utah juniper. In areas where soils have developed, a broad range of communities may be present, including pinyon-juniper woodlands and sagebrush shrublands. The summits of Douglas and Split mountains support open, rocky stands of ponderosa pine (Figure 7).

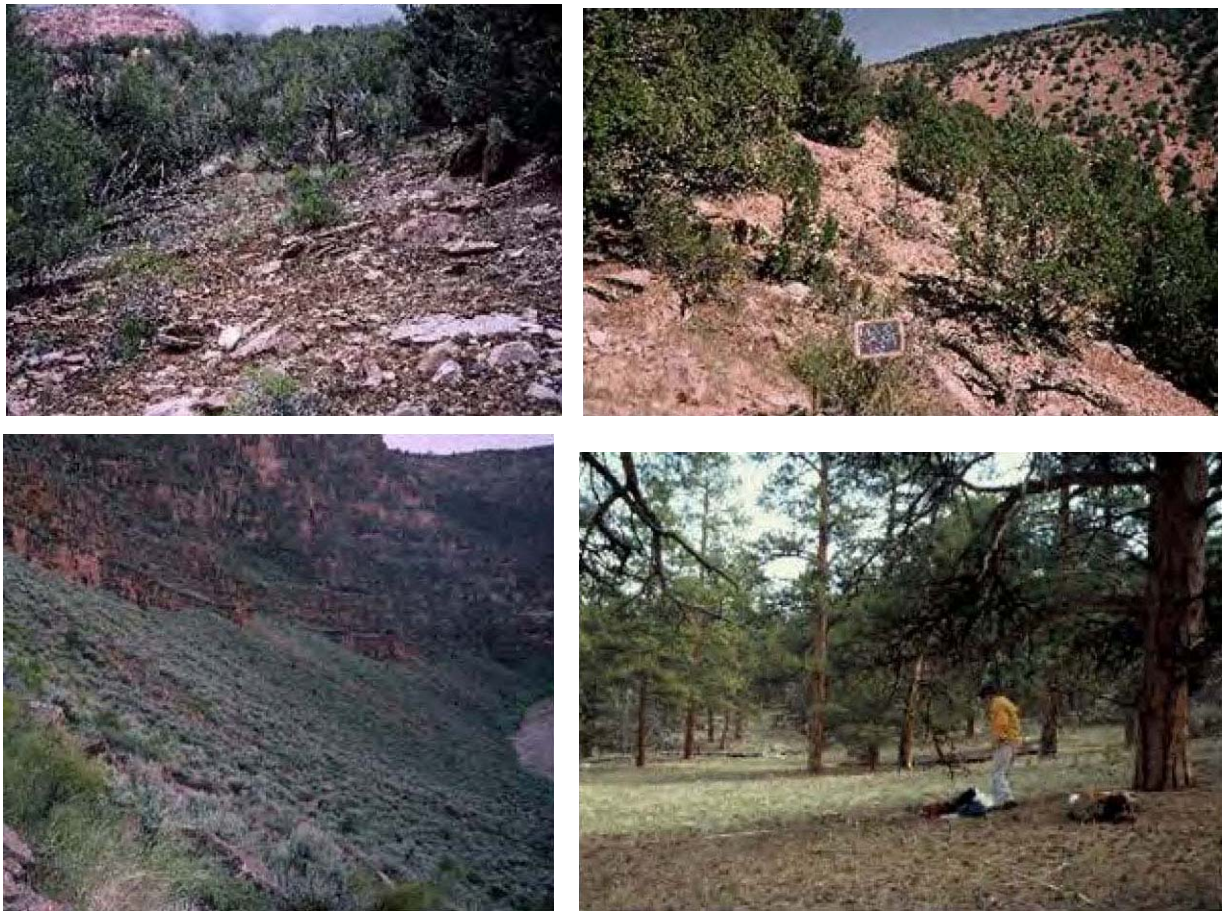


Figure 7. Characteristic plant communities of Pennsylvanian geologic strata.

Park City Formation (Lower Permian). These beds were deposited on a sea floor approximately 250 million years ago and may be up to 130 m (430 ft.) thick. The erosion-resistant limestone at the base of the formation caps the Weber Sandstone on the southern flank of Split Mountain and on Iron Springs Bench. It is also visible at the Harpers Corner overlook. The colorful orange, yellow, and red shales of this formation tend to support a very sparse juniper woodland with salt-tolerant shrubs in the understory (Figure 8), while the basal limestone supports a mosaic of pinyon-juniper woodlands with grasses or black sagebrush in the understory as well as grasslands and black sagebrush shrublands (Figure 8).

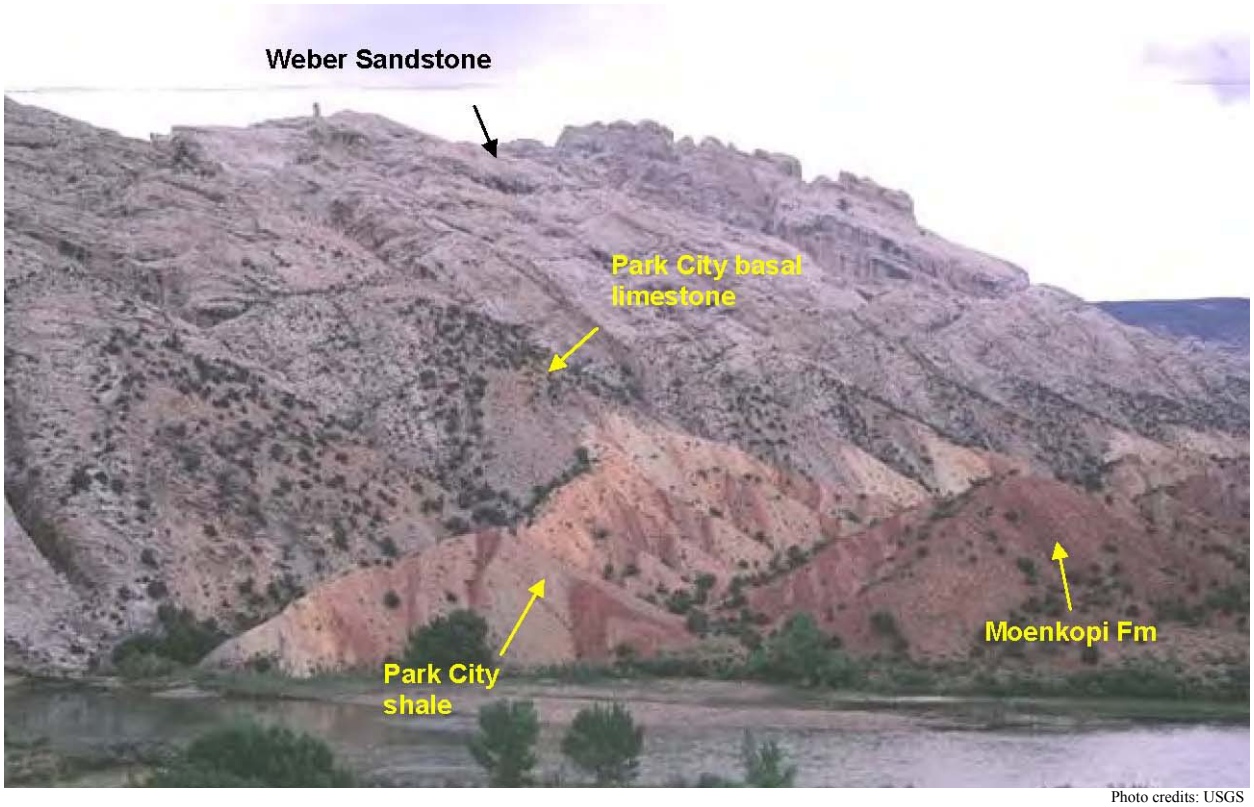


Photo credits: USGS

Figure 8. Characteristic sparsely vegetated exposures of tilted Permian and Triassic geologic strata at the mouth of Split Mountain Canyon.

Moenkopi Formation (Lower Triassic) and Chinle Formation (Upper Triassic). These red beds were deposited between 200 and 220 million years ago on the floor of a shallow sea. A brief regression of the sea resulted in a conglomerate layer (the Gartra Formation) separating the two thick layers of red shale. The soft sediments of the Chinle and Moenkopi formations tend to form slopes and valleys supporting sparse shrublands of big sagebrush or salt-tolerant desert plants (Figure 8). In contrast, north-facing slopes have a characteristic community of pinyon-juniper woodlands with true mountain- mahogany dominating the understory. The Gartra formation appears as a minor caprock supporting open pinyon-juniper woodlands with a variety of understory species (Figure 9).

Glen Canyon Sandstone (Upper Triassic and Lower Jurassic). These petrified sand dunes were deposited approximately 200 million years ago and form prominent hogbacks and cuestas on the flanks of Split Mountain as well as Buena Vista Peak on Blue Mountain. The strata range from 180 to 200 m (600 to 650 ft.) thick and exhibit sweeping cross beds. Glen Canyon Sandstone exposures may be devoid of vegetation or may support communities of two-needle pinyon pine and Utah juniper; littleleaf mountain mahogany, spiny greasebush (*Glossopetalon spinescens*), Utah fendlerbush (*Fendlerella utahensis*), green Mormon-tea (*Ephedra viridis*), Utah serviceberry (*Amelanchier utahensis*), black sagebrush, bluebunch wheatgrass (*Pseudoroegneria spicata*) and Indian ricegrass (*Achnatherum hymenoides*), hairy golden-aster (*Heterotheca villosa*) and other species of cushion plants (Figure 9).





Photo credits: NCPN

Figure 9. Characteristic plant communities of Triassic geologic strata.

Carmel Formation (Middle Jurassic). This distinctive, 155-million-year-old red marine mudstone forms a ribbon of easily eroded rocks approximately 19 to 40 m (60 to 130 ft.) thick. It is exposed in strike valleys ringing the Split Mountain anticline as well as in steep, carmine red slopes in Island Park, Cub Creek and around Plug Hat Rock (Figure 10). Carmel Formation exposures support sparse pinyon-juniper woodlands with little in the understory except for scattered true mountain mahogany (Figure 10).

Entrada Sandstone (Middle Jurassic). These cross-bedded sandstones were deposited as sand dunes approximately 150 million years ago. The formation is exposed as a long line of vertical cliffs 12 to 50 m (40 to 165 ft.) thick in Island Park, Deerlodge Park, and near Plug Hat Rock. Entrada Sandstone exposures may be delineated as a geology map unit or may support dwarfed pinyon-juniper woodlands with littleleaf mountain mahogany or true mountain mahogany dominating the shrub layer.

Stump Formation (Middle and Upper Jurassic). The members of this formation are marine deposits that form ledgy outcrops (Curtis Member) and slopes (Redwater Member). They were deposited from 175 to 150 million years ago to depths of 22 to 72 m (70 to 230 ft.). This formation is relatively thin, and thus appears in very long, narrow outcrops scattered around the margins of the monument. It supports a variety of shrub and herbaceous communities, as well as sparse pinyon-juniper woodlands.

Morrison Formation (Upper Jurassic). Deposited about 145 million years ago, the Morrison Formation is exposed in valleys between hogbacks and in low ridges around the margins of the monument. The formation is composed of multi-hued, clay-rich sediments 200 to 300 m (650 to 1,000 ft.) thick deposited in a swampy, delta environment. This formation is minor in terms of exposures, but is the key to the entire monument, as sandstone lenses within the colorful shale

layers contain the abundant, well-preserved fossil sauropod skeletons that were the original reasons the monument was established. Rainbow Park at the head of Split Mountain Canyon is so named for its purple, green, gray, and white Morrison shale slopes. Morrison Formation exposures may be devoid of vegetation; where vegetated, this formation tends to support sparse shrublands dominated by salt-tolerant saltbush (*Atriplex* spp.) and Salinas lyme grass (*Leymus salinus*), or sparse pinyon-juniper woodlands with little growth in the understory (Figure 10).



Photo credits: NCPN

Figure 10. Characteristic plant communities of Jurassic geologic strata.

Cedar Mountain Formation and Dakota Sandstone (Lower Cretaceous). These similar formations are discontinuous and sometimes difficult to distinguish. They were deposited 110 to 120 million years ago in beach and stream environments. They range from 12 to 60 m (40 to 200 ft.) thick and like most of the younger formations exposed at DINO, Cedar Mountain and Dakota sandstones are evident mostly in hogbacks around the margins of the mapping area. Cracks in the rock collect water and soil, so that these formations tend to support sparse woodlands with species usually found at slightly higher elevations, including pinyon pine, Utah serviceberry (*Amelanchier utahensis*), and several species of mountain mahogany (Figure 11).

Mowry Shale (Lower Cretaceous). Deposited approximately100 million years ago, the Mowry Shale ranges from 10 to 65m (33 to 220 ft.) thick. It is a marine deposit and includes intermittent bentonite clay beds. It forms a low, distinctive hogback around the base of Split Mountain and in Deerlodge Park. Wherever this formation is exposed within the mapping area, it supports an unusual plant community. In Deerlodge Park, it supports an isolated, low-elevation stand of ponderosa and pinyon pines (Figure 11). On the southern flanks of Split Mountain, it is easily recognized not only because of its blue-white color, but also the unusual community of crispleaf wild buckwheat (*Eriogonum corymbosum*) shrubs (Figure 11). On the north side of Split Mountain, near Rainbow Park, it supports a very sparse community of montane species such as pinyon pine and serviceberry at an unusually low elevation.

Frontier Sandstone (Upper Cretaceous). This formation was deposited approximately 100 million years ago near the shoreline separating marine and swampy environments. It ranges from 35 to 90 m (115 to 300 ft.) thick and forms minor hogbacks among the outermost ridges flanking Split and Blue mountains. This seldom-exposed formation tends to support shrublands of big sagebrush (*Artemisia* spp.) and/or salt-tolerant saltbush species, or sometimes is unvegetated.

Mancos Shale (Upper Cretaceous). This formation was deposited approximately 90 million years ago on the floor of a shallow sea; the entire formation is more than 1,500 m (5,000 ft.) thick, although only the upper parts of the formation are exposed within the mapping area. Because this is a soft shale, it tends to form flats and broad valleys that are quickly buried in eroded materials from higher elevations. Near the Dinosaur Quarry, it appears only in low, rounded hogbacks; in Deerlodge Park it forms rolling hills and flat-topped ridges capped by Pleistocene alluvium. Some exposures are unvegetated; rarely does vegetative cover exceed 15%. Mat saltbush (*Atriplex corrugata*) is the most common species found growing on the Mancos Shale (Figure 11); sparse grasslands of Salinas lyme grass occur on north-facing slopes. Other saltbush species may occur on outcrops, and flats are typically dominated by exotic annual grasses and forbs.



Photo credits: NCPN

Figure 11. Characteristic plant communities of Cretaceous geologic strata.

Bishop Conglomerate (Oligocene). This formation was deposited approximately 29 million years ago as coarse, calcareous outwash shed from a rising Uinta Mountain range. It forms level benches on Blue Mountain, the Yampa Plateau, Ruple Ridge, Harper's Corner, Jones Hole, and in the upper tributaries of Lodore Canyon. It ranges in thickness from 60 to 150 m (200 to 500

ft.). Bishop Conglomerate exposures typically support pinyon-juniper woodlands and shrublands with a well-developed understory that may include greenleaf manzanita (*Arctostaphylos patula*), mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), black sagebrush, bluebunch wheatgrass, Indian ricegrass, and mixed cushion plants (Figure 12).

Browns Park Formation (Miocene). This formation accumulated in a topographic and structural trough approximately 5 to 15 million years ago and is exposed north of the Gates of Lodore in a bench separating Vermilion Creek from the Green River. It can attain a thickness of 490 m (1,600 ft.). Generally, this layer is a series of rhyolitic, light-colored, cross-bedded to massive, glassy tuffs deposited by airfall and reworked by wind and streams, eroding to unique sand dune features. Browns Park Formation exposures typically support shrublands characterized by spiny hopsage (*Grayia spinosa*), black greasewood (*Sarcobatus vermiculatus*), shadscale (*Atriplex confertifolia*), Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), and snakeweed (*Gutierrezia sarothrae*). The understory of this community includes the grasses sandhill muhly (*Muhlenbergia pungens*), Indian ricegrass, needle-and-thread (*Hesperostipa comata*), and cheatgrass (*Bromus tectorum*), and the forb hairy golden-aster (*Heterotheca villosa*) (Figure 12).



Photo credits: NCPN

Figure 12. Characteristic plant communities of Oligocene (L) or Miocene (R) geologic strata.

Surficial Deposits (Pleistocene and Holocene). Unconsolidated surface deposits dating from approximately one million years ago to present are widespread throughout the monument. Weathering, erosion, and sedimentation contribute to the formation and distribution of colluvium, talus, landslides, eolian sands and loess, and alluvium,. Surficial deposits are generally vegetated (Figure 13), except for some talus deposits and active stream channels.

Colluvial deposits originate in cliffs and outcrops of hard rocks such as sandstone, limestone, and quartzite. Weathering processes cause pieces of the exposed bedrock to break off and fall onto slopes below, and over time colluvium may cover most or all of the surface. These slopes often include softer rocks such as shale, mudstone, and siltstone. Most areas of colluvium are on the walls of the main canyons. Larger blocks of colluvium help to stabilize the slope and provide germination sites for long-lived woody species of shrubs and trees. Within DINO, colluvium supports most of the mixed canyon wall vegetation types, quaking aspen (*Populus tremuloides*) and Douglas-fir (*Pseudotsuga menziesii*) woodlands, and large stands of mixed mountain shrublands. Talus is a specialized type of colluvium, consisting of a thick layer of broken rock

that completely covers the underlying substrate. Talus fields can act as cold air traps because the rock "mulch" holds ice and snow well into the growing season. Most talus fields are sparsely vegetated, but species such as chokecherry (*Prunus virginiana*) and serviceberry (*Amelanchier* spp.) thrive on the margins of talus fields (Figure 13).

Landslides also result from the downslope movement of geologic material, but this term describes conditions (sometimes facilitated by groundwater) under which an entire slope fails and breaks up as it moves, rapidly or slowly, downslope. Small landslides may be called slumps or slips. A series of very large landslides form the scalloped northern wall of the Yampa river canyon. These landslides occurred when a shale layer at the base of the Morgan Formation failed, allowing huge blocks of bedrock to rotate and collapse as they slumped toward the river. Landslides support pinyon-juniper woodlands with a sparse understory (Figure 13). Many small springs emerge from the landslide debris, including Warm Spring and the springs of Lake Bench.

Eolian deposits include sand, usually derived from local sandstones and alluvium, as well as loess, which may originate from distant sources. Eolian sands, derived primarily from Glen Canyon sandstone, cover much of the lower slopes of Split Mountain. These deposits support a community of pinyon and juniper trees that are widely spaced and have very large crowns (Figure 13). The understory is often nearly devoid of vascular vegetation, but may support a well-developed biological soil crust in areas that have not been disturbed by grazing or recreation. Other eolian sand deposits support sagebrush shrublands, or rubber rabbitbrush (*Ericameria nauseosa*) shrublands where fires have burned in recent decades. Whether or not woody species are present, these sandy sites tend to support high cover by native bunchgrasses including Indian ricegrass (*Achnatherum hymenoides*) and needle-and-thread (*Hesperostipa comata*) (Figure 13). Silty eolian deposits support big sagebrush shrubland and pinyon-juniper woodlands with a sagebrush understory on the Yampa Bench.

Alluvial deposits along the rivers and most of the major tributaries support a diversity of vegetation, varying primarily based on depth to the water table. The best drained sites on higher river and stream terraces, swales, and intermittent drainages support woodlands of two-needle pinyon pine or Utah juniper. Finer-textured soils with good drainage often support shrublands of basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*), Wyoming big sagebrush, shadscale, spiny hopsage, rubber rabbitbrush, or grasslands dominated by needle-and-thread, alkali sacaton (*Sporobolus airoides*), basin wildrye (*Leymus cinereus*), and cheatgrass. Middle terraces may support dense stands of the non-native forb quackgrass (*Elymus repens*) (Figure 13).

Lower terraces and river banks support riparian woodlands or gallery forests of Rio Grande cottonwood (*Populus deltoides* ssp. *wislizeni*), narrowleaf cottonwood (*Populus angustifolia*), lanceleaf cottonwood (*Populus* x *acuminata*), boxelder (*Acer negundo*), hackberry (*Celtis laevigata* ssp. *reticulata*), Rocky Mountain juniper (*Juniperus scopulorum*), Russian-olive (*Elaeagnus angustifolia*), water birch (*Betula occidentalis*); shrublands characterized by sandbar willow (*Salix exigua*), threeleaf sumac (*Rhus aromatica* var. *trilobata*), and salt-cedar or tamarisk (*Tamarix ramosissima*); and herbaceous communities comprised of basin wildrye, saltgrass (*Distichlis spicata*), and cheatgrass (Figure 13). Black greasewood and rubber rabbitbrush may occur with an alkali sacaton and/or saltgrass understory on alkaline sites. Patches and small stands of the non-natives cheatgrass, perennial pepperweed (*Lepidium*

latifolium), rough cocklebur (*Xanthium strumarium*), Russian-thistle (*Salsola tragus*), lambsquarter (*Chenopodium album*), and desert madwort (*Alyssum desertorum*) can occur.

Gravelly, intermittent washes typically support open stands of rubber rabbitbrush, viscid rabbitbrush (*Chrysothamnus viscidiflorus*), spearleaf rabbitbrush (*Chrysothamnus linifolius*), basin big sagebrush, or green Mormon-tea. Alkaline or saline flats typically support black greasewood, Gardner saltbush (*Atriplex gardneri*), halogeton (*Halogeton glomeratus*), and bur-buttercup (*Ranunculus testiculatus*).

Point bars and river banks sometimes support grass or grass-like stands characterized by common reed (*Phragmites australis*), reed canarygrass (*Phalaris arundinacea*), alkali cordgrass (*Spartina gracilis*), prairie cordgrass (*Spartina pectinatus*), scouring-rush (*Equisetum* spp.), needle-and-thread, Indian ricegrass, sand dropseed (*Sporobolus cryptandrus*), purple threeawn(*Aristida purpurea*) or stands of forbs, including wild licorice (*Glycyrrhiza lepidota*) and common milkweed (*Asclepias speciosa*). Alkaline sites may support alkali sacaton (*Sporobolus airoides*), Baltic rush (*Juncus balticus*), hardstem bulrush (*Schoenoplectus acutus*), and three-square bulrush (*Schoenoplectus pungens*). Stands of the invasive perennial peppergrass (*Lepidium latifolium*) may also occur. Seeps and sites with saturated soil support mountain willow (*Salix monticola*) shrublands at higher elevations and the graminoids, including Nebraska sedge (*Carex nebrascencis*), woolly sedge (*Carex pellita*), clustered field sedge (*Carex praegracilis*), and spikerush (*Eleocharis palustris*); the exact composition varies with the alkalinity of the groundwater, elevation, and the stability of the substrate.








Photo credits: NCPN

Figure 13. Characteristic plant communities of unconsolidated geologic strata: eolian (top), alluvial (middle), and colluvial (bottom).

Soils

Eighty soil series or soil complexes are known to occur in the monument (Appendix I), varying widely in erodibility and productivity depending on topographic position, parent material, hydrology, slope, and other factors (NRCS 2007). Most of the soils in the monument are likely to form a surface crust. Precipitation is the main controlling factor for soil productivity. Relatively low precipitation typical of the monument produces limited vegetative cover and consequently limited soil organic matter. Soil susceptibility to water erosion is generally slight to moderate, but can be severe in areas with low permeability. Runoff potential is generally moderate.

On a broad scale, soils mapped at DINO are contained within four ecotypes and one life zone (NRCS 2007):

(1) Desert Ecotype (3% of DINO)
   a. One map unit of hills, hillslopes, terraces, and alluvial flats
   b. Nearly level to steep slopes
   c. Very deep, well-drained soils (fine sandy loam, sandy loam, silty clay loam)
   d. Soils formed in alluvium and colluvium and/or residuum
   e. Characteristic plant communities include black greasewood, alkali sacaton, shadscale, mat saltbush, Indian ricegrass, James' galleta, seepweed

(2) Semi Desert Ecotype (19% of DINO)
   a. One map unit of cuestas, hills, hillslopes, structural benches, and fan remnants
   b. Nearly level to steep and steep slopes
   c. Very shallow to very deep, well-drained to excessively drained soils (loamy fine sand, cobbly loam, extremely channery loam)
   d. Soils formed in eolian deposits, alluvium and/or colluvium
   e. Characteristic plant communities include pinyon pine, Utah juniper, true mountain mahogany, black sagebrush, Wyoming big sagebrush, Mormon tea,

winterfat, Salinas lyme grass (*Leymus salinus*), bluebunch wheatgrass, James' galleta, Indian ricegrass, needle-and-thread

(3) Upland Ecotype (25% of DINO)
   a. One map unit of mountains, ridges, cliffs, hills, and valleys
   b. Gentle to steep and very steep slopes
   c. Shallow to very deep, well-drained (very channery loam, gravelly loam, exposed hard sandstone or limestone) soils
   d. Soils formed in residuum or are exposed hard sandstone and limestone rocks;
   e. Plant communities include Utah juniper, pinyon pine, true mountain mahogany, black sagebrush, Wyoming big sagebrush, antelope bitterbrush, Mormon tea, bluebunch wheatgrass, Indian ricegrass, needle-and-thread

(4) Mountain Ecotype (50% of DINO)
   a. One map unit of mountains, cliffs, and canyons
   b. Steep to very steep (Rock Outcrop, Torriorthents, Ustorthents) slopes
   c. Soils are very shallow to moderately deep (gravelly loam, cobbly loam, exposed hard sandstone or limestone) and well drained
   d. Soils formed in colluviums and/or residuum or are exposed hard sandstone and limestone rocks
   e. Plant communities include Utah juniper, pinyon pine, true mountain mahogany, Utah serviceberry, mountain snowberry, mountain big sagebrush, Wyoming big sagebrush, antelope bitterbrush, Mormon tea, bluebunch wheatgrass, Idaho fescue, Indian ricegrass, needle-and-thread, western wheatgrass

(5) Riparian Life Zone (3% of DINO)
   a. One map unit of floodplains and fan remnants
   b. Soils are level to gently sloping (Green River, Riverwash, Ustic Torrifluvents)
   c. Soils are very deep (fine sandy loam) and moderately well drained to well drained
   d. Soils formed in alluvium
   e. Plant communities include Utah juniper, pinyon pine, Fremont cottonwood, basin big sagebrush, rubber rabbitbrush, sandbar willow, bluebunch wheatgrass, needle-and-thread, Indian ricegrass, western wheatgrass, basin wildrye, bluegrass, alkali sacaton, saltgrass

In areas of similar climate, topography, and land-use history, differences in the kind and density of vegetation are closely related to soil characteristics. Ecological sites describe this relationship using combinations of: (1) characteristic soils that have developed over time; (2) characteristic hydrology including infiltration and runoff; and (3) establishment of a characteristic plant community or vegetation type (NRCS 2007). Ecological sites described for DINO include:

(1) Alkali Flat (Greasewood)
(2) Clayey Saltdesert
(3) Clayey Slopes
(4) Desert Loam (Shadscale)
(5) Desert Shallow Clay (Mat Saltbush)

(6) Loamy Bottom (Basin Big Sagebrush)
(7) Mountain Loam (Mountain Big Sagebrush)
(8) Mountain Shallow Loam (Mountain Big Sagebrush)
(9) Mountain Stony Loam
(10) Mountain Stony Loam (Bitterbrush)
(11) Mountain Stony Loam (Browse)
(12) Mountain Windswept Ridge (Black Sagebrush)
(13) River Floodplain (Fremont Cottonwood)
(14) Rolling Loam
(15) Sandy Foothills
(16) Sandy Land
(17) Semidesert Clay Loam
(18) Semidesert Gravelly Sandy Loam (Wyoming Big Sagebrush)
(19) Semidesert Loam
(20) Semidesert Loam (Wyoming Big Sagebrush)
(21) Semidesert Sand (Fourwing Saltbush)
(22) Semidesert Sandy Loam
(23) Semidesert Sandy Loam (Fourwing Saltbush)
(24) Semidesert Shallow Loam (Wyoming Big Sagebrush)

Hydrology and Water Resources

Although most of the monument consists of xeric uplands, it also contains diverse water resources in the form of rivers, perennial and intermittent streams, seeps, and springs. The Green and Yampa rivers form the core of management interest within DINO; the Green River flows into the monument from the north at the Gates of Lodore and the Yampa River flows into the monument from the east at Deerlodge Park. The confluence of the Yampa and Green rivers occurs at Echo Park near the center of the monument. The rivers alternate between narrow, bedrock-controlled canyons and broad valleys with well-developed floodplains where the geology consists of softer marine shales.

The Green River hydrograph was significantly modified by the closure of Flaming Gorge Dam upstream from DINO in 1962 (NRCS 2007). The timing and magnitude of flows, water quality, sediment loads, and river habitats through the monument have been markedly altered by dam operation. In recent years, characterized by moderate to severe drought, flows released from Flaming Gorge Dam have been restricted to around 850 cfs. In many areas, the lack of peak floods and overbank sediment deposition has caused the Green River to become entrenched in its own channel. Many terraces are no longer connected to the water table, and the communities they support are transitioning to upland vegetation.

The Yampa River is essentially free-flowing, affected minimally by a few small headwater impoundments. Average annual flows on the Yampa River range from peaks of 13,700 cfs in May-June to lows of 350 cfs (USGS 2008) in the late summer and mid-winter. The unaltered runoff pattern in the Yampa River mitigates some of the effects of Flaming Gorge Dam below the confluence with the Green River (NRCS 2007). The Yampa River is the only remaining large tributary in the Colorado River system that retains its free-flowing character, making the river the single most important area in the Colorado River watershed for survival of four federally

listed endangered fish species: humpback chub (*Gila cypha*), bonytail chub (*Gila elegans*), Colorado pikeminnow (*Ptychocheilus lucius*), and razorback sucker (*Xyrauchen texanus*), as well as roundtail chub (*Gila robusta*), currently considered a sensitive species (U.S. Fish and Wildlife Service 1994).

Perennial tributary streams within the monument include Rippling Brook, Pool Creek, Alcove Brook, Cub Creek, and Jones Hole Creek. Only Pool and Jones Hole creeks contribute significant base flows; however, flash flooding and debris flows are possible from early spring through fall in any tributary. The monument also contains limited water resources in the form of intermittent streams, plunge pools, intermittently filled bedrock potholes (tinajas), seeps, and springs. Intermittent streams in side canyons may support stands of riparian and wetland vegetation, especially below pour-offs where plunge-pools form.

Tinajas develop in solution pits formed in level exposures of sandstone and limestone; the geology at DINO are such that few potholes hold more than a few hundred gallons of water. Seeps and springs with flow rates of only a few gallons per minute provide sufficient water for localized surface flows in canyon heads and moist to saturated soils where they emerge from bedding planes and joints in sandstone cliffs. These seeps may provide hanging garden habitat for the Mancos columbine – Ditch reedgrass (*Aquilegia micrantha – Calamagrostis scopulorum*) Herbaceous Vegetation association, also characterized by darkthroat shootingstar (*Dodecatheon pulchellum*), sheathed deathcamas (*Zigadenus vaginatus*), and stream orchid (*Epipactis gigantea*). Seeps emerging from cliff faces often deposit dissolved salts as the water evaporates, staining the surface white.

Biological Soil Crusts

Biological soil crusts occur commonly within DINO, particularly where thin, sandy soils overlie slickrock (Figure 14). 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 erosion or land uses such as livestock grazing have removed the crusts, decades can pass before they begin to reestablish.



Figure 14. Example of well-developed biological soil crusts on the Colorado Plateau (l) and in Dinosaur National Monument (r).

Land Use and Settlement History

Dinosaur National Monument has a long history of human occupation and use (NPS 2005, NPS 2008). The monument is significant as a transition zone between Desert, Intermontane, and High Plains Native American cultures (8000 B.C. to A.D. 950). Available data suggests that use of the DINO area by prehistoric peoples reached its apex during the Desert Archaic Period (6,0001,900 years ago) with cultural influences from the Wyoming Basin, Western Great Plains, and the Four Corners region. The monument also contains excellent examples of artifacts representing the Fremont culture (A.D. 950 to 1150). Of more than 400 prehistoric sites recorded within DINO, seventy are rock art sites belonging to the Fremont culture. The Fremont occupation of the area was extensive and included pit house villages whose occupants raised corn as an important subsistence food.

During historic times, the northern portion of DINO was used as hunting grounds by the Shoshone Tribe and the southern portion by the Ute Tribe (NRCS 2007). This pattern changed following 18th century European exploration of the region and settlements that began in the second half of the 19th century (Athearn 1982). The monument retains many traces of the early homesteading and ranching period. The Chew Ranch and the Baker cabin located on the Yampa Bench are remnants of early European settlements; descendents of these families remain in the area to this day.

Current land use within the monument is varied. Recreational use is concentrated along roads and boating access points. Many visitors hike the short trails accessible from the Harpers Corner Road and the Quarry Entrance Road. Deerlodge Park, Echo Park, Rainbow Park and the mouth of Split Mountain Canyon are the major access points for boaters; each has a boat ramp and associated camping or picnic developments. The Dinosaur Quarry Visitor Center is currently closed due to structural issues with the building, but when open is very popular with visitors, as it provides close-up display of in-situ fossils showing their natural arrangement.

Human activities within the DINO landscape over the past 150 years have resulted in changes in the distribution and abundance of native vegetation and have contributed to invasions of non-native plant species. In particular, livestock grazing and fire suppression allowed big sagebrush, two-needle pinyon pine, and Utah juniper and increase while decreasing the abundance of native grasses. Much of DINO has been grazed for more than a century; ranching began on a large scale in the 1880s and the area was heavily used by both cattle and sheep through the 1920s (Athearn 1982). The combination of fire suppression and repeated spring and summer grazing pressure has converted much of the sagebrush/ perennial grass shrub-steppe to monotypic, decadent Wyoming big sagebrush stands with invasive annual understories (Petersburg personal communication 2004).

Fire suppression has also resulted in the increase and encroachment of Utah juniper at lower elevations and may account for loss of some Wyoming big sagebrush communities (Petersburg personal communication 2004). Pre-settlement return intervals for lightning-ignited fires are estimated at 10 to 70 years in big sagebrush / mixed grassland types. Ground fires can be expected in pinyon-juniper stands every 10 to 50 years, while stand-replacing fires occur only every 100 to 400 years (Petersburg personal communication 2004). This type of fire history was sufficient to prevent pinyon and juniper trees from encroaching into big sagebrush / mixed grassland habitat. Current fire management practices are designed to restore a more natural fire regime through use of prescribed fire and fire effects monitoring.

Early settlers to the area arrived in the mid-1800s and established homesteads and ranches, introducing some of the first non-native plants to the area for livestock forage. More recently, development of roads, campgrounds, trails, boat ramps, picnic areas, and buildings to accommodate increased visitation has contributed to the establishment of non-native species.

At present, 75 of the 687 plant species known to occur within DINO are non-native, some imported accidentally by livestock, maintenance and construction activities, and visitors (Naumann 1990; Appendix D). Other species were intentionally introduced, such as chicory (*Cichorium intybus*) and burdock (*Arctium minus*) for food, smooth brome (*Bromus inermis*) for forage, or tamarisk (*Tamarix ramosissima*), crested wheatgrass (*Agropyron cristatum*) and yellow sweetclover (*Melilotus officinalis*) for soil stabilization. DINO began managing for invasive species because of three concerns: (1) negative effects on native plant communities and associated wildlife species, (2) effects on natural river processes and aquatic resources, and (3) concerns from downriver agricultural producers regarding invasions of perennial pepperweed (*Lepidium latifolium*) and Russian knapweed (*Acroptilon repens*) into irrigated pastures (Naumann 2003).

Previous Vegetation Studies

DINO is an area where elements of Great Basin, Colorado Plateau, Wyoming Basins and Rocky Mountain floras converge, and partly because of the diverse geology, it is also rich in rare and endemic species and native plant communities. For these reasons, the area has drawn much interest from botanists and ecologists since the monument was established. Ecologists have also been drawn to DINO because it offers the opportunity to compare riparian communities associated with controlled (Green), uncontrolled (Yampa), and hybrid (Green below the

confluence with the Yampa) river systems. The list of reports and scientific publications for DINO's flora and vegetation is extensive; only a few will be discussed here.

The earliest regional floristic inventory that included DINO was by Graham (1937); this work also contains descriptions of common plant associations. It was completed before the monument was expanded to include the Green and Yampa river canyons, so the congruence with the current monument boundary is imperfect. Two plant surveys were published in 1957: a new inventory of plant species presented in an ecologic and geologic context by Welsh, and an annotated checklist of the flora (and fauna) by Beidleman based on a review of herbarium collections. In 1962, Goodrich and Neese published Uinta Basin Flora, which remains the best field key for the monument. A thorough, systematic inventory of the monument's flora took place between 1987 and 1989 (Naumann 1990); in addition to documenting common species, researchers made a special effort to identify as many populations of rare and endemic plant species as possible. These major studies, as well as several smaller ones and incidental collections have documented nearly 700 plant species occurring within the monument (Appendix D).

While the Graham (1937) and Welsh (1957) reports provided informal documentation of the plant associations of the monument, the first attempt to systematically survey, classify and map vegetation was undertaken by Wathen and Friedlander (1983). Their mapping units were relatively broad in scope, including 16 vegetation types that incorporated a larger number of plant associations (Table 2). There is little documentation available for this study, but the associations appear to follow European phytosociological naming conventions. Associations were sampled in plots of variable sizes, based on ocular estimates of cover. The map was drawn on 1:24,000-scale topographic maps and was used primarily for fire planning and management at the time the Vegetation Mapping Program began work at DINO in 2002.

Table 2. Vegetation types identified and mapped for Dinosaur National Monument by Wathen and Friedlander (1983). Species names have been updated to Kartesz (1999).

Vegetation Type / Map Unit	**Associations (not a complete list)**
Alpine	*Festuca ovina-Koeleria micrantha-Stenotus acaulis*
Annual Grass	*Bromus tectorum*
Native Grass	*Hesperostipa comata-Bromus tectorum, Leymus cinereus-Bromus tectorum*
Sagebrush	*Artemisia tridentata/Hesperostipa comata-Festuca idahoensis, Artemisia tridentata/Hesperostipa comata-Balsamorhiza sagittata, Artemisia nova/Koeleria macrantha, Artemisia tridentata/Pseudoroegneria spicata*
Desert Shrub	*Atriplex confertifolia-Artemisia tridentata/Bromus tectorum, Sarcobatus vermiculatus-(Artemisia tridentata)/Bromus tectorum*
Pinyon-Juniper Desert Shrub	*Juniperus osteosperma/Artemisia tridentata-Gutierrezia sarothrae-(Glossopetalon spinescens)/Bromus tectorum*
Pinyon-Juniper	*Juniperus osteosperma/Opuntia/Bromus tectorum*
Pinyon-Juniper/Sagebrush	*Juniperus osteosperma/Artemisia tridentata/Koeleria macrantha-Pseudoroegneria spicata, Juniperus osteosperma/Artemisia nova/Koeleria macrantha*
Mountain Shrub	*Cercocarpus ledifolius/Symphoricarpos oreophilus/Agropyron smithii, Amelanchier utahensis/Artemisia tridentata, Cercocarpus montanus-Artemisia tridentata/ Hesperostipa comata*
Pinyon-Juniper Mountain Shrub	*Pinus edulis/Cercocarpus montanus/Koeleria macrantha-Pseudoroegneria spicata*
Giant Mountain Mahogany	*Cercocarpus ledifolius/Amelanchier utahensis-Symphoricarpos oreophilus*
Hackberry	*Celtis laevigata ssp. reticulata/Phragmites australis-Bromus tectorum*

Box Elder	*Acer negundo/Prunus virginiana, Acer negundo/Juniperus scopulorum/Bromus tectorum*
Cottonwoods	*Populus deltoides ssp. wislizeni/Artemisia tridentata/Bromus tectorum*
Ponderosa Pine	*Pinus ponderosa-Pinus edulis-Juniperus osteosperma/Festuca idahoensis*
Aspen	*Populus tremuloides/Symphoricarpos oreophilus/*Shrubs
Douglas-fir	*Pseudotsuga menziesii-Juniperus scopulorum/Ribes cereum/Pseudoroegneria spicata*

There is a significant body of peer-reviewed and gray literature concerning the riparian systems of the monument, most of it completed in the past 25 years. Prior to the closure of Flaming Gorge Dam in 1962, the Yampa and Green rivers were very similar in discharge, water chemistry, sediment load, and fish communities, with minor differences in the timing of peak discharge (Neuhold 1981). Fischer et al. (1983) investigated pre- and post-dam floodplain morphology and vegetation in order to predict the effects of a proposed dam on the ecology of the Yampa River. Cooper and Merritt (1995) conducted a series of experiments to determine limiting factors and optimal conditions for cottonwood recruitment on the Yampa and Green rivers. Merritt (1997) completed a direct comparison of geomorphic surfaces, substrate characteristics and woody plant communities of the two river systems. Grams and Schmidt (e.g., 1999, 2002) studied the effects of upstream dam management on floodplain geomorphology of the Green River. Recent studies have focused on changes in floodplain geomorphology following tamarisk removal on the Green River (e.g., Alexander et al. 2005).

The first systematic invasive plant inventory occurred in 1996 when approximately 300 acres affected by six target species (perennial pepperweed, Russian-olive, tamarisk, Russian knapweed, Canada thistle (*Cirsium arvense*), and leafy spurge (*Euphorbia esula*)) were identified and mapped along roads and around campgrounds, housing, headquarter areas, and in the river corridors (NPS 2005). A systematic inventory of areas with a high potential for invasive plants was conducted between 2003 and 2004 (Dewey et al. 2003, Dewey and Andersen 2005). This study searched 11,567 ha (28,583 acres) of the monument, including selected backcountry areas, locating populations of 22 exotic and invasive weeds covering 493 ha (1,218 acres).

In 1997, the monument botanist initiated the Weed Warrior program with funding provided through the National Park Foundation. In its first year, this program recruited 500 volunteers to pull tamarisk and perennial pepperweed along the river corridors and in campgrounds (Naumann 2003). The Weed Warrior program continues to be highly successful in engaging visitors in invasive species issues. Additional information on the monument's integrated approach to vegetation management can be derived from the current Invasive Management Plan (NPS 2005).

Overview

General Approach and Timeline

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

The NCPN vegetation classification and mapping program was launched in July 2001 at a scoping meeting among network park staff, NCPN staff, and potential project cooperators. Following this meeting, NCPN prepared a multi-year, multi-park project proposal to the USGS/NPS Vegetation Characterization Program to cost-share network I&M funding with the National Vegetation Characterization Program funding to complete vegetation maps for all network parks (Evenden 2001). Meetings to determine the DINO project boundary, biophysical model parameters, supplemental fuels data, and park specials were held in the spring of 2002. Table 3 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 DINO. Stereo aerial photography for DINO was flown during July 2001; orthophotography was flown in July 2002.

Table 3. Timeline for DINO 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							

Vegetation plot and observation point data collection at DINO occurred during the 2002 and 2003 field seasons. A few additional observation points were sampled in 2004 to support photointerpretation.

Field data were entered into a Microsoft Access database developed for the project and were analyzed in the fall following the first two field seasons. Analysis following the 2002 field season indicated that some vegetation types and sections of the monument were undersampled, prompting additional targeted vegetation sampling during the 2003 field season. Both sets of data were analyzed by ecologists contracted by e^2M, who prepared a preliminary vegetation classification report. The final assignment of plots to associations of the National Vegetation Classification was made by NatureServe ecologists in 2005-06. Local and global plant association descriptions based on the classification were drafted in 2004 and completed in 2006. An illustrated field key to DINO 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 DINO 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 with input from the monument botanist. A traditional photo interpretation was performed, with interpreted polygons drawn initially on Mylar overlays and transferred to a digital format via a scanning, orthorectification, and attribution process. Polygon attribution followed standards developed by NCPN for all park mapping projects (Evenden 2004). A guide to the map classes was drafted in 2004 and revised in 2006.

A draft map and associated spatial database were completed in the spring of 2005. Accuracy assessment data collection occurred during the 2005 field season. Data were entered into the DINO project database and analyzed, with results tabulated into a contingency matrix. A meeting held among project cooperators in December 2005 determined which map classes should be retained and which should be merged or eliminated because they failed to meet the 80% accuracy standard. Final revisions were made to the vegetation classification, map and spatial database in late 2007 and early 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 Dinosaur National Monument Vegetation Mapping Project. The roles of each contributor are described below.

engineering-environmental Management, Inc.

- *Jim Von Loh, Senior Biologist* – managed AA field data collection, collected AA data, created draft field key, wrote draft association local descriptions, contributed to final report
- *Matt Smith, Staff Biologist* – collected AA data
- *Jack Doria, Database Programmer* – developed the plots database
- *Julie Thompson, Consulting Ecologist* – collected field data, wrote draft local descriptions
- *Peter Williams, Consulting Ecologist* – collected plot, observation point, and AA data
- *Stephanie Shoemaker, Consulting Ecologist* – collected AA data
- *Karin Edwards, 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 and co-author of the final report; coordinated creation of final products
- *Margaret Beer, Data Manager* – project database development
- *Helen Thomas* – project database support, photo database development
- *Russ Den Bleyker* – project database support and QC
- *Lisa Hahn, Biological Technician* – collected plot and observation point data
- *Amy Schwarzbach, Biological Technician* – collected plot and observation point data
- *Liz Ballenger, Biological Technician* – collected AA data, revised map class guide and association field key
- *Amy Tendick, Biological Technician* – AA data collection, entry and QC
- *Bruce Condie, Biological Technician* – collected plot and observation point data
- *Sarah Topp, Biological Technician* – collected plot and observation point 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

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
- *Janet Coles, Ecologist* – Coordinated plot and observation point data collection, entered plot data, prepared preliminary vegetation classification, developed map class concepts, wrote draft map class guide, primary photointerpreter, made post-AA map revisions
- *Dan Cogan, Ecologist* – Photointerpreter, prepared AA analysis, produced draft map
- *David Salas, Cartographer* – Photointerpreter
- *Trudy Meyer, GIS Technician* – GIS support, draft map digitizing and production
- *Lisa Tasker, Consulting Ecologist* – Collected plot and observation point data
- *Rita Berberian, Consulting Ecologist* – Collected plot and observation point data

NatureServe

- *Marion Reid, Senior Regional Ecologist* – project manager, reviewed classification
- *Janet Coles, Regional Ecologist* – Reviewed field key, reviewed draft local descriptions, prepared global association descriptions, trained field crews in AA methodology
- *Michael Schindel, TNC Oregon Ecologist* – generated gradsect sampling design
- *Mary Russo, Ecology Data Manager* – Entered DINO local and global descriptions into NatureServe's Biotics database, formatted descriptions, completed plant species crosswalk
- *Kristin Snow, Assistant Ecologist/Ecological Information Manager* – Developed format for NCPN plant association local and global descriptions

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

- *Mike Story, NPS Program Leader* – Provided national level program oversight
- *Karl Brown, Ph.D., USGS Program Leader* – Provided national level program oversight
- *Tammy Hamer, Vegetation Mapping Program Biologist* – Facilitated generation of final products

Aerial Photography

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

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 presented special challenges due to extreme drought conditions across the Colorado Plateau. As a result, the orthoimagery acquired in 2002 represents extremely arid conditions and did not capture average vegetation expression in the monument. 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 photos were acquired. For these reasons, the stereo photographs flown in 2001 were especially valuable in detecting community boundaries not otherwise apparent on the orthoimagery.

Stereoscopic Aerial Photo Coverage

NCPN contracted with the USDA - Farm Services Agency Aerial Photo Field Office (APFO) to acquire new 23 cm x 23 cm (9 in x 9 in) true color aerial photographs for DINO. The imagery was acquired on July 22-30, 2001 by Blue Skies Consulting, LLC of Albuquerque, New Mexico. The photography was acquired at a nominal elevation of 6,000 ft (1,829 m) above ground level in a Cessna T210N aircraft. A Wild RC10 camera with 15.2 cm (6 in) lens was used with Kodak Aerocolor negative film. The target scale for this photography was 1:12,000 (1 in = 1,000 ft). The mission was designed with approximately 30% sidelap between flight lines and 60% overlap between photos. The project encompassed 1,060 linear km (658.5 miles) divided among 30 flight lines and 710 individual photos (Figure 15). An extra flight line was added to follow the course of Lodore Canyon, in order to provide imagery that minimized the viewing angle and therefore the shadows cast by steep canyon walls.

The environs were not included in the contract, therefore no stereo photography is available for the mapped area outside the monument boundary. Figure 16 is an example of the 23 cm x 23 cm aerial stereo photographs for DINO. These photographs were used for photo interpretation during the mapping phase of the project, as well as by field crews during plot data collection.

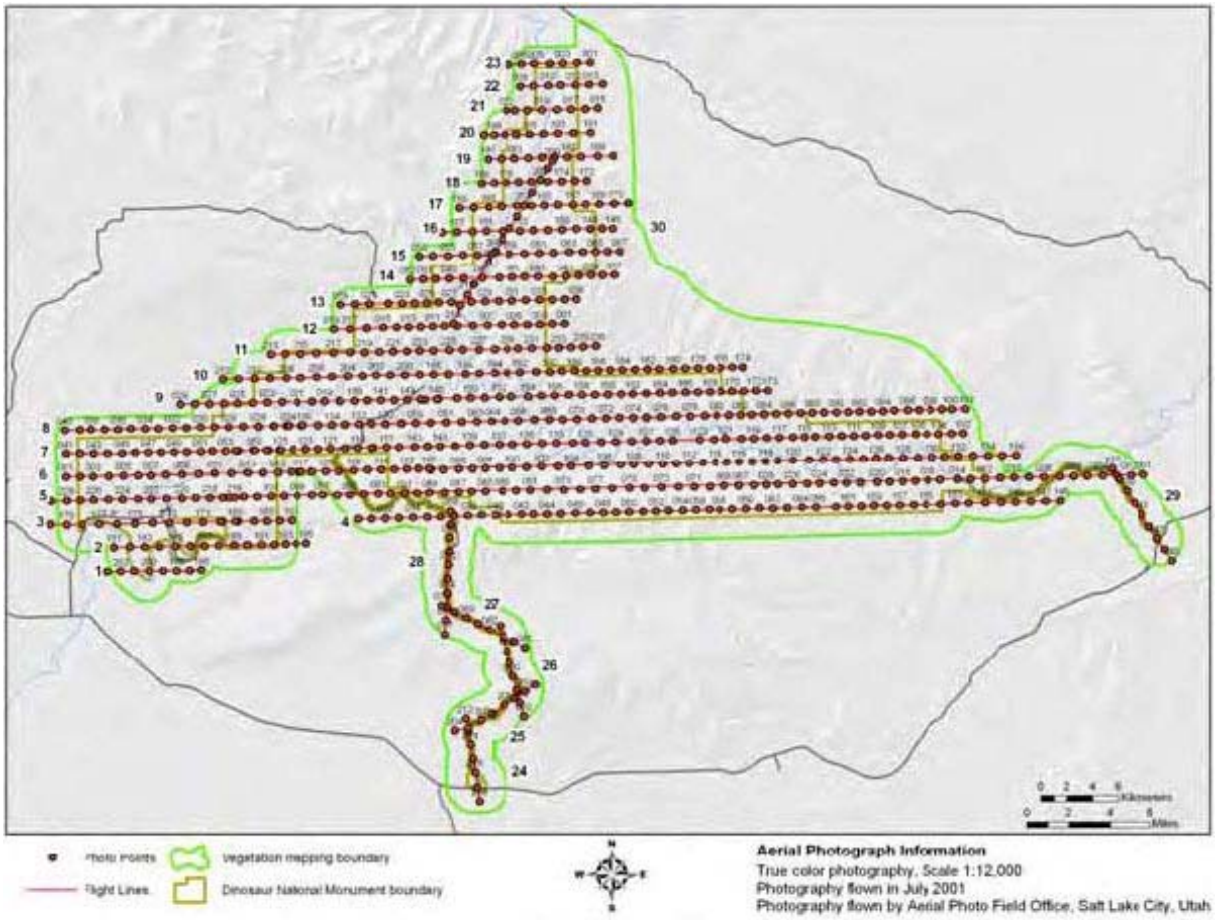


Figure 15. Flight lines for 2001 stereo aerial photograph coverage of DINO.

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 of these was distributed to DINO and the other is retained at the NCPN offices in Moab, Utah.

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 DINO from new imagery . This work was subcontracted to Horizons Inc. of Rapid City, South Dakota. The photography was flown on July 9, 2002, at a mean above ground level elevation of 6,096 m (20,000 ft). Sidelap was approximately 40% and overlap about 60%. Airborne global positioning system (GPS) data were collected for each exposure. A Zeiss RMK 15/23 camera with a 15.2 cm (6 in) lens was used with AGFA100 film. Aerial coverage was greater than the stereo photo imagery (Figure 17).



Figure 16. Example of a 9" x 9" stereo aerial photograph taken for the DINO vegetation classification and mapping project.

The original film was scanned at 21 microns to create pixels of approximately 0.84 m. Horizons, Inc. created a photographic mosaic by extracting the high quality image from the center of each photograph and stitching them together digitally. The photographic mosaic was then magnified to the 1:12,000 scale and corrected through a computational process that warps and stretches the image between known control points. The orthorectification process removes distortion caused by tilting of the camera and scale variation of the terrain. Control points for the orthorectification were obtained from USGS digital elevation model (DEM) 10 m data, aero triangulation data, and airborne GPS data. The X, Y, Z, omega, phi, and kappa for each photograph were calculated by Horizons, Inc. Final adjustments to the digital orthophoto database were solved using Erio Technologies ALBANY software. ALBANY is a simultaneous least squares bundle adjustment, which is designed for use with airborne GPS. Color adjustment of the final orthophoto coverage

was achieved by visually matching the tone, contrast, and brightness to the original film. Each scanned image was checked for missing data.

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

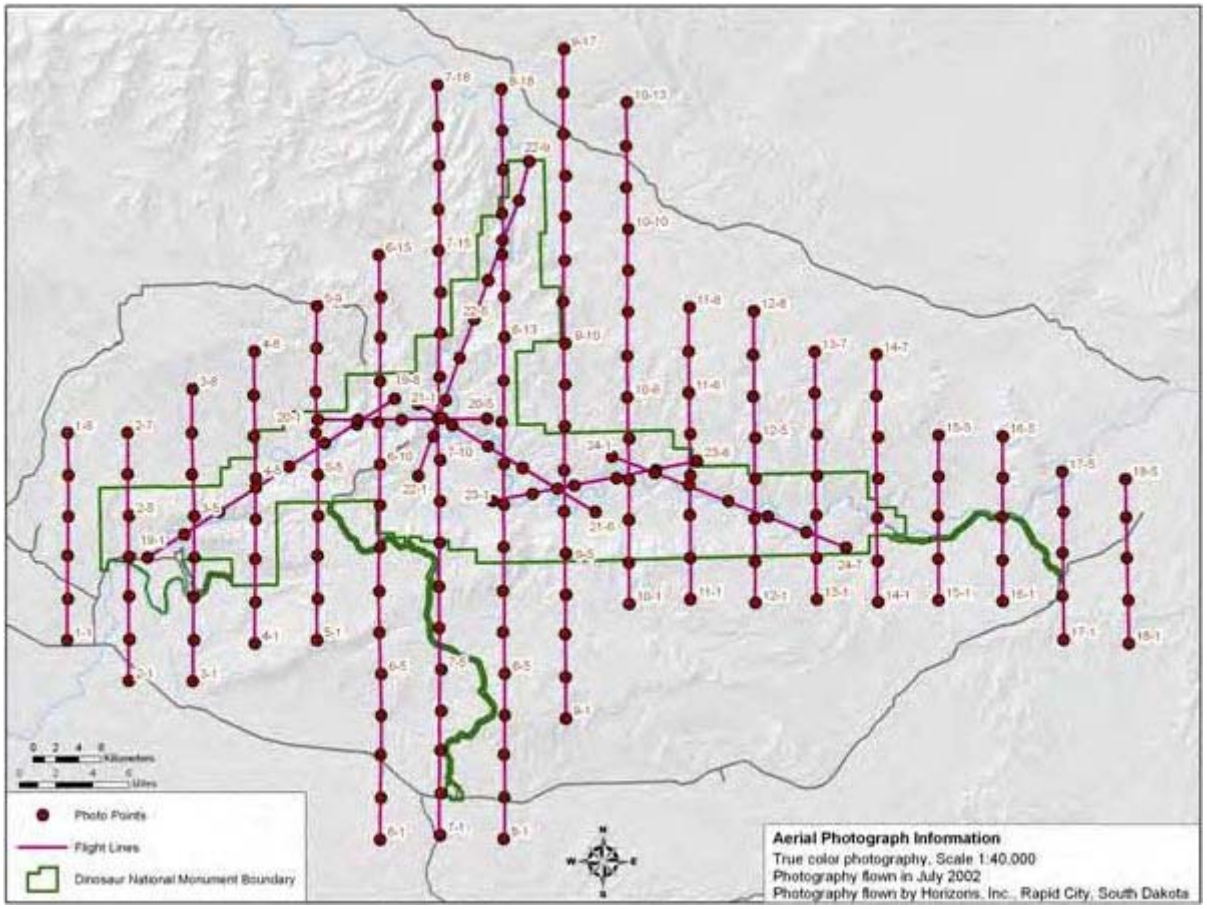


Figure 17. Flight lines for 2002 orthophotography coverage of DINO.

Project Boundary and Map Extent

A variable project boundary ranging between approximately 1.6 km (1 mile) and 9.5 km (6 miles) around the edge of the monument (environs) was chosen by network and DINO staff over the course of several scoping meetings held in 2002 (Figure 1). The total project mapping area is 161,169 hectares (398,258 acres). Of this area, 85,096 ha (210,278 acres) are within the DINO boundary and 76,073 ha (187,980 acres) are in the environs. The environs were extended on

Douglas Mountain to include an important part of the Yampa River watershed.

Minimum Mapping Unit

A standard 0.5 ha (1.24 acres) minimum mapping unit (MMU) was employed in the DINO vegetation mapping project. The major exception was that project photointerpreters attempted to delineate all wetland vegetation, regardless of patch size.

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 Colorado and Utah contain more than 80 ecological systems (NatureServe Explorer 2008). This approach complements the NVC; the finer-scale associations provide a basis for interpreting larger-scale ES patterns and concepts. A description of each of ecological system identified in DINO appears in Appendix A.

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

- 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 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 Wash (CES304.781)
- North American Arid West Emergent Marsh (CES300.729)
- 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 Limber-Bristlecone Pine Woodland (CES306.819)
- 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 DINO in 2001. This list was developed by intersecting NVC associations and alliances (NatureServe Explorer 2008) with Bailey ecoregions (Bailey 2001). Previous vegetation classification work, floristic information for DINO (e.g., Naumann 1990), the monument's plant species list, and expert local knowledge were used to refine the list. This process resulted in a preliminary list of 119 plant associations for the vegetation mapping project area . This association list was a useful gauge for estimating and planning field work and for assigning provisional association names to vegetation plots and observation points.

Legacy Data Review

Existing vegetation data for DINO were reviewed for possible use in the classification. The primary dataset reviewed was that created by Watham and Friedlander during their 1982-1983 vegetation mapping project. These data were determined to be too spatially imprecise and too lacking in floristic detail to contribute to the mapping or classification efforts. The vegetation classification presented in this report was derived from new field data collected specifically for the DINO vegetation mapping project.

Field Methods

The primary purpose of classification plot data was to document the composition and structure of DINO vegetation and associated environmental conditions. These data became the basis for classifying the vegetation at the monument. 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 monument. The plot dataset was enhanced by collecting observation point data, whose primary purpose was to support photo interpretation.

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

Field Sampling Approach

The sampling area included the entire monument as well as BLM lands in the environs. Private lands in the environs as well as private inholdings within the monument were not visited. Because the project area is large, complex, and access can be logistically complex, the areas to be sampled were selected in advance of the 2002 field season. The selection was based on biophysical units designed to ensure that all major environmental settings were visited and a good spatial dispersion of sample plots was achieved.

The project area was divided into biophysical units (BPUs) constructed by layering soils, geology, solar budget, fire history, and elevation information. The result was a set of polygons representing unique combinations of these environmental factors. The "cost" (distance from road or trail multiplied by a factor accounting for steep slopes) of accessing each polygon was calculated, and the polygons deemed too difficult to access were withdrawn. A random sample of polygons representing each combination of factors became the target areas for sampling, although field crews were encouraged to use their judgment and sample areas outside the BPUs if they contained unusual vegetation types.

Field crews were led by ecologists with experience sampling plant communities in national parks and other landscapes. The list of 119 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 DINO project area. However, some common associations were sampled more often and some rare types were sampled less often. An effort was made to achieve good spatial distribution of plots across the landscape and to capture the full range of variation of each association.

The initial data collection was conducted between May and October, 2002. Six hundred twenty-seven vegetation plots and 103 observation points were sampled. After reviewing a summary of the data, monument staff requested that a number of additional areas be sampled in 2003, including Jones Hole, the east end of Douglas Mountain, Lake Bench, Starvation Valley, Douglas Mountain between Warm Springs Cedars and Five Springs Draw, Sage Creek, the west side of the Green River floodplain opposite the Gates of Lodore, Pearl Park, West Cactus Flat, and Wild Mountain. These sites and others were sampled during the 2003 and 2004 field seasons, adding 100 plots and 114 observation points to the data set.

Plot Data Collection

Field crews located classification plots subjectively within biophysical units in order to best represent the association being sampled. Crews also had the option of locating plots outside of BPUs. 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 Characterization Program guidelines (TNC and ESRI 1994a). Plot size was determined by the physiognomy of the community being sampled (Table 4). DINO 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 4. Plot sizes used for vegetation classification sampling at DINO.

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

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

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

Location and Plot Identifiers DINO staff requested that the vegetation 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 5 and are described in detail in Appendix C. Locations were recorded on topographic maps during each field trip to avoid duplication of effort and to ensure good spatial distribution of sampling points within the monument.

Table 5. 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 5; Appendix B). These characteristics included physical site features (elevation, slope, aspect, topography), hydrology, geology, and soils. Description of the ground surface included an estimate 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 disturbance and environmental 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 6. Consistent and

repeatable cover estimates were obtained by training field crews to relate 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, adjacent vegetation, and site disturbance history. The overall character of the vegetation and features of each plot were recorded in two or more 35 mm color slide photographs.

Table 6. Vegetation cover and height classes used in the DINO vegetation mapping project.

Species and Strata Canopy Cover Classes				**Strata Height Classes**			
Code	***Range***	***Code***	***Range***	***Code***	***Range***	***Code***	***Range***
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

Seven hundred twenty-seven vegetation plots were sampled within the mapping project area during the 2002 and 2003 field seasons (Figure 18). Plot data were manually entered into the DINO 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 Characterization Program by TNC (1997), and revised by NatureServe in 2002. 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 DINO plots database are described in Appendix C.

Each 35 mm slide associated with the project was scanned into digital format. The 3254 digital images of plots, observation points, accuracy assessment points and scenery were stored in a photograph database. A unique identifier allows each photograph to be linked with the plots and spatial databases.

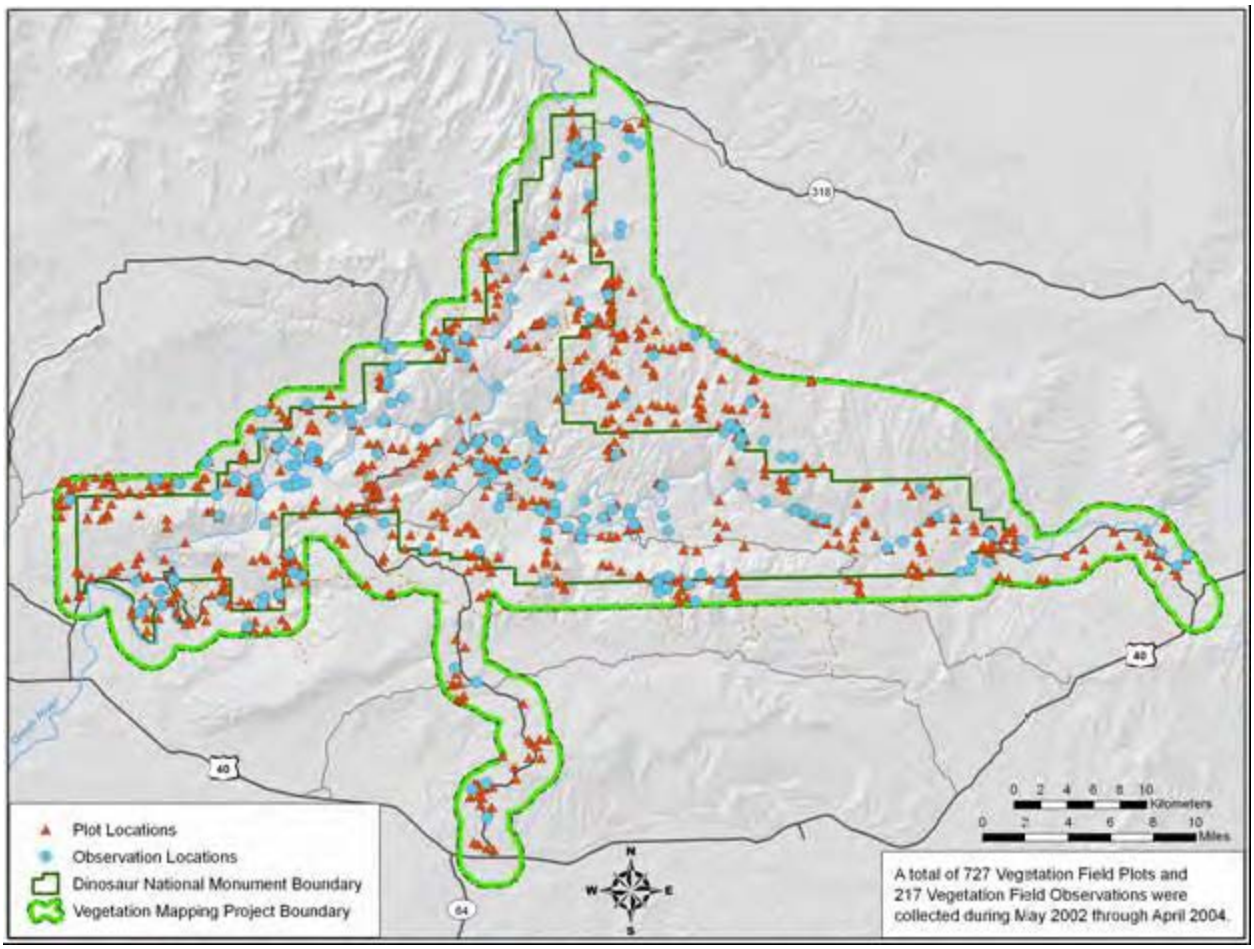


Figure 18. Vegetation plot and observation point locations in the DINO mapping project area.

Observation Points

In addition to classification plots, field crews collected vegetation and environmental data at 217 observation points (Figure 18). Data collected at observation points reflected the vegetation of a loosely undefined area around the point (the "stand") rather than a measured plot, and were less detailed (Appendix B). Overall conditions at each observation point were documented by one or more 35mm color slide photographs. These data were intended primarily to support modeling and 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 classification plot when:

- they were sampling the environs outside the monument boundary
- the vegetation was highly disturbed, ecotonal, or otherwise anomalous and therefore unlikely to be classified under the NVC
- project photointerpreters requested documentation of a specific photo signature or area
- they wished to document special features as requested by monument 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 plot and observation point data following entry to the plots database. Individual plot data records were reviewed with the individual field data sheets in hand. Additional QA/QC was performed using a set of queries designed to identify inconsistencies across data fields and check for missing data. NCPN technicians standardized the scientific names in the database and noted name changes on the field forms. The primary authority used for plant names for the DINO vegetation mapping project and all other NCPN I&M projects is *A Utah Flora* (Welsh et al. 2003). Weber and Wittmann (2001) and Goodrich and Neese (1986) were the primary floristic keys used in the field. It is important to note that NatureServe, a primary project partner, follows Kartesz (1999) as its primary nomenclatural authority. As a result, nomenclature used in the body of this report follows Kartesz (1999), whereas nomenclature in the project database follows Welsh et al. (2003). Differences between the two nomenclatural authorities are reconciled in a crosswalk table (Appendix D).

Following completion of QA/QC procedures, the database was made available to e^2M and NatureServe ecologists for vegetation classification analysis as described in the next section. 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 multivariate analysis of vegetation plot data augmented by observation point data. 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. Exploratory multivariate statistical analyses (summary statistics, outlier analysis, Bray-Curtis ordination, cluster analysis, and Indicator Species Analysis (ISA)) 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.

The complete data set of 727 plots and 482 species was first evaluated to find outliers, which potentially distort the matrix. Outlier analysis revealed 47 plots in the DINO data set with average distance greater than two standard deviations. As is often the case in heterogeneous ecological datasets, these outliers represented uncommon vegetation types. The outliers were retained in subsequent analyses. An initial cluster analysis (McCune and Mefford 1999) suggested 20 potential groups, using the "25% information remaining" point as an arbitrary cut point. To explore whether these 20 groups represented real ecological units, an Indicator Species Analysis (Dufrêne and Legendre 1997) was performed on the dataset divided into 2 to 24 groups as sorted by the cluster analysis. The object of ISA is to find the number of groups that maximizes the number of significant indicators while minimizing the p-value. Figure 19 shows three points that met these criteria: 3 groups, 9 groups, and 18 groups.

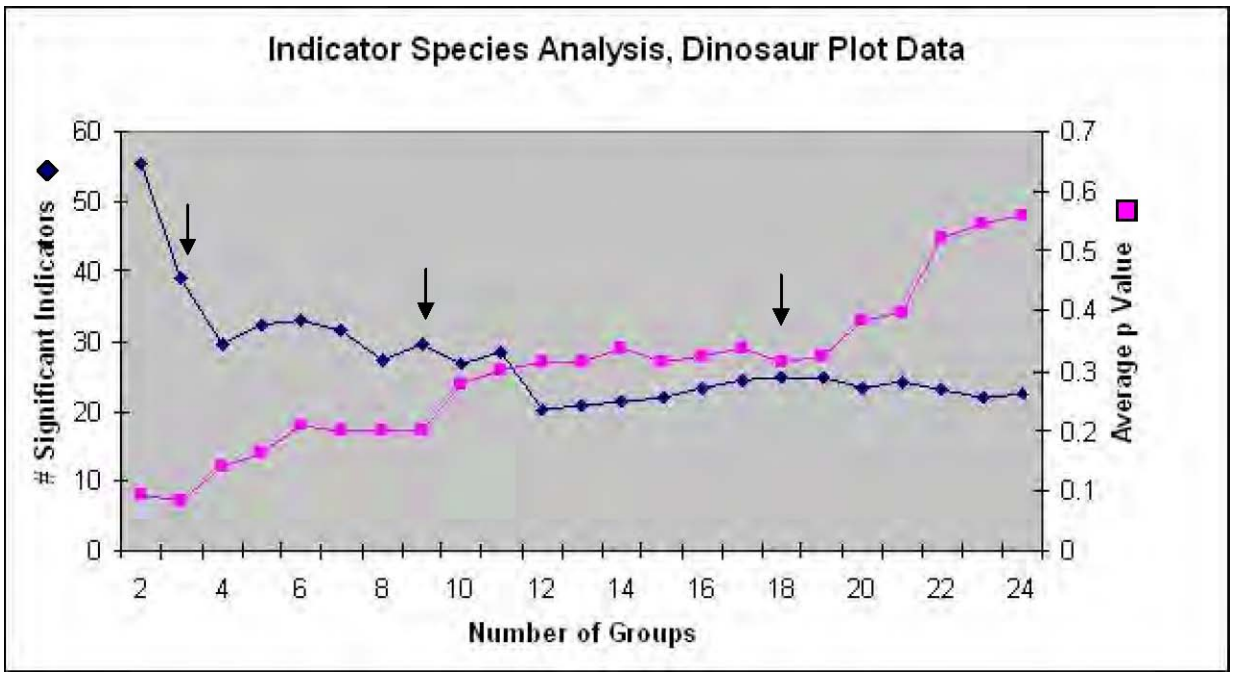


Figure 19. Results of Indicator Species Analysis of the full DINO plots dataset. The data were divided into two groups (using cluster analysis) and analyzed for the number of significant indicator species and the p value of species in each group. The analysis was repeated for 3, 4, 5 and so on up to 24 groups. Arrows indicate the three points within the analysis that meet the criteria of local maximum number of indicators and local minimum p-value.

Because 18 groups appeared to be potentially significant in both the initial cluster analysis and the ISA, the cluster analysis was repeated for 18 groups and the results were inspected. Eighteen groups appeared to represent too fine a division, as several ecologically meaningful groups, such as sagebrush shrublands and pinyon-juniper woodlands, were split in ways that did not make sense to experienced ecologists. The cluster analysis was repeated for nine groups (Sorenson distance measure, flexible beta linkage method, $\beta = -0.25$). However, nine groups were also not satisfactory, as four of the nine groups still contained heterogeneous mixes of ecologically unrelated communities. Further runs of the clustering routine determined that 12 groups gave the best separation of distinct vegetation communities while keeping related communities together (Figure 20; Table 7).

Table 7. A summary of the twelve groups of communities revealed by cluster analysis and ISA of the entire plot data set. Significant indicator species had an indicator value >25 and $p < .05$.

# Plots	Description	Significant Indicator Species
70	Miscellaneous upland woodlands and shrublands	None
127	Miscellaneous mesic and wetland communities	None
86	Wyoming big sagebrush communities	*Artemisia tridentata* ssp. *wyomingensis*
39	Needle-and-thread communities	*Hesperostipa comata, Achnatherum hymenoides*
11	Box elder woodlands	*Acer negundo, Elymus glaucus, Lepidium latifolium*
37	Bottomland woodlands and shrublands with a cheatgrass understory	*Sarcobatus vermiculatus, Artemisia tridentata* ssp. *tridentata, Bromus tectorum*

# Plots	Description	Significant Indicator Species
92	Pinyon-juniper woodlands on rocky substrates	*Pinus edulis*
66	Limestone communities	*Artemisia nova, Pseudoroegneria spicata*
41	Vasey big sagebrush and mixed mountain shrublands	*Artemisia tridentata* ssp. *vaseyana, Purshiatridentata, Eriogonum umbellatum*
105	Pinyon-juniper woodlands	*Juniperus osteosperma*
33	True mountain mahogany communities	*Cercocarpus montanus, Symphoricarpos oreophilus, Stenotus acaulis*
20	Ponderosa pine woodlands	*Pinus ponderosa, Arenaria congesta*

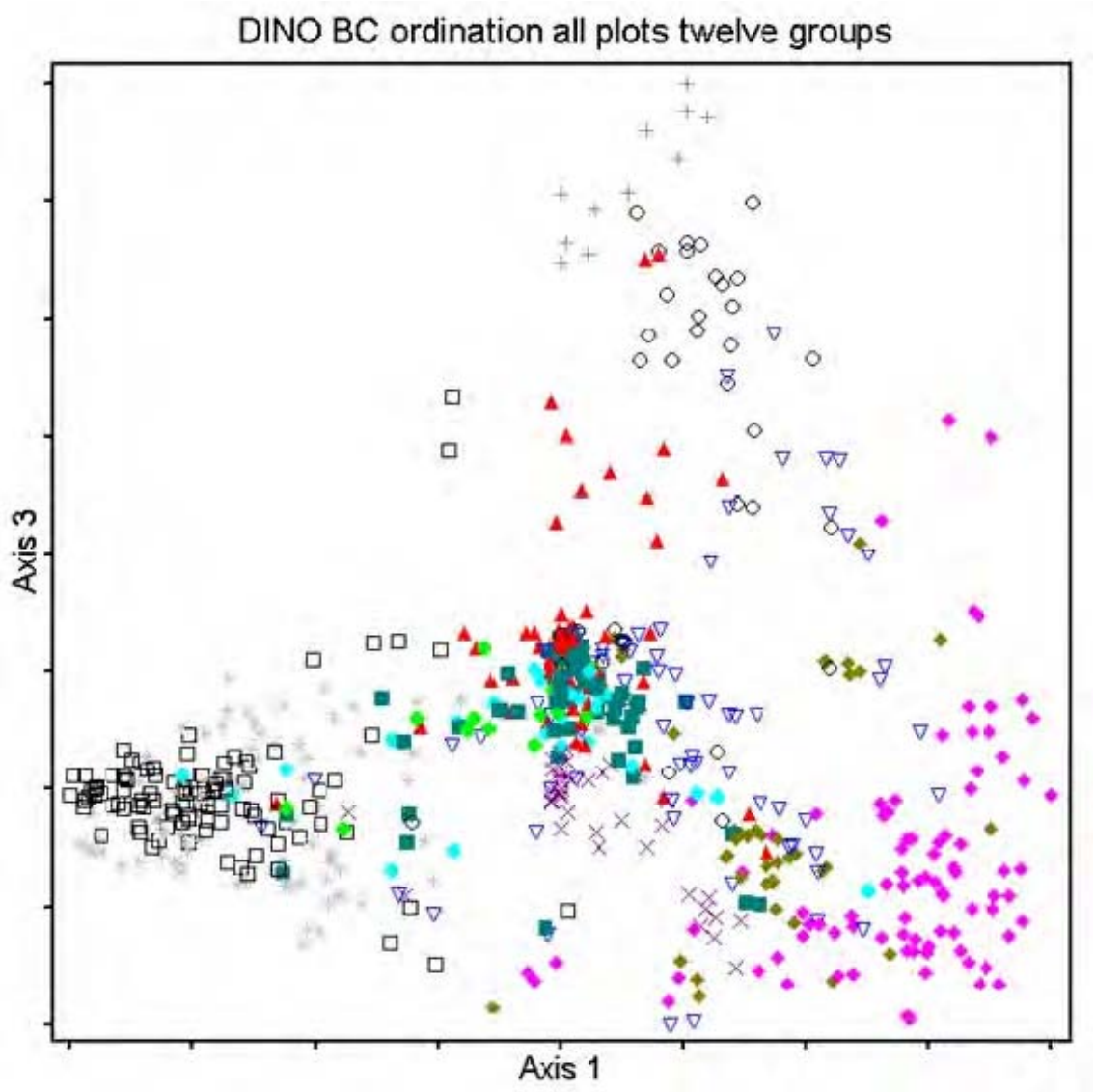


Figure 20. Bray-Curtis ordination of the 727 vegetation plots sampled at DINO. The different symbols and colors represent the twelve main groups identified through ISA and cluster analysis. The data were square root transformed to reduce the "dust bunny" effect of a data set that is mostly zeroes (McCune and Grace 2002).

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

Because the DINO plots are intended to fit into an existing national classification instead of a stand-alone, site specific classification, the analysis techniques described above were used in combination with our ecological field experience and the plot environmental data to assign plots provisionally to associations. Some of the more difficult groups, including sagebrush shrublands and grass-cushion plant communities, were compared with plots from other NCPN parks. The association assignment for each plot was based on 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 assign unusual types to a "Park Special" category. The final classification was issued by NatureServe in 2005. Slight revisions in 2006 and 2007 included amending the classification to include information gathered during the accuracy assessment phase and to update assignments of associations to ecological systems.

Classification Results

The vegetation of the DINO mapping project area is classified into 174 community types (Table 8). Of these, 157 are described at the plant association level; six others are described at the alliance level. The remaining eleven are described as 'park specials' because they occur only in small stands and appear to be unique to the monument. Park specials are not assigned to NVC associations or alliances. Eighteen of the associations are documented exclusively from data gathered during accuracy assessment. The vegetation of the mapping project area is relatively diverse, including 73 NVC alliances and 24 ecological systems. Pinyon-juniper woodlands and sagebrush shrublands dominate the vegetation, accounting for 29 associations.

Each association, alliance, or park special is represented by between at least one and as many as 41 plot samples (Appendix E). Types with only one plot may have been rare in the monument, 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.

Table 8. Plant associations identified within the DINO vegetation mapping project area*.

NVC Association	Common Name	Element Code†
UPLAND ASSOCIATIONS		
FORESTS AND WOODLANDS		
Rocky Mountain Aspen Forest and Woodland (CES306.813)‡		
Populus tremuloides / Amelanchier alnifolia - Symphoricarpos oreophilus / Mixed Graminoid Forest	Quaking Aspen / Saskatoon Serviceberry - Mountain Snowberry / Mixed Graminoid Forest	CEGL002816
Populus tremuloides / Ceanothus velutinus Forest	Quaking Aspen / Tobacco-brush Forest	CEGL000581
Populus tremuloides / Juniperus communis Forest	Quaking Aspen / Common Juniper Forest	CEGL000587
Populus tremuloides / Prunus virginiana Forest	Quaking Aspen / Choke Cherry Forest	CEGL000596
Populus tremuloides / Symphoricarpos oreophilus / Carex rossii Forest	Quaking Aspen / Mountain Snowberry / Ross' Sedge Forest	CEGL000613
Populus tremuloides / Symphoricarpos oreophilus Forest	Quaking Aspen / Mountain Snowberry Forest	CEGL000610
Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)		
Pseudotsuga menziesii Woodland Alliance	Douglas-fir Woodland Alliance	A.552
Pseudotsuga menziesii / Amelanchier alnifolia Forest	Douglas-fir / Saskatoon Serviceberry Forest	CEGL000420
Pseudotsuga menziesii / Cercocarpus ledifolius Woodland	Douglas-fir / Curl-leaf Mountain-mahogany Woodland	CEGL000897
Pseudotsuga menziesii / Cercocarpus montanus Woodland	Douglas-fir / Mountain-mahogany Woodland	CEGL000898
Pseudotsuga menziesii / Juniperus communis Forest	Douglas-fir / Common Juniper Forest	CEGL000439
Pseudotsuga menziesii / Mahonia repens Forest	Douglas-fir / Creeping Oregon-grape Forest	CEGL000442
Pseudotsuga menziesii / Poa fendleriana Woodland	Douglas-fir / Muttongrass Woodland	CEGL002809
Pseudotsuga menziesii / Pseudoroegneria spicata Woodland	Douglas-fir / Bluebunch Wheatgrass Woodland	CEGL000908
Pseudotsuga menziesii / Symphoricarpos oreophilus Forest	Douglas-fir / Mountain Snowberry Forest	CEGL000462
Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland (CES306.819)		
Pinus flexilis / Juniperus communis Woodland	Limber Pine / Common Juniper Woodland	CEGL000807
Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)		
Pinus ponderosa / Artemisia tridentata ssp. vaseyana Woodland	Ponderosa Pine / Mountain Big Sagebrush Woodland	CEGL002794
Pinus ponderosa / Cercocarpus ledifolius Woodland	Ponderosa Pine / Curl-leaf Mountain-mahogany Woodland	CEGL000850

Table 8. Plant associations identified within the DINO vegetation mapping project area*.

NVC Association	Common Name	Element Code†
Pinus ponderosa / Juniperus scopulorum Woodland	Ponderosa Pine / Rocky Mountain Juniper Woodland	CEGL000861
Pinus ponderosa / Rockland Woodland	Ponderosa Pine / Rockland Woodland	CEGL000877
Colorado Plateau Pinyon-Juniper Woodland (CES304.767)		
Juniperus osteosperma / Artemisia nova Woodland	Utah Juniper / Black Sagebrush Woodland	CEGL000728
Juniperus osteosperma / Artemisia tridentata - Grayia spinosa Woodland	Utah Juniper / Big Sagebrush - Spiny Hop-sage Woodland	Park Special
Juniperus osteosperma / Artemisia tridentata ssp. tridentata Woodland	Utah Juniper / Basin Big Sagebrush Woodland	CEGL002360
Juniperus osteosperma / Artemisia tridentata ssp. wyomingensis Woodland	Utah Juniper / Wyoming Big Sagebrush Woodland	CEGL000730
Juniperus osteosperma / Bromus tectorum Semi-natural Woodland	Utah Juniper / Cheatgrass Semi-natural Woodland	CEGL002817
Juniperus osteosperma / Cercocarpus montanus Woodland	Utah Juniper / Mountain-mahogany Woodland	CEGL000735
Juniperus osteosperma / Glossopetalon spinescens Woodland	Utah Juniper / Spiny Greasebush Woodland	Park Special
Juniperus osteosperma / Hesperostipa comata Woodland	Utah Juniper / Needle-and-Thread Woodland	CEGL002815
Juniperus osteosperma / Leymus salinus Woodland	Utah Juniper / Salinas Lyme Grass Woodland	CEGL003109
Juniperus osteosperma / Pleuraphis jamesii Woodland	Utah Juniper / James' Galleta Woodland	CEGL002362
Juniperus osteosperma / Pseudoroegneria spicata Woodland	Utah Juniper / Bluebunch Wheatgrass Woodland	CEGL000738
Juniperus osteosperma / Sparse Understory Woodland	Utah Juniper / Sparse Understory Woodland	CEGL000732
Juniperus scopulorum / Artemisia tridentata Woodland	Rocky Mountain Juniper / Big Sagebrush Woodland	CEGL000743
Juniperus scopulorum Temporarily Flooded Woodland Alliance	Rocky Mountain Juniper Temporarily Flooded Woodland Alliance	A.563
Pinus edulis - (Juniperus spp.) Woodland Alliance	Two-needle Pinyon - (Juniper species) Woodland Alliance	A.516
Pinus edulis - Juniperus osteosperma / Amelanchier utahensis Woodland	Two-needle Pinyon - Utah Juniper / Utah Serviceberry Woodland	CEGL002329
Pinus edulis - Juniperus osteosperma / Artemisia nova Woodland	Two-needle Pinyon - Utah Juniper / Black Sagebrush Woodland	CEGL002331
Pinus edulis - Juniperus spp. / Artemisia tridentata (ssp. wyomingensis, ssp. vaseyana) Woodland	Two-needle Pinyon - Juniper species / (Wyoming Big Sagebrush, Mountain Big Sagebrush) Woodland	CEGL000776
Pinus edulis - Juniperus osteosperma / Cercocarpus ledifolius Woodland	Two-needle Pinyon - Utah Juniper / Curl-leaf Mountain-mahogany Woodland	CEGL002940

Table 8. Plant associations identified within the DINO vegetation mapping project area*.

NVC Association	Common Name	Element Code†
Pinus edulis - Juniperus spp. / Cercocarpus montanus - Mixed Shrubs/ Woodland	Two-needle Pinyon - Juniper species / Mountain-mahogany – Mixed Shrubs Woodland	CEGL000780
Pinus edulis - Juniperus spp. / Leymus salinus Woodland	Two-needle Pinyon - Juniper species / Salinas Lyme Grass Woodland	CEGL002340
Pinus edulis - Juniperus osteosperma / Petradoria pumila Woodland	Two-needle Pinyon - Utah Juniper / Grassy Rock-goldenrod Woodland	CEGL002332
Pinus edulis - Juniperus spp. / Poa fendleriana Woodland	Two-needle Pinyon - Juniper species / Muttongrass Woodland	CEGL000787
Pinus edulis - Juniperus osteosperma / Pseudoroegneria spicata - Cushion Plant Woodland	Two-needle Pinyon - Utah Juniper / Bluebunch Wheatgrass - Cushion Plant Woodland	CEGL002819
Pinus edulis - Juniperus osteosperma / Purshia tridentata Woodland	Two-needle Pinyon - Utah Juniper/ Antelope Bitterbrush Woodland	CEGL000789
Pinus edulis - Juniperus osteosperma / Sparse Understory Woodland	Two-needle Pinyon - Utah Juniper / Sparse Understory Woodland	CEGL002148
Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)		
Pinus edulis - Juniperus osteosperma / Cercocarpus intricatus Woodland	Two-needle Pinyon - Utah Juniper / Littleleaf Mountain-mahogany Woodland	CEGL000779
Pinus edulis - Juniperus osteosperma / Ephedra viridis Woodland	Two-needle Pinyon - Utah Juniper / Mormon-tea Woodland	CEGL002370
Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland (CES304.772)		
Cercocarpus ledifolius Woodland Alliance	Curl-leaf Mountain-mahogany Woodland Alliance	A.586
Cercocarpus ledifolius / Artemisia tridentata ssp. vaseyana Woodland	Curl-leaf Mountain-mahogany / Mountain Big Sagebrush Woodland	CEGL001022
Cercocarpus ledifolius / Prunus virginiana Shrubland	Curl-leaf Mountain-mahogany / Choke Cherry Shrubland	CEGL000966
Cercocarpus ledifolius / Pseudoroegneria spicata Shrubland	Curl-leaf Mountain-mahogany / Bluebunch Wheatgrass Shrubland	CEGL000967
SHRUBLANDS AND SHRUB-HERBACEOUS VEGETATION		
Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818)		
Amelanchier alnifolia / Symphoricarpos oreophilus Shrubland	Saskatoon Serviceberry / Mountain Snowberry Shrubland	CEGL002569
Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)		
Amelanchier utahensis / Pseudoroegneria spicata Shrubland	Utah Serviceberry / Bluebunch Wheatgrass Shrubland	CEGL001069
Amelanchier utahensis Shrubland	Utah Serviceberry Shrubland	CEGL001067

Table 8. Plant associations identified within the DINO vegetation mapping project area*.

NVC Association	Common Name	Element Code†
Amelanchier (utahensis, alnifolia) - Cercocarpus montanus Shrubland	(Utah Serviceberry, Saskatoon Serviceberry) - Mountain-mahogany Woodland	CEGL001070
Cercocarpus montanus / Pseudoroegneria spicata Shrubland	Mountain-mahogany / Bluebunch Wheatgrass Shrubland	CEGL001090
Prunus virginiana - (Prunus americana) Shrubland	Choke Cherry - (American Plum) Shrubland	CEGL001108
Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)		
Artemisia tridentata (ssp. tridentata, ssp. xericensis) Shrubland Alliance	(Basin Big Sagebrush, Foothill Big Sagebrush) Shrubland Alliance	A.830
Artemisia tridentata - (Ericameria nauseosa) / Bromus tectorum Semi-natural Shrubland	Basin Big Sagebrush - (Rubber Rabbitbrush) / Cheatgrass Semi-natural Shrubland	CEGL002699
Artemisia tridentata ssp. tridentata / Hesperostipa comata Shrubland	Basin Big Sagebrush / Needle-and-Thread Shrubland	CEGL002966
Artemisia tridentata ssp. tridentata / Leymus cinereus Shrubland	Basin Big Sagebrush / Great Basin Lyme Grass Shrubland	CEGL001016
Artemisia tridentata ssp. tridentata / Sporobolus airoides Shrubland	Basin Big Sagebrush / Alkali Sacaton Shrubland	CEGL002200
Artemisia tridentata ssp. wyomingensis / Balsamorhiza sagittata Shrubland	Wyoming Big Sagebrush / Arrowleaf Balsamroot Shrubland	CEGL000994
Artemisia tridentata ssp. wyomingensis / Disturbed Understory Semi-natural Shrubland	Wyoming Big Sagebrush / Disturbed Understory Semi-natural Shrubland	CEGL002083
Artemisia tridentata ssp. wyomingensis / Elymus elymoides Shrubland	Wyoming Big Sagebrush / Bottlebrush Shrubland	CEGL001043
Artemisia tridentata ssp. wyomingensis / Hesperostipa comate Colorado Plateau Shrubland	Wyoming Big Sagebrush / Needle-and-Thread Colorado Plateau Shrubland	CEGL002761
Artemisia tridentata ssp. wyomingensis / Leymus salinus Shrubland	Wyoming Big Sagebrush / Salinas Lyme Grass Shrubland	CEGL002813
Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrubland	Wyoming Big Sagebrush / Bluebunch Wheatgrass Shrubland	CEGL001009
Artemisia tridentata ssp. wyomingensis / Pleuraphis jamesii Shrubland	Wyoming Big Sagebrush / James' Galleta Shrubland	CEGL002084
Artemisia tridentata ssp. wyomingensis / Poa fendleriana Shrubland	Wyoming Big Sagebrush / Muttongrass Shrubland	CEGL002775
Artemisia tridentata ssp. wyomingensis / Poa secunda Shrubland	Wyoming Big Sagebrush / Curly Bluegrass Shrubland	CEGL001049
Artemisia tridentata ssp. wyomingensis / Sparse Understory Shrubland	Wyoming Big Sagebrush / Sparse Understory Shrubland	CEGL002768
Grayia spinosa / Achnatherum hymenoides Shrubland	Spiny Hop-sage / Indian Ricegrass Shrubland	CEGL001350

Table 8. Plant associations identified within the DINO vegetation mapping project area*.

NVC Association	Common Name	Element Code†
Krascheninnikovia lanata / Hesperostipa comata Dwarf-shrubland	Winter-fat / Needle-and-Thread Dwarf-shrubland	CEGL001327
Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785)		
Artemisia tridentata (ssp. vaseyana, ssp. wyomingensis) – Amelanchier utahensis Shrubland	(Mountain Big Sagebrush, Wyoming Big Sagebrush) – Utah Serviceberry Shrubland	CEGL002820
Artemisia tridentata ssp. vaseyana / Achnatherum lettermanii Shrubland	Mountain Big Sagebrush / Letterman's Needlegrass Shrubland	CEGL002811
Artemisia tridentata ssp. vaseyana / Balsamorhiza sagittata Shrubland	Mountain Big Sagebrush / Arrowleaf Balsamroot Shrubland	CEGL001020
Artemisia tridentata ssp. vaseyana / Hesperostipa comata Shrubland	Mountain Big Sagebrush / Needle-and-Thread Shrubland	CEGL002931
Artemisia tridentata ssp. vaseyana / Leymus cinereus Shrubland	Mountain Big Sagebrush / Great Basin Lyme Grass Shrubland	CEGL001027
Artemisia tridentata ssp. vaseyana / Pascopyrum smithii Shrubland	Mountain Big Sagebrush / Western Wheatgrass Shrubland	CEGL001028
Artemisia tridentata ssp. vaseyana / Poa fendleriana Shrubland	Mountain Big Sagebrush / Muttongrass Shrubland	CEGL002812
Artemisia tridentata ssp. vaseyana / Poa secunda Shrubland	Mountain Big Sagebrush / Curly Bluegrass Shrubland	CEGL001029
Artemisia tridentata ssp. vaseyana / Pseudoroegneria spicata Shrubland	Mountain Big Sagebrush / Bluebunch Wheatgrass Shrubland	CEGL001030
Artemisia tridentata ssp. wyomingensis / Leymus salinus Shrubland	Wyoming Big Sagebrush / Salinas Lyme Grass Shrubland	CEGL002813
Artemisia tridentata ssp. wyomingensis / Pascopyrum smithii Shrub Herbaceous Vegetation	Wyoming Big Sagebrush / Western Wheatgrass Shrub Herbaceous Vegetation	CEGL001047
Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)		
Chrysothamnus viscidiflorus / Hesperostipa comata Shrubland	Green Rabbitbrush / Needle-and-Thread Shrubland	CEGL002799
Ephedra viridis / Bromus tectorum Semi-natural Shrubland	Mormon-tea / Cheatgrass Semi-natural Shrubland	CEGL002355
Ericameria nauseosa / Bromus tectorum Semi-natural Shrubland	Rubber Rabbitbrush / Cheatgrass Semi-natural Shrubland	CEGL002937
Ericameria nauseosa / Pascopyrum smithii Shrubland	Rubber Rabbitbrush / Western Wheatgrass Shrubland	Park Special
Krascheninnikovia lanata / Poa secunda Dwarf-shrubland	Winter-fat / Curly Bluegrass Dwarf-shrubland	CEGL001326
Philadelphus microphyllus - Ephedra viridis Shrubland	Littleleaf Mock Orange - Mormon-tea Shrubland	Park Special
Tetradymia canescens Shrubland	Gray Horsebrush Shrubland	Park Special
Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762)		
Artemisia arbuscula ssp. longiloba / Elymus lanceolatus Shrubland	Alkali Sagebrush / Streamside Wild Rye Herbaceous Vegetation	CEGL002585

Table 8. Plant associations identified within the DINO vegetation mapping project area*.

NVC Association	Common Name	Element Code†
Artemisia nova / Pseudoroegneria spicata Shrubland	Black Sagebrush / Bluebunch Wheatgrass Shrubland	CEGL001424
Artemisia nova Shrubland	Black Sagebrush Shrubland	CEGL001417
Great Basin Semi-Desert Chaparral (CES304.001)		
Arctostaphylos patula - Artemisia tridentata (ssp. vaseyana, ssp. wyomingensis) Shrubland	Greenleaf Manzanita - (Mountain Big Sagebrush, Wyoming Big Sagebrush) Shrubland	CEGL002694
Inter-Mountain Basins Wash (CES304.781)		
Ericameria nauseosa Desert Wash Shrubland	Rubber Rabbitbrush Desert Wash Shrubland	CEGL002261
Xanthium strumarium Herbaceous Vegetation	Rough Cocklebur Herbaceous Vegetation	Park Special
Inter-Mountain Basins Shale Badland (CES304.789)		
Atriplex gardneri Dwarf-shrubland	Gardner's Saltbush Dwarf-shrubland	CEGL001438
Atriplex corrugata Dwarf-shrubland	Mat Saltbush Dwarf-shrubland	CEGL001437
Ephedra torreyana - (Atriplex spp.) / Nonvascular Gypsum Sparse Vegetation	Torrey's Joint-fir - (Saltbush species) / Nonvascular Gypsum Sparse Vegetation	CEGL002349
Eriogonum (corymbosum, leptocladon) Dwarf-shrubland Alliance	(Crispleaf Wild Buckwheat, Sand Wild Buckwheat) Dwarf-shrubland Alliance	A.1126
Inter-Mountain Basins Greasewood Flat (CES304.780)		
Sarcobatus vermiculatus / Sporobolus airoides Shrubland	Black Greasewood / Alkali Sacaton Shrubland	CEGL001368
Sarcobatus vermiculatus / Artemisia tridentata Shrubland	Black Greasewood / Basin Big Sagebrush Shrubland	CEGL001359
Sarcobatus vermiculatus / Atriplex gardneri Shrubland	Black Greasewood / Gardner's Saltbush Shrubland	CEGL001360
Sarcobatus vermiculatus Disturbed Shrubland	Black Greasewood Disturbed Shrubland	CEGL001357
Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)		
Atriplex canescens / Achnatherum hymenoides Shrubland	Fourwing Saltbush / Indian Ricegrass Shrubland	CEGL001289
Atriplex confertifolia - Krascheninnikovia lanata Shrubland	Shadscale - Winter-fat Shrubland	CEGL001301
Atriplex confertifolia / Achnatherum hymenoides Shrubland	Shadscale / Indian Ricegrass Shrubland	CEGL001311
Atriplex confertifolia / Pleuraphis jamesii Shrubland	Shadscale / James' Galleta Shrubland	CEGL001304
Atriplex confertifolia / Hesperostipa comata Shrubland	Shadscale / Needle-and-Thread Shrubland	CEGL001314

Table 8. Plant associations identified within the DINO vegetation mapping project area*.

NVC Association	Common Name	Element Code†
Atriplex confertifolia Great Basin Shrubland	Shadscale Great Basin Shrubland	CEGL001294
Artemisia tridentata ssp. wyomingensis - Atriplex confertifolia Shrubland	Wyoming Big Sagebrush - Shadscale Shrubland	CEGL001040
Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)		
Chrysothamnus viscidiflorus Talus Shrubland	Green Rabbitbrush Talus Shrubland	CEGL002347
Cercocarpus intricatus Montane Shrubland	Littleleaf Mountain-mahogany Montane Shrubland	CEGL002587
Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)		
Ceanothus velutinus Shrubland	Tobacco-brush Shrubland	CEGL002167
Inter-Mountain Basins Active and Stabilized Dune (CES304.775)		
Ericameria nauseosa Sand Deposit Sparse Shrubland	Rubber Rabbitbrush Sand Deposit Sparse Shrubland	CEGL002980
GRASSLANDS AND FORB-DOMINATED VEGETATION		
Inter-Mountain Basins Semi-Desert Grassland (CES304.787)		
Achnatherum hymenoides Colorado Plateau Herbaceous Vegetation	Indian Ricegrass Colorado Plateau Herbaceous Vegetation	CEGL002343
Achnatherum lettermanii Herbaceous Alliance	Letterman's Needlegrass Herbaceous Alliance	A.2524
Bromus tectorum Semi-natural Herbaceous Vegetation	Cheatgrass Semi-natural Herbaceous Vegetation	CEGL003019
Elymus lanceolatus Herbaceous Vegetation	Streamside Wild Rye Herbaceous Vegetation	CEGL002588
Glycyrrhiza lepidota Herbaceous Vegetation	American Licorice Herbaceous Vegetation [Park Special]	Park Special
Hesperostipa comata - Achnatherum hymenoides Herbaceous Vegetation	Needle-and-Thread - Indian Ricegrass Herbaceous Vegetation	CEGL001703
Hesperostipa comata Great Basin Herbaceous Vegetation	Needle-and-Thread Great Basin Herbaceous Vegetation	CEGL001705
Heterotheca villosa Herbaceous Vegetation	Hairy Goldenaster Herbaceous Vegetation [Park Special]	Park Special
Leymus cinereus - Pascopyrum smithii Herbaceous Vegetation	Great Basin Lyme Grass - Western Wheatgrass Herbaceous Vegetation	CEGL001483
Pascopyrum smithii Herbaceous Vegetation	Western Wheatgrass Herbaceous Vegetation	CEGL001577
Pleuraphis jamesii Herbaceous Vegetation	James' Galleta Herbaceous Vegetation	CEGL001777
Post-fire Herbaceous Vegetation	Post-fire Herbaceous Vegetation	Park Special

Table 8. Plant associations identified within the DINO vegetation mapping project area*.

NVC Association	Common Name	Element Code†
Pseudoroegneria spicata Herbaceous Vegetation	Bluebunch Wheatgrass Herbaceous Vegetation	CEGL001660
Pseudoroegneria spicata - Leymus salinus Herbaceous Vegetation	Bluebunch Wheatgrass - Salinas Lyme Grass Herbaceous Vegetation	Park Special
Sporobolus cryptandrus Great Basin Herbaceous Vegetation	Sand Dropseed Great Basin Herbaceous Vegetation	CEGL002691
Inter-Mountain Basins Greasewood Flat (CES304.780)		
Distichlis spicata Herbaceous Vegetation	Saltgrass Herbaceous Vegetation	CEGL001770
Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)		
Pseudoroegneria spicata - Cushion Plants Herbaceous Vegetation	Bluebunch Wheatgrass - Cushion Plants Herbaceous Vegetation	CEGL001666
Inter-Mountain Basins Active and Stabilized Dune (CES304.775)		
Muhlenbergia pungens Herbaceous Vegetation	Sandhills Muhly Herbaceous Vegetation	CEGL002363
Inter-Mountain Basins Shale Badland (CES304.789)		
Leymus salinus Shale Sparse Vegetation	Salinas Lyme Grass Shale Sparse Vegetation	CEGL002745
Shale Annual Herbaceous Vegetation	Shale Annual Herbaceous Vegetation	Park Special
RIPARIAN, WETLAND AND MESIC ASSOCIATIONS		
Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)		
Pseudotsuga menziesii / Acer negundo Woodland	Douglas-fir / Box-elder Woodland	CEGL002754
Rocky Mountain Lower Montane Riparian Woodland and Shrubland (CES306.821)		
Acer negundo / Equisetum arvense Forest	Box-elder / Field Horsetail Forest	CEGL000626
Acer negundo / Prunus virginiana Forest	Box-elder / Choke Cherry Forest	CEGL000628
Acer negundo - Celtis laevigata var. reticulata Woodland	Box-elder - Netleaf Hackberry Woodland	CEGL002599
Acer negundo / Disturbed Understory Woodland	Box-elder / Disturbed Understory Woodland	CEGL002693
Acer negundo / Rhus trilobata Woodland	Box-elder / Threeleaf Sumac Woodland	CEGL002750
Elaeagnus angustifolia Semi-natural Woodland	Russian-olive Semi-natural Woodland	CEGL005269
Populus angustifolia / Salix exigua Woodland	Narrowleaf Cottonwood / Coyote Willow Woodland	CEGL000654
Populus angustifolia / Rhus trilobata Woodland	Narrowleaf Cottonwood / Threeleaf Sumac Woodland	CEGL000652

Table 8. Plant associations identified within the DINO vegetation mapping project area*.

NVC Association	Common Name	Element Code†
Populus angustifolia / Betula occidentalis Woodland	Narrowleaf Cottonwood / Water Birch Woodland	CEGL000648
Populus angustifolia - Juniperus scopulorum Woodland	Narrowleaf Cottonwood - Rocky Mountain Juniper Woodland	CEGL002640
Populus deltoides ssp. wislizeni / Acer negundo Woodland	Rio Grande Cottonwood / Box-elder Woodland	CEGL002336
Populus deltoides (ssp. wislizeni, ssp. monilifera) / Distichlis spicata Woodland	(Rio Grande Cottonwood, Plains Cottonwood) / Saltgrass Woodland	CEGL000939
Populus deltoides ssp. wislizeni / Disturbed Understory Woodland	Rio Grande Cottonwood / Disturbed Understory Woodland	CEGL003810
Populus deltoides ssp. wislizeni / Rhus trilobata Woodland	Rio Grande Cottonwood / Threeleaf Sumac Woodland	CEGL000940
Betula occidentalis / Mesic Graminoids Shrubland	Salinas Lyme Grass Shale Sparse Vegetation	CEGL002654
Betula occidentalis Shrubland	Water Birch Shrubland	CEGL001080
Rhus trilobata Intermittently Flooded Shrubland	Threeleaf Sumac Intermittently Flooded Shrubland	CEGL001121
Salix exigua / Barren Shrubland	Coyote Willow / Barren Shrubland	CEGL001200
Salix exigua / Mesic Forbs Shrubland	Coyote Willow / Mesic Forbs Shrubland	CEGL001202
Salix exigua / Mesic Graminoids Shrubland	Coyote Willow / Mesic Graminoids Shrubland	CEGL001203
Tamarix spp. Temporarily Flooded Semi-natural Shrubland	Salt-cedar species Temporarily Flooded Semi-natural Shrubland	CEGL003114
Carex pellita Herbaceous Vegetation	Woolly Sedge Herbaceous Vegetation	CEGL001809
Carex praegracilis Herbaceous Vegetation	Clustered Field Sedge Herbaceous Vegetation	CEGL002660
Eleocharis palustris Herbaceous Vegetation	Marsh Spikerush Herbaceous Vegetation	CEGL001833
Elymus repens Semi-natural Herbaceous Vegetation	Creeping Wild Rye Semi-natural Herbaceous Vegetation	CEGL005868
Equisetum hyemale Herbaceous Vegetation	Common Scouring-rush Herbaceous Vegetation	CEGL002760
Equisetum laevigatum Herbaceous Vegetation	Smooth Horsetail Herbaceous Vegetation	CEGL002241
Leymus cinereus - Distichlis spicata Herbaceous Vegetation	Great Basin Lyme Grass - Saltgrass Herbaceous Vegetation	CEGL001481
Phragmites australis Western North America Temperate Semi-natural Herbaceous Vegetation	Common Reed Western North America Temperate Semi-natural Herbaceous Vegetation	CEGL001475
Spartina gracilis Herbaceous Vegetation	Alkali Cordgrass Herbaceous Vegetation	CEGL001588
Spartina pectinata Western Herbaceous Vegetation	Prairie Cordgrass Western Herbaceous Vegetation	CEGL001476
North American Arid West Emergent Marsh (CES300.729)		

Table 8. Plant associations identified within the DINO vegetation mapping project area*.

NVC Association	Common Name	Element Code†
Juncus balticus Herbaceous Vegetation	Baltic Rush Herbaceous Vegetation	CEGL001838
Schoenoplectus pungens Herbaceous Vegetation	Common Threesquare Herbaceous Vegetation	CEGL001587
Schoenoplectus acutus Herbaceous Vegetation	Hardstem Bulrush Herbaceous Vegetation	CEGL001840
Colorado Plateau Hanging Garden (CES304.764)		
Calamagrostis scopulorum Hanging Garden Herbaceous Vegetation	Ditch Reedgrass Hanging Garden Herbaceous Vegetation	CEGL002751
Aquilegia micrantha - Calamagrostis scopulorum Herbaceous Vegetation	Mancos Columbine - Ditch Reedgrass Herbaceous Vegetation	CEGL002592

* 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 DINO vegetation by physiognomic group. Appendix F provides detailed local and global descriptions of the 174 plant associations, alliances and park special vegetation types found within the monument. Local descriptions are based on plot and observation point data from the monument and environs. Global descriptions characterize the association across its range and are based primarily on published and unpublished literature.

Most of the vegetation types at DINO fit into existing NVC association concepts, or were considered significant enough to create new NVC associations. Eleven associations were considered unique to the monument; NatureServe designated these as Park Specials. Seven vegetation types fit into alliance concepts but lacked sufficient information to place in an existing association or justify creating new associations.

Upland Forest and Woodland Associations

Tree-dominated vegetation types are common and widely distributed within DINO. They occupy nearly every available habitat, from riparian corridors to sand dunes to rock outcrops. All stands are subject to fire; those on steep canyon walls are vulnerable to downslope soil movement or rock fall. Canopy density is controlled by stand age and the availability of soil moisture. Most examples at DINO do not have the closed tree canopy that usually characterizes forest (as opposed to more open woodland) associations. The upland forest and woodland associations at DINO include:

- Cercocarpus ledifolius / Artemisia tridentata ssp. vaseyana Woodland
- Cercocarpus ledifolius / Prunus virginiana Shrubland
- Cercocarpus ledifolius / Pseudoroegneria spicata Shrubland
- Cercocarpus ledifolius Woodland Alliance
- Juniperus osteosperma / Artemisia nova Woodland
- Juniperus osteosperma / Artemisia tridentata - Grayia spinosa Woodland
- Juniperus osteosperma / Artemisia tridentata ssp. tridentata Woodland
- Juniperus osteosperma / Artemisia tridentata ssp. wyomingensis Woodland
- Juniperus osteosperma / Bromus tectorum Semi-natural Woodland
- Juniperus osteosperma / Cercocarpus montanus Woodland
- Juniperus osteosperma / Glossopetalon spinescens Woodland
- Juniperus osteosperma / Hesperostipa comata Woodland
- Juniperus osteosperma / Leymus salinus Woodland
- Juniperus osteosperma / Pleuraphis jamesii Woodland
- Juniperus osteosperma / Pseudoroegneria spicata Woodland
- Juniperus osteosperma / Sparse Understory Woodland
- Juniperus scopulorum / Artemisia tridentata Woodland
- Pinus edulis - (Juniperus spp.) Woodland Alliance
- Pinus edulis - Juniperus osteosperma / Amelanchier utahensis Woodland
- Pinus edulis - Juniperus osteosperma / Artemisia nova Woodland
- Pinus edulis - Juniperus osteosperma / Cercocarpus intricatus Woodland
- Pinus edulis - Juniperus osteosperma / Cercocarpus ledifolius Woodland
- Pinus edulis - Juniperus osteosperma / Ephedra viridis Woodland
- Pinus edulis - Juniperus osteosperma / Petradoria pumila Woodland
- Pinus edulis - Juniperus osteosperma / Pseudoroegneria spicata - Cushion Plant Woodland

- Pinus edulis - Juniperus osteosperma / Purshia tridentata 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. / Poa fendleriana Woodland
- Pinus flexilis / Juniperus communis Woodland
- Pinus ponderosa / Artemisia tridentata ssp. vaseyana Woodland
- Pinus ponderosa / Cercocarpus ledifolius Woodland
- Pinus ponderosa / Juniperus scopulorum Woodland
- Pinus ponderosa / Rockland Woodland
- Populus tremuloides / Amelanchier alnifolia - Symphoricarpos oreophilus / Mixed Graminoid Forest
- Populus tremuloides / Ceanothus velutinus Forest
- Populus tremuloides / Juniperus communis Forest
- Populus tremuloides / Prunus virginiana Forest
- Populus tremuloides / Symphoricarpos oreophilus / Carex rossii Forest
- Populus tremuloides / Symphoricarpos oreophilus Forest
- Pseudotsuga menziesii / Amelanchier alnifolia Forest
- Pseudotsuga menziesii / Cercocarpus ledifolius Woodland
- Pseudotsuga menziesii / Cercocarpus montanus Woodland
- Pseudotsuga menziesii / Juniperus communis Forest
- Pseudotsuga menziesii / Mahonia repens Forest
- Pseudotsuga menziesii / Poa fendleriana Woodland
- Pseudotsuga menziesii / Pseudoroegneria spicata Woodland
- Pseudotsuga menziesii / Symphoricarpos oreophilus Forest
- Pseudotsuga menziesii Woodland Alliance

Juniper and pinyon-juniper woodlands are among the most diverse and common communities within the mapping area. Pinyon pine tends to be absent in stands on dry or low-elevation sites. Deep soils support dense woodlands with understories of shrubs or grasses; shallow rocky soils are sparser, but more diverse. Stands on deep sand have trees with large crowns but little groundcover other than biological soil crusts. Marine shales support stands that tend to be very open, but also diverse in their understory composition. Woodlands of ponderosa pine or curl-leaf mountain mahogany are restricted to the rocky summits of the highest ridges in the monument. Stands of Douglas-fir cling to the steep upper slopes of north-facing canyon walls. Aspen stands are generally limited to lee slopes at higher elevations where snow collects.

Upland Shrubland Associations

Shrublands are as diverse and widespread within the mapping area as woodlands. The upland shrubland associations of DINO include:

- Amelanchier (utahensis, alnifolia) - Cercocarpus montanus Shrubland
- Amelanchier alnifolia / Symphoricarpos oreophilus Shrubland
- Amelanchier utahensis / Pseudoroegneria spicata Shrubland
- Amelanchier utahensis Shrubland
- Arctostaphylos patula - Artemisia tridentata (ssp. vaseyana, ssp. wyomingensis) Shrubland
- Artemisia arbuscula ssp. longiloba / Elymus lanceolatus Shrubland
- Artemisia nova / Pseudoroegneria spicata Shrubland
- Artemisia nova Shrubland

- Artemisia tridentata - (Ericameria nauseosa) / Bromus tectorum Semi-natural Shrubland
- Artemisia tridentata (ssp. tridentata, ssp. xericensis) Shrubland Alliance
- Artemisia tridentata (ssp. vaseyana, ssp. wyomingensis) - Amelanchier utahensis Shrubland
- Artemisia tridentata ssp. tridentata / Hesperostipa comata Shrubland
- Artemisia tridentata ssp. tridentata / Leymus cinereus Shrubland
- Artemisia tridentata ssp. tridentata / Sporobolus airoides Shrubland
- Artemisia tridentata ssp. vaseyana / Achnatherum lettermanii Shrubland
- Artemisia tridentata ssp. vaseyana / Balsamorhiza sagittata Shrubland
- Artemisia tridentata ssp. vaseyana / Hesperostipa comata Shrubland
- Artemisia tridentata ssp. vaseyana / Leymus cinereus Shrubland
- Artemisia tridentata ssp. vaseyana / Pascopyrum smithii Shrubland
- Artemisia tridentata ssp. vaseyana / Poa fendleriana Shrubland
- Artemisia tridentata ssp. vaseyana / Poa secunda Shrubland
- Artemisia tridentata ssp. vaseyana / Pseudoroegneria spicata Shrubland
- Artemisia tridentata ssp. wyomingensis - Atriplex confertifolia Shrubland
- Artemisia tridentata ssp. wyomingensis / Balsamorhiza sagittata Shrubland
- Artemisia tridentata ssp. wyomingensis / Disturbed Understory Semi-natural Shrubland
- Artemisia tridentata ssp. wyomingensis / Elymus elymoides Shrubland
- Artemisia tridentata ssp. wyomingensis / Hesperostipa comata Colorado Plateau Shrubland
- Artemisia tridentata ssp. wyomingensis / Leymus salinus Shrubland
- Artemisia tridentata ssp. wyomingensis / Pascopyrum smithii Shrub Herbaceous Vegetation
- Artemisia tridentata ssp. wyomingensis / Pleuraphis jamesii Shrubland
- Artemisia tridentata ssp. wyomingensis / Poa fendleriana Shrubland
- Artemisia tridentata ssp. wyomingensis / Poa secunda Shrubland
- Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrubland
- Artemisia tridentata ssp. wyomingensis / Sparse Understory Shrubland
- Atriplex canescens / Achnatherum hymenoides Shrubland
- Atriplex confertifolia - Krascheninnikovia lanata Shrubland
- Atriplex confertifolia / Achnatherum hymenoides Shrubland
- Atriplex confertifolia / Hesperostipa comata Shrubland
- Atriplex confertifolia / Pleuraphis jamesii Shrubland
- Atriplex confertifolia Great Basin Shrubland
- Atriplex corrugata Dwarf-shrubland
- Atriplex gardneri Dwarf-shrubland
- Ceanothus velutinus Shrubland
- Cercocarpus intricatus Montane Shrubland
- Cercocarpus montanus / Pseudoroegneria spicata Shrubland
- Chrysothamnus viscidiflorus / Hesperostipa comata Shrubland
- Chrysothamnus viscidiflorus Talus Shrubland
- Ephedra torreyana - (Atriplex spp.) / Nonvascular Gypsum Sparse Vegetation
- Ephedra viridis / Bromus tectorum Semi-natural Shrubland
- Ericameria nauseosa / Bromus tectorum Semi-natural Shrubland
- Ericameria nauseosa / Pascopyrum smithii Shrubland
- Ericameria nauseosa Desert Wash Shrubland
- Ericameria nauseosa Sand Deposit Sparse Shrubland
- Eriogonum (corymbosum, leptocladon) Dwarf-shrubland Alliance
- Grayia spinosa / Achnatherum hymenoides Shrubland
- Krascheninnikovia lanata / Hesperostipa comata Dwarf-shrubland
- Krascheninnikovia lanata / Poa secunda Dwarf-shrubland
- Philadelphus microphyllus - Ephedra viridis Shrubland
- Prunus virginiana - (Prunus americana) Shrubland
- Sarcobatus vermiculatus / Artemisia tridentata Shrubland

- Sarcobatus vermiculatus / Atriplex gardneri Shrubland
- Sarcobatus vermiculatus / Sporobolus airoides Shrubland
- Sarcobatus vermiculatus Disturbed Shrubland
- Tetradymia canescens Shrubland

Wyoming and mountain big sagebrush shrublands are the most common, occupying deep soils throughout the monument. Marine shales support sparse communities of shadscale and other desert shrubs. Black sagebrush is common on windswept ridgelines underlain by limestone. Cool, rocky slopes are the main habitat for mountain shrublands of serviceberry, mountain mahogany, and chokecherry. Rubber rabbitbrush shrublands occur primarily in sandy areas where the sagebrush has burned; the understory is often dominated by cheatgrass. Black greasewood and basin big sagebrush dominate dry alluvial terraces in valley bottoms. An unusual shrubland dominated by littleleaf mockorange and green Mormon-tea is a common type on rocky canyon walls in the major river canyons.

Upland Herbaceous Associations

Grass-dominated associations are common but patchy within the mapping area, tending to occur where soils are thin and windswept or where fire has removed the competing woody vegetation. Forb-dominated types tend to be weedy. The upland herbaceous associations of DINO include:

- Achnatherum hymenoides Colorado Plateau Herbaceous Vegetation
- Achnatherum lettermanii Herbaceous Alliance
- Bromus tectorum Semi-natural Herbaceous Vegetation
- Elymus lanceolatus Herbaceous Vegetation
- Hesperostipa comata - Achnatherum hymenoides Herbaceous Vegetation
- Hesperostipa comata Great Basin Herbaceous Vegetation
- Heterotheca villosa Herbaceous Vegetation
- Leymus cinereus - Distichlis spicata Herbaceous Vegetation
- Leymus cinereus - Pascopyrum smithii Herbaceous Vegetation
- Leymus salinus Shale Sparse Vegetation
- Muhlenbergia pungens Herbaceous Vegetation
- Pascopyrum smithii Herbaceous Vegetation
- Pleuraphis jamesii Herbaceous Vegetation
- Post-fire Herbaceous Vegetation
- Pseudoroegneria spicata - Cushion Plants Herbaceous Vegetation
- Pseudoroegneria spicata - Leymus salinus Herbaceous Vegetation
- Pseudoroegneria spicata Herbaceous Vegetation
- Shale Annual Herbaceous Vegetation
- Sporobolus cryptandrus Great Basin Herbaceous Vegetation

When fires remove the woody pinyon-juniper or sagebrush overstory, native bunchgrasses including needle-and-thread, streamside wildrye and bluebunch wheatgrass characterize the community for at least a few decades. Areas that burn especially hot tend to be dominated by cheatgrass (Naumann personal communication 2008). Persistent bluebunch wheatgrass grasslands are rare, occurring only on canyon walls (Figure 21) or on windswept ridgelines in a mosaic with black sagebrush shrublands. Cushion-type forbs like phlox are common in these sites, and occasionally dominant. Another sparse herbaceous community of mixed grasses and forbs occurs on cobble-covered islands and point bars in the lower Green River. Relict stands of

Great Basin wildrye (*Leymus cinereus*) are especially rare in floodplains and draws. Loose, sandy sites will sometimes support sparse grasslands of sand dropseed, sand muhly (*Muhlenbergia pungens*), or Indian ricegrass. North-facing shale slopes at low elevations will occasionally support sparse communities of Salinas lyme grass. Disturbed marine shales will support exotic-dominated communities that may include kochia (*Kochia scoparia*), halogeton, cheatgrass, and African mustard (*Malcolmia africana*).

Riparian and Wetland Forest and Woodland Associations

Riparian woodlands are restricted to floodplains, tributary canyons, and plunge pools below pouroffs. They tend to be dominated by box elder or cottonwoods, except in narrow, rock-walled canyons, where Douglas-fir sometimes occurs in the canopy. Riparian forest and woodland associations of DINO include:

- Acer negundo - Celtis laevigata var. reticulata Woodland
- Acer negundo / Disturbed Understory Woodland
- Acer negundo / Equisetum arvense Forest
- Acer negundo / Prunus virginiana Forest
- Acer negundo / Rhus trilobata Woodland
- Elaeagnus angustifolia Semi-natural Woodland
- Juniperus scopulorum Temporarily Flooded Woodland Alliance
- Populus angustifolia - Juniperus scopulorum Woodland
- Populus angustifolia / Betula occidentalis Woodland
- Populus angustifolia / Rhus trilobata Woodland
- Populus angustifolia / Salix exigua Woodland
- Populus deltoides (ssp. wislizeni, ssp. monilifera) / Distichlis spicata Woodland
- Populus deltoides ssp. wislizeni / Acer negundo Woodland
- Populus deltoides ssp. wislizeni / Disturbed Understory Woodland
- Populus deltoides ssp. wislizeni / Rhus trilobata Woodland
- Pseudotsuga menziesii / Acer negundo Woodland

The broad, well-developed floodplains of Deerlodge Park, Echo Park and Rainbow / Island Park support a mosaic of Rio Grande or lanceleaf cottonwood woodlands of varying ages. Stands on the Yampa River and on the Green River below the confluence are maintained by a high water table and periodic overbank sediment deposition. The understory will vary from early successional scouring rushes to dry upland shrubs depending on the age of the stand and the depth to the water table. Cottonwood is rare on the banks of the upper Green River and in all the narrow canyons with rocky shoreline; in these areas, box elder woodlands are dominant. Slot canyons with a perennial water source or at least a high water table will often contain a belt of narrowleaf cottonwood. Tamarisk occurs along the banks of both rivers; it is especially abundant on middle terraces that were cut off from flooding once Flaming Gorge dam closed in 1962.

Riparian and Wetland Shrubland Associations

Mesic and wetland shrub communities are very limited in their size and distribution within the monument. All are restricted to areas with high water tables, including stream banks, stock pond margins, pouroffs, and seeps. Riparian and wetland shrubland associations of DINO include:

- Betula occidentalis / Mesic Graminoids Shrubland
- Betula occidentalis Shrubland
- Rhus trilobata Intermittently Flooded Shrubland
- Salix exigua / Barren Shrubland
- Salix exigua / Mesic Forbs Shrubland
- Salix exigua / Mesic Graminoids Shrubland
- Tamarix spp. Temporarily Flooded Semi-natural Shrubland

Coyote willow shrublands are most common on the banks of the Green and Yampa rivers on stream banks, islands or bars that are vulnerable to frequent scouring from floods. Threeleaf sumac shrublands also occur in the larger floodplains, but on higher terraces that are isolated from the abrasive effects of high water. Water birch shrublands are limited to cool, narrow tributary canyons and pouroffs. Tamarisk has replaced all of these shrubland communities along significant stretches of the main rivers and their tributaries.

Riparian and Wetland Herbaceous Associations

Like mesic shrub communities, riparian and wetland herbaceous associations are uncommon and limited in their distribution within the mapping area. All are restricted to areas with water at or near the surface for at least part of the growing season. Diversity is high, but most associations occur in mosaics of patches smaller than the minimum mapping unit. Riparian and wetland herbaceous associations of DINO include:

- Aquilegia micrantha - Calamagrostis scopulorum Herbaceous Vegetation
- Calamagrostis scopulorum Hanging Garden Herbaceous Vegetation
- Carex pellita Herbaceous Vegetation
- Carex praegracilis Herbaceous Vegetation
- Distichlis spicata Herbaceous Vegetation
- Eleocharis palustris Herbaceous Vegetation
- Elymus repens Semi-natural Herbaceous Vegetation
- Equisetum hyemale Herbaceous Vegetation
- Equisetum laevigatum Herbaceous Vegetation
- Glycyrrhiza lepidota Herbaceous Vegetation
- Juncus balticus Herbaceous Vegetation
- Phragmites australis Western North America Temperate Semi-natural Herbaceous Vegetation
- Schoenoplectus acutus Herbaceous Vegetation
- Schoenoplectus pungens Herbaceous Vegetation
- Spartina gracilis Herbaceous Vegetation
- Spartina pectinata Western Herbaceous Vegetation
- Xanthium strumarium Herbaceous Vegetation

Hanging gardens emerging from cracks or alcoves in canyon walls support communities of unusual species, including Mancos columbine, ditch reed grass, shooting star and hellborine orchid. Other kinds of seeps support a variety of graminoid communities, depending on water chemistry. The banks of both rivers support patches of prairie cordgrass and wild licorice; exposed sand of the river bed will support patches of rough cocklebur in the late summer. The riparian zone is also home to communities dominated by introduced or invasive exotic species, including quackgrass and perennial pepperweed.

Field Key Preparation

An illustrated dichotomous field key to plant associations of the DINO mapping 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, tall shrubland, shrubland, dwarfshrubland, graminoid, or forb. The second level focuses on the dominant species' canopy cover. Brief environmental descriptions are included with the floristic descriptions to assist in identifying plant associations. To increase the utility of the key, individual plant associations are cross-referenced to the final map classes.

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

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

Assessment of Global 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 to each. 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 that the plant community is at little or no risk of extirpation. No plant associations within DINO are currently considered critically imperiled (G1). 10 associations are considered imperiled (G2 or G2?; Figure 21). Eighty-nine associations are ranked vulnerable to secure (G3, G4, and G5) and the remaining associations are not yet ranked or are new to the NVC.

All vegetation communities within DINO are subject to change over time; drought and fire are the most likely agents of change. Recent proposals to dam the Yampa river above Maybell represent a threat to the integrity of that river’s riparian system through the monument. Because of recent regional drought and a general change over time to a warmer and drier climate, riparian and wetland plant communities within DINO are threatened to some degree. This threat is heightened due to the introduction of non-native plant species that invade mesic habitats more readily than dry upland habitats.



Photo credit: NCPN

Figure 21. The globally imperiled *Pseudoroegneria spicata* Herbaceous Vegetation association at DINO.

Fuels Data Collection

Natural and prescribed fires are an established element of the DINO ecosystem. Under the current management plan, all fires are managed intensively, and suppressed if the prescribed conditions are not present. The proximity of private land, ranching operations, and developments adjacent to the monument boundary, especially on Douglas Mountain and the southern boundary increases the concern associated with any fire. Fire fuels data were collected as part of the DINO vegetation mapping project in order to assist managers with fire planning and management. The attributes described below were selected in consultation with fuels management experts to supplement the vegetation plot data and map class attributes in providing a complete picture of fire fuels for DINO. These data were entered in the DINO plots database. Fuels data were not analyzed as part of this project.

Fuels Data

Field forms, protocols, and definitions for collecting fuels data appear in Appendix B.1 and Appendix B.3. Quantitative fuels data collected in the vegetation plots at DINO included these measurements for each stem in ponderosa pine or Douglas-fir plots exceeding 5 cm (2 in) in diameter:

- trunk diameter at breast height (DBH)
- crown height
- crown base height
- crown ratio
- structural stage (position in the canopy)

Different variables were measured in woodland plots (two-needle pinyon, Utah juniper). Fuels data gathered for each stem or tree greater than 1.4 m (4.5 ft) in height included:

- stem diameter at root crown (DRC)
- crown height
- crown width

Field crews also collected qualitative information to support fuels categorization at each plot. Each woodland plot was placed in one of four age class categories (invasive, young, mature, old-growth). Fuel conditions for each forest, woodland or shrubland plot were characterized by comparing the site to a photo series depicting different fuel loading conditions (USFS 2008, Ottmer et al. 2000a, Ottmer et al. 2000b, Fischer 1981) and recording the most representative photo number. Two 35 mm color slides were taken of each plot, and a digital 360° video of 30–40 seconds duration was shot from plot center. Nikon Coolpix cameras, hand-held at shoulder height or mounted on a 1.4 m (4.5 ft) high monopod were used to acquire the digital movies. Digital movies were collected at 507 locations within the DINO project area. Plots in sites that would not carry fire, e.g., sparse vegetation or riparian communities, did not have corresponding movies. Color slides are available for all 944 plots and observation points as well as the 1543 accuracy assessment points; these can be used to estimate fuel loads.

Vegetation Mapping

Methods

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

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

Each step built upon information created during the previous stage. Field reconnaissance was intended to familiarize the photointerpreters with the monument, patterns of vegetation distribution, and environmental factors useful for developing mapping models. Map class development followed this reconnaissance and was based on intensive review of the aerial imagery in concert with data from the first year of vegetation plot sampling. The mapping phase applied the map class concepts in order to draw consistent, homogenous polygons on the base orthoimagery. The draft polygon set was digitized and given additional attributes (spatial database development).

Field Reconnaissance

Most of the reconnaissance was conducted concurrently with the vegetation plot data collection in 2002 and 2003. Photointerpreters visited the monument several times to assign plant communities or complexes to distinct signatures on the orthophotographs. Understanding the environmental drivers influencing vegetation patterns and identifying what information could be extracted from the project imagery were other important products of the reconnaissance. Field notes were written directly on paper plots of the stereo photographs; these helped to guide the photo interpretation and mapping process.

Map Class and Polygon Attribute Development

The goal of mapping was to identify meaningful units to represent existing vegetation and land uses for the DINO vegetation mapping project area at a sufficient level of detail to support management. Map classes specific to this project were developed to characterize vegetation types within the monument and most of the environs. Standard land-use map classes (Anderson et al. 2002) were used to map developed parts of the mapping area including monument facilities and roads.

The current standard for the USGS-NPS Vegetation Classification and Mapping Program projects is to map to the plant association level of the NVC. DINO staff also requested that vegetation initially be mapped to individual plant associations, then lumped in order to achieve the desired accuracy. 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 DINO, the relationships between map classes and plant associations are

complex. The initial set of map classes was developed from a list of associations defined from 2002 field data in consultation with the monument botanist. This initial map class list had roughly a one-to-one relationship of association to map class. As the mapping progressed, it became apparent that similar plant associations were better grouped into a single map class because they could not be distinguished consistently or accurately using remote sensing or modeling. Map class definitions and concepts continued to be adjusted throughout the mapping phase of the project.

Vegetation map class names are descriptive of the physiognomy and diagnostic species, with reference to environmental setting where appropriate. In order to facilitate tracking and management of vegetation map classes across NCPN park units, a coding system was developed. The photointerpreters' map class coding system assigned a unique number to each map class. Although these numeric codes have been retained within the spatial database and map class keys (Appendix I), a complementary, five-letter alphacode system for map classes was created for all NCPN park vegetation mapping projects. Each alphacode begins with the first letter of the corresponding NVC Class (F = Forest, W = Woodland, S = Shrubland, H = Herbaceous and N = nonvascular). The subsequent four letters generally abbreviate the map class name. For example, the Pinyon-Juniper / Sparse Understory Woodland map class is represented by the alphacode "W-PJSP". This same code is used for similar map classes at other NCPN parks. For map classes representing 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 9), 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 9. Physiognomic attributes assigned to polygons during mapping. When appropriate, 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 Sagebrush Canopy (> 40% cover)
	E	Light Sagebrush 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

	G	Forest and Woodlands 15 – 30 meters
Vegetation Height	H	Forest and Woodlands 5 – 15 meters
(Applied to woody terrestrial vegetation	I	Forest and Woodlands 1 – 5 meters
map classes only)	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 10 is a list of the modifiers used in the DINO project.

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

Category	Code	Name	Description
Vegetation Modifiers	a	Altered	Applies when some alteration of the vegetation is evident or documented, but the type is visually indistinguishable from unaltered stands of the same vegetation type.
	g	Limestone Grassland	A subset of the Black Sagebrush Shrubland and Cushion Plant Herbaceous Vegetation map class; polygons originally mapped as this special type were retained with this modifier; restricted to thin soils overlying limestone outcrops.
	d	Sandhill Muhly Dune Grassland	A subset of the Native Grasslands map class; polygons originally mapped as this special type were retained with this modifier; most are near the Gates of Lodore on Browns Park Formation
	h	Low Sagebrush	A subset of the Sagebrush / Rabbitbrush Shrubland Map Class; polygons originally mapped as this special type were retained with this modifier; all are on the north flank of Split Mountain.
	i	Tamarisk	Applies to riparian vegetation dominated by invasive tamarisk, in which native trees are also evident.
	r	Russian-olive	Mixed riparian stands along the lower Green River (below Rainbow Park), that contain Russian-olive trees.
	b	Recent Burn	Applies to upland vegetation disturbed by recent burning – within 1 year of photography – visible as blackened areas. Most are mapped as a best guess of the original vegetation with this modifier.
	o	Older Burned	Applies to upland vegetation disturbed by burns more than one year old; evidence includes fire scar landscape patterns or visible dead tree trunks.
	p	Prairie Dog Town	Applies to upland vegetation disturbed by prairie dogs.

	q	Talus	Rock fragments, usually large and angular, derived from and completely covering steep slopes at the base of outcrops.
	m	Mowry Shale	This modifier is intended to emphasize the presence and influence of this unusual acid shale substrate.
	s	Serviceberry Shrubland	A subset of the Mixed Mountain Shrubland map class; polygons originally mapped as serviceberry shrubland were retained with this modifier because their accuracy was high.
	z	Chokecherry Thicket	A subset of the Mixed Mountain Shrubland map class; polygons originally mapped as chokecherry thicket were retained with this modifier because their accuracy was high.
Transportation Modifiers	t	Paved road	A transportation corridor consisting of a roadbed topped by an asphalt or concrete surface. Right-ofway 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.
Utility Modifiers	x	Pipeline Right-of-Way	Altered vegetation shows the route of a natural gas pipeline that crosses the western edge of Split Mountain in the environs.
	w	Telephone line	Altered vegetation shows the route of a telephone line leading to a ranch house on the southern boundary of the monument.

Park Specials

In the scoping phase of the project, monument staff identified several natural resource features of interest that might otherwise not have been identified. Except for hackberry and quaking aspen stands, these features were photographed and noted by field workers as encountered, but were not sampled or mapped:

- Upland seeps and springs
- Rare plant populations
- Noxious weed populations
- Old agricultural fields
- Flammable archaeological/historical features (wikiups, corrals, wing fences / horse traps)
- Raptor nests
- Hackberry stands, aspen stands
- Concentrations of 1000-hour fuels (dead trees)

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

Mapping

The mapping component of the DINO project used a combination of methods to interpret and delineate vegetation polygons. A trained photointerpreter drew polygons on Mylar overlays covering 1m resolution, 1:12,000-scale, digital orthophoto quarter quadrangles (DOQQs). In order to see fine detail, the interpreter examined the 9 x 9-inch 1:12,000-scale aerial photographs in stereo, and transferred this information to the DOQQ. The Mylar overlays were scanned and corrected digitally for distortion. Digitizing was performed using vector editing in ArcGIS. The monument 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 22. This format allows text and image information to be incorporated and linked to spatial coordinates. A detailed description of the geodatabase is provided in Appendix C.

Map Classes

One hundred-one map classes were developed by photointerpreters to describe the DINO vegetation mapping project area; 66 map classes remain following accuracy assessment analysis (Table 11). Of these, 37 are vegetation map classes, 20 are unvegetated geologic map classes and nine are land-use map classes. Of the vegetation map classes, one is represented by points only and eleven represent single NVC plant associations. The remaining 25 vegetation map classes contain multiple plant associations.

Ecological systems (Comer et al. 2003) are used to organize the vegetation map classes (Table 11; see also Project Overview and Appendix A). They were developed by NatureServe to complement the NVC by creating mappable classification units representing groups of associations 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.

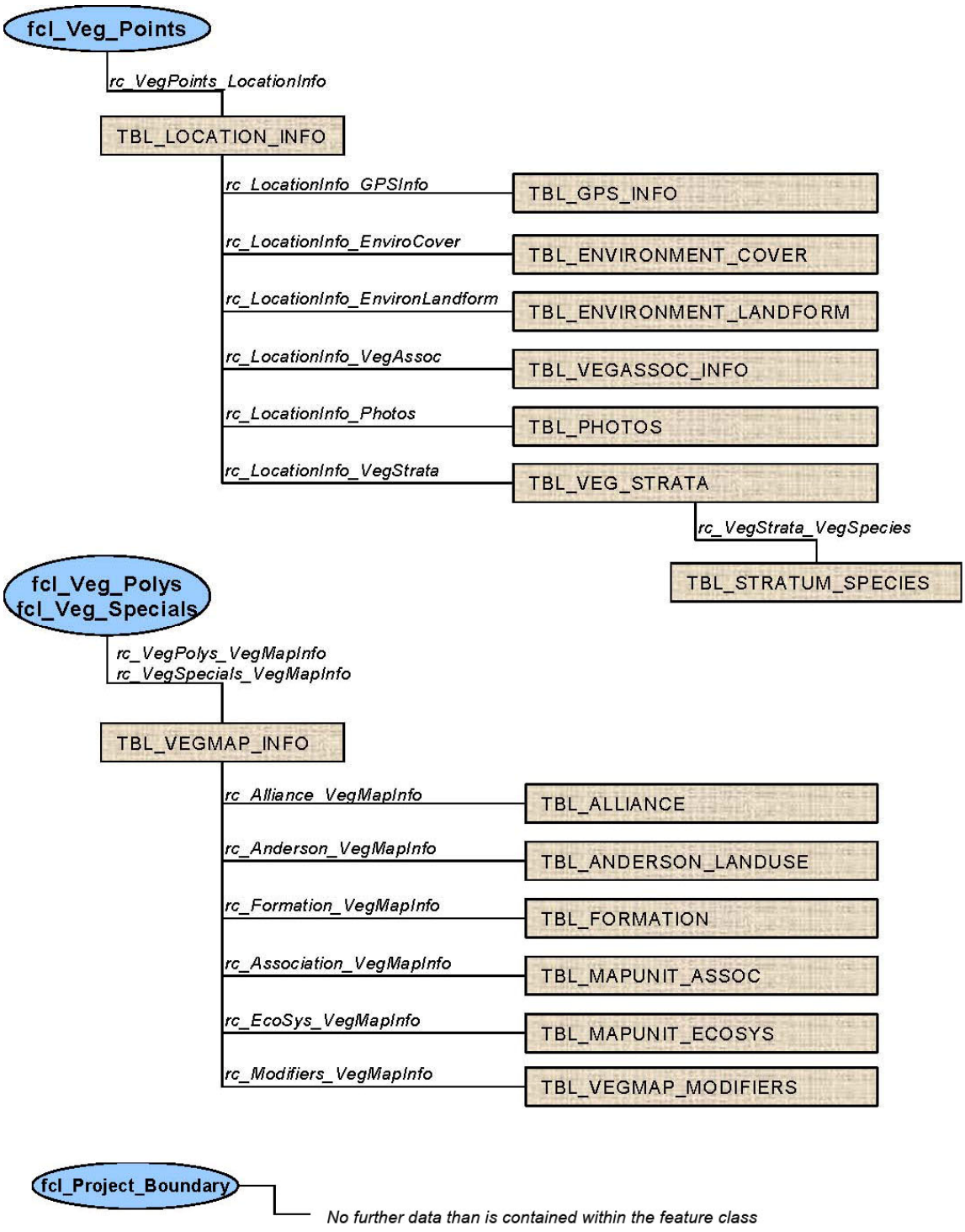


Figure 22. General structure of the DINO geodatabase.

Results

Table 11 shows the relationship of vegetation map classes to ecological systems. 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 11. Map classes used in the final (post-AA) DINO vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. DINO vegetation map classes are arranged using the NatureServe ecological systems classification (shaded boxes).

Map Class #	Map Class Code	Map Class Name	Associations Assigned to Map Class	Relation
Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)				
1	W-DOFI	Douglas-fir	*Pseudotsuga menziesii / Amelanchier alnifolia* Forest *Pseudotsuga menziesii / Cercocarpus ledifolius* Woodland *Pseudotsuga menziesii / Cercocarpus montanus* Woodland *Pseudotsuga menziesii / Juniperus communis* Forest *Pseudotsuga menziesii / Mahonia repens* Forest *Pseudotsuga menziesii / Poa fendleriana* Woodland *Pseudotsuga menziesii / Pseudoroegneria spicata* Woodland *Pseudotsuga menziesii / Symphoricarpos oreophilus* Forest *Pseudotsuga menziesii* Woodland Alliance	1 : many
Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)				
2	W-POPI	Ponderosa Pine Woodland	*Pinus ponderosa / Artemisia tridentata* ssp. *vaseyana* Woodland *Pinus ponderosa / Cercocarpus ledifolius* Woodland *Pinus ponderosa / Juniperus scopulorum* Woodland *Pinus ponderosa* / Rockland Woodland	1 : many
Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland (CES306.819)				
3	W-LIPI	Limber Pine Woodland	*Pinus flexilis / Juniperus communis* Woodland	1 : 1
Rocky Mountain Aspen Forest and Woodland (CES306.813)				
4	W-ASPE	Aspen Forest	*Populus tremuloides / Amelanchier alnifolia - Symphoricarpos oreophilus* / Mixed Graminoid Forest *Populus tremuloides / Ceanothus velutinus* Forest *Populus tremuloides / Juniperus communis* Forest *Populus tremuloides / Prunus virginiana* Forest *Populus tremuloides / Symphoricarpos oreophilus / Carex rossii* Forest *Populus tremuloides / Symphoricarpos oreophilus* Forest	1 : many
Colorado Plateau Pinyon-Juniper Woodland (CES304.767)				
8	W-PJSP	Pinyon-Juniper / Sparse Understory Woodland	*Juniperus osteosperma / Sparse Understory* Woodland (in part; see map class 13) *Pinus edulis - Juniperus osteosperma / Sparse Understory* Woodland (in part; see map class 13)	many : 1
9	W-PJMM	Pinyon-Juniper / True Mountain Mahogany Woodland	*Juniperus osteosperma / Cercocarpus montanus* Woodland *Pinus edulis - Juniperus osteosperma / Amelanchier utahensis* Woodland *Pinus edulis - Juniperus spp. / Cercocarpus montanus* - Mixed Shrubs Woodland	1 : many

Table 11. Map classes used in the final (post-AA) DINO vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. DINO vegetation map classes are arranged using the NatureServe ecological systems classification (shaded boxes).

Map Class #	Map Class Code	Map Class Name	Associations Assigned to Map Class	Relation
Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)				
10	W-PJHE	Pinyon-Juniper / Herbaceous Woodland	*Juniperus osteosperma / Bromus tectorum* Semi-natural Woodland *Juniperus osteosperma / Hesperostipa comata* Woodland *Juniperus osteosperma / Leymus salinus* Woodland *Juniperus osteosperma / Pleuraphis jamesii* Woodland *Juniperus osteosperma / Pseudoroegneria spicata* Woodland *Pinus edulis - Juniperus osteosperma / Petradoria pumila* Woodland *Pinus edulis - Juniperus osteosperma / Pseudoroegneria spicata* - Cushion Plant Woodland *Pinus edulis - Juniperus* spp. */ Leymus salinus* Woodland *Pinus edulis - Juniperus* spp. */ Poa fendleriana* Woodland	1 : many
11	W-PJMD	Pinyon-Juniper / Mixed Desert Shrub Woodland	*Juniperus osteosperma / Glossopetalon spinescens* Woodland *Pinus edulis - Juniperus osteosperma / Ephedra viridis* Woodland	1 : many
13	W-PJSC	Pinyon-Juniper / Soil Crust Woodland	*Juniperus osteosperma* / Sparse Understory Woodland (in part; see map class 8) *Pinus edulis - Juniperus osteosperma* / Sparse Understory Woodland (in part; see map class 8)	1 : many
15	W-PJBS	Pinyon-Juniper / Black Sagebrush Woodland	*Juniperus osteosperma / Artemisia nova* Woodland *Pinus edulis - Juniperus osteosperma / Artemisia nova* Woodland *Pinus edulis - Juniperus osteosperma / Purshia tridentata* Woodland	1 : many
16	W-PJWS	Pinyon-Juniper / Sagebrush Woodland	*Juniperus osteosperma / Artemisia tridentata* ssp. *wyomingensis* Woodland *Pinus edulis - Juniperus* spp. */ Artemisia tridentata (*ssp. *wyomingensis,* ssp. *vaseyana)* Woodland	1 : many
17	W-PJCM	Pinyon-Juniper-Curlleaf Mountain Mahogany Woodland	*Pinus edulis - Juniperus osteosperma / Cercocarpus ledifolius* Woodland	1 : 1
19	W-PJBB	Pinyon-Juniper / Basin Big Sagebrush Woodland	*Juniperus osteosperma / Artemisia tridentata - Grayia spinosa Woodland* *Juniperus osteosperma / Artemisia tridentata* ssp. *tridentata* Woodland	1 : many
20	W-JSBB	Rocky Mountain Juniper / Sagebrush Woodland	*Juniperus scopulorum / Artemisia tridentata* Woodland	1 : 1
21	W-JSRT	Rocky Mountain Juniper / Three-leaf Sumac Woodland	*Juniperus scopulorum* Temporarily Flooded Woodland Alliance	1 : 1
Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)				
14	W-PJLM	Pinyon-Juniper / Littleleaf Mountain Mahogany Shrubland and Woodland	*Cercocarpus intricatus* Montane Shrubland *Pinus edulis - Juniperus osteosperma / Cercocarpus intricatus* Woodland	1 : many
Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland (CES304.772)				

Table 11. Map classes used in the final (post-AA) DINO vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. DINO vegetation map classes are arranged using the NatureServe ecological systems classification (shaded boxes).

Map Class #	Map Class Code	Map Class Name	Associations Assigned to Map Class	Relation
22	W-CELE	Curlleaf Mountain Mahogany Woodland	*Cercocarpus ledifolius* / *Artemisia tridentata* ssp. *vaseyana* Woodland *Cercocarpus ledifolius* / *Prunus virginiana* Shrubland *Cercocarpus ledifolius* / *Pseudoroegneria spicata* Shrubland *Cercocarpus ledifolius* Woodland Alliance	1 : many
Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785)				
32	S-SAPT	Sagebrush-Antelope Bitterbrush Shrubland	*Artemisia tridentata (*ssp. *vaseyana,* ssp. *wyomingensis) – Amelanchier utahensis* Shrubland (in part; see map classes 31 and 54) *Artemisia tridentata* ssp. *vaseyana* / *Balsamorhiza sagittata* Shrubland	1 : many
Multiple Ecological Systems: **Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)** **Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785)** **Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)** **Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)** **Inter-Mountain Basins Active and Stabilized Dune (CES304.775)** **Inter-Mountain Basins Semi-Desert Grassland (CES304.787)** **Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762)**				

Table 11. Map classes used in the final (post-AA) DINO vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. DINO vegetation map classes are arranged using the NatureServe ecological systems classification (shaded boxes).

Map Class #	Map Class Code	Map Class Name	Associations Assigned to Map Class	Relation
31	S-SAGE	Sagebrush / Rabbitbrush Shrubland	*Artemisia arbuscula* ssp. *longiloba* / *Elymus lanceolatus* Shrubland *Artemisia tridentata (*ssp. *vaseyana,* ssp. *wyomingensis) - Amelanchier utahensis* Shrubland (in part; see map class 32 and 54) *Artemisia tridentata* ssp. *vaseyana* / *Achnatherum lettermanii* Shrubland *Artemisia tridentata* ssp. *vaseyana* / *Balsamorhiza sagittata* Shrubland *Artemisia tridentata* ssp. *vaseyana* / *Hesperostipa comata* Shrubland *Artemisia tridentata* ssp. *vaseyana* / *Leymus cinereus* Shrubland *Artemisia tridentata* ssp. *vaseyana* / *Pascopyrum smithii* Shrubland *Artemisia tridentata* ssp. *vaseyana* / *Poa fendleriana* Shrubland *Artemisia tridentata* ssp. *vaseyana* / *Poa secunda* Shrubland *Artemisia tridentata* ssp. *vaseyana* / *Pseudoroegneria spicata* Shrubland *Artemisia tridentata* ssp. *wyomingensis - Atriplex confertifolia* Shrubland (in part; see map class 44) *Artemisia tridentata* ssp. *wyomingensis* / *Balsamorhiza sagittata* Shrubland *Artemisia tridentata* ssp. *wyomingensis* / Disturbed Understory Semi-natural Shrubland *Artemisia tridentata* ssp. *wyomingensis* / *Elymus elymoides* Shrubland *Artemisia tridentata* ssp. *wyomingensis* / *Hesperostipa comata* ColoradoPlateau Shrubland *Artemisia tridentata* ssp. *wyomingensis* / *Leymus salinus* Shrubland *Artemisia tridentata* ssp. *wyomingensis* / *Pascopyrum smithii* Shrub Herbaceous Vegetation *Artemisia tridentata* ssp. *wyomingensis* / *Pleuraphis jamesii* Shrubland *Artemisia tridentata* ssp. *wyomingensis* / *Poa fendleriana* Shrubland *Artemisia tridentata* ssp. *wyomingensis* / *Poa secunda* Shrubland *Artemisia tridentata* ssp. *wyomingensis* / *Pseudoroegneria spicata* Shrubland (in part; see map class 53) *Artemisia tridentata* ssp. *wyomingensis* / Sparse Understory Shrubland *Atriplex canescens* / *Achnatherum hymenoides* Shrubland *Ephedra viridis* / *Bromus tectorum* Semi-natural Shrubland *Ericameria nauseosa* / *Bromus tectorum* Semi-natural Shrubland *Ericameria nauseosa* / *Pascopyrum smithii* Shrubland *Ericameria nauseosa* Sand Deposit Sparse Shrubland *Krascheninnikovia lanata* / *Hesperostipa comata* Dwarf-shrubland *Krascheninnikovia lanata* / *Poa secunda* Dwarf-shrubland *Tetradymia canescens* Shrubland	1 : many
Multiple Ecological Systems: **Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)** **Inter-Mountain Basins Greasewood Flat (CES304.780)**				
37	S-BOTT	Bottomland Shrubland	*Artemisia tridentata - (Ericameria nauseosa)* / *Bromus tectorum* Semi-natural Shrubland *Artemisia tridentata (*ssp. *tridentata,* ssp. *xericensis)* Shrubland Alliance *Artemisia tridentata* ssp. *tridentata* / *Hesperostipa comata* Shrubland *Artemisia tridentata* ssp. *tridentata* / *Leymus cinereus* Shrubland *Artemisia tridentata* ssp. *tridentata* / *Sporobolus airoides* Shrubland *Sarcobatus vermiculatus* / *Artemisia tridentata* Shrubland *Sarcobatus vermiculatus* / *Sporobolus airoides* Shrubland *Sarcobatus vermiculatus* Disturbed Shrubland	1 : many
Multiple Ecological Systems: **Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762)** **Inter-Mountain Basins Semi-Desert Grassland (CES304.787)**				

Table 11. Map classes used in the final (post-AA) DINO vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. DINO vegetation map classes are arranged using the NatureServe ecological systems classification (shaded boxes).

Map Class #	Map Class Code	Map Class Name	Associations Assigned to Map Class	Relation
40	S-BSCU	Black Sagebrush Shrubland and Cushion Plant Herbaceous	*Artemisia nova / Pseudoroegneria spicata* Shrubland *Artemisia nova* Shrubland *Pseudoroegneria spicata - Cushion Plants* Herbaceous Vegetation *Pseudoroegneria spicata* Herbaceous Vegetation	1 : many
Multiple Ecological Systems: **Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)** **Inter-Mountain Basins Shale Badland (CES304.789)** **Inter-Mountain Basins Greasewood Flat (CES304.780)**				
44	S-MXDD	Mixed Desert Shrubland	*Artemisia tridentata* ssp. *wyomingensis - Atriplex confertifolia* Shrubland (in part; see map class 31) *Atriplex confertifolia - Krascheninnikovia lanata* Shrubland *Atriplex confertifolia / Achnatherum hymenoides* Shrubland *Atriplex confertifolia / Hesperostipa comata* Shrubland *Atriplex confertifolia / Pleuraphis jamesii* Shrubland *Atriplex confertifolia* Great Basin Shrubland *Atriplex gardneri* Dwarf-shrubland (in part; see map class 59) *Ephedra torreyana - (Atriplex* spp.*)* / Nonvascular Gypsum Sparse Vegetation *Eriogonum (corymbosum, leptocladon)* Dwarf-shrubland Alliance *Leymus salinus* Shale Sparse Vegetation *Sarcobatus vermiculatus / Atriplex gardneri* Shrubland	1 : many
Multiple Ecological Systems: **Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)** **Inter-Mountain Basins Active and Stabilized Dune (CES304.775)**				
47	S-WSSG	Sagebrush-Spiny Hopsage-Black Greasewood Shrubland	*Grayia spinosa / Achnatherum hymenoides* Shrubland *Muhlenbergia pungens* Herbaceous Vegetation (in part; see map class 73)	1 : many
Multiple Ecological Systems: **Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)** **Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)**				
53	S-CANY	Canyon Wall Mixed Shrubland	*Artemisia tridentata* ssp. *wyomingensis / Pseudoroegneria spicata* Shrubland (in part; see map class 31) *Chrysothamnus viscidiflorus* Talus Shrubland (in part; see map class73) *Philadelphus microphyllus - Ephedra viridis* Shrubland	1 : many
Multiple Ecological Systems: **Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)** **Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818)** **Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)**				
54	S-MXDM	Mixed Mountain Shrubland	*Amelanchier (utahensis, alnifolia) - Cercocarpus montanus* Shrubland *Amelanchier alnifolia / Symphoricarpos oreophilus* Shrubland *Amelanchier utahensis / Pseudoroegneria spicata* Shrubland *Amelanchier utahensis* Shrubland *Artemisia tridentata (*ssp. *vaseyana,* ssp. *wyomingensis) – Amelanchier utahensis* Shrubland (in part; see map classes 31 and 32) *Ceanothus velutinus* Shrubland *Cercocarpus montanus / Pseudoroegneria spicata* Shrubland *Prunus virginiana - (Prunus americana)* Shrubland	1 : many
Great Basin Semi-Desert Chaparral (CES304.001)				

Table 11. Map classes used in the final (post-AA) DINO vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. DINO vegetation map classes are arranged using the NatureServe ecological systems classification (shaded boxes).

Map Class #	Map Class Code	Map Class Name	Associations Assigned to Map Class	Relation
56	S-MANZ	Greenleaf Manzanita Shrubland	*Arctostaphylos patula - Artemisia tridentata (*ssp. *vaseyana,* ssp. *wyomingensis)* Shrubland	1 : 1
Inter-Mountain Basins Shale Badland (CES304.789)				
59	S-MATS	Mat Saltbush Shrubland	*Atriplex corrugata* Dwarf-shrubland *Atriplex gardneri* Dwarf-shrubland (in part; see map class 44)	1 : many
Inter-Mountain Basins Wash (CES304.781)				
67	H-COBB	Cobble Bar Mixed Herbaceous Vegetation	*Heterotheca villosa* Herbaceous Vegetation	1 : 1
101	H-RIVE	Active River Channel	*Glycyrrhiza lepidota* Herbaceous Vegetation Xanthium strumarium Herbaceous Vegetation	1 : many
103	G-ALLU	Alluvial Deposits (Small Streams)	*Ericameria nauseosa* Desert Wash Shrubland	1 : 1
Multiple Ecological Systems: **Inter-Mountain Basins Semi-Desert Grassland (CES304.787)** **Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)** **Inter-Mountain Basins Shale Badland (CES304.789)**				
68	H-WEED	Weedy Herbaceous Vegetation	*Bromus tectorum Semi-natural* Herbaceous Vegetation *Elymus repens Semi-natural* Herbaceous Vegetation Post-fire Herbaceous Vegetation Shale Annual Herbaceous Vegetation	1 : many
Multiple Ecological Systems: **Inter-Mountain Basins Semi-Desert Grassland (CES304.787)** **Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)** **Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)** **Inter-Mountain Basins Greasewood Flat (CES304.780)** **Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)** **Inter-Mountain Basins Active and Stabilized Dune (CES304.775)**				
75	H-GRAS	Native Grassland	*Achnatherum lettermanii* Herbaceous Alliance *Chrysothamnus viscidiflorus / Hesperostipa comata* Shrubland *Chrysothamnus viscidiflorus* Talus Shrubland (in part; see map class 53) *Distichlis spicata* Herbaceous Vegetation *Elymus lanceolatus* Herbaceous Vegetation *Hesperostipa comata - Achnatherum hymenoides* Herbaceous Vegetation *Hesperostipa comata* Great Basin Herbaceous Vegetation *Leymus cinereus - Distichlis spicata* Herbaceous Vegetation *Leymus cinereus - Pascopyrum smithii* Herbaceous Vegetation *Leymus salinus* Shale Sparse Vegetation *Muhlenbergia pungens* Herbaceous Vegetation *Pascopyrum smithii* Herbaceous Vegetation *Pleuraphis jamesii* Herbaceous Vegetation *Pseudoroegneria spicata - Leymus salinus* Herbaceous Vegetation *Pseudoroegneria spicata* Herbaceous Vegetation *Sporobolus cryptandrus* Great Basin Herbaceous Vegetation	1 : many

Table 11. Map classes used in the final (post-AA) DINO vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. DINO vegetation map classes are arranged using the NatureServe ecological systems classification (shaded boxes).

Map Class #	Map Class Code	Map Class Name	Associations Assigned to Map Class	Relation
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)				
76	W-COTT	Broadleaf Cottonwood Woodland	*Populus deltoides (*ssp. *wislizeni,* ssp. *monilifera) / Distichlis spicata* Woodland *Populus deltoides* ssp. *wislizeni / Acer negundo* Woodland *Populus deltoides* ssp. *wislizeni* / Disturbed Understory Woodland *Populus deltoides* ssp. *wislizeni / Rhus trilobata* Woodland	1 : many
80	W-COEL	Box Elder Woodland	*Acer negundo* / Disturbed Understory Woodland *Acer negundo / Equisetum arvense* Forest *Acer negundo / Prunus virginiana* Forest *Acer negundo / Rhus trilobata* Woodland	1 : many
83	W-BOHA	Box Elder / Netleaf Hackberry Woodland	*Acer negundo - Celtis laevigata* var. *reticulata* Woodland	1 : 1
85	S-TARU	Tamarisk Thicket and Russian Olive Woodland	*Elaeagnus angustifolia* Semi-natural Woodland *Tamarix* spp. Temporarily Flooded Semi-natural Shrubland	1 : many
92	S-SUMA	Threeleaf Sumac Riparian Thicket	*Rhus trilobata* Intermittently Flooded Shrubland	1 : 1
Mapped as Points Only, Not Polygons: **Colorado Plateau Hanging Garden (CES304.764)** **Park Special (unclassified)**				
98	F-FUEL	Concentration of 1000-hour fuels	N/A	N/A
99	H-HANG	Hanging Garden	*Aquilegia micrantha – Calamagrostis scopulorum* Herbaceous Vegetation *Calamagrostis scopulorum* Hanging Garden Herbaceous Vegetation (in part; see map class 95)	1 : many
Multiple Ecological Systems: **Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)** **Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)**				
79	W-NARR	Narrow Canyon Mesic Woodland	*Betula occidentalis* / Mesic Graminoids Shrubland (in part; see map class 95) *Betula occidentalis* Shrubland (in part; see map class 95) *Populus angustifolia - Juniperus scopulorum* Woodland *Populus angustifolia / Betula occidentalis* Woodland *Populus angustifolia / Rhus trilobata* Woodland *Populus angustifolia / Salix exigua* Woodland *Pseudotsuga menziesii / Acer negundo* Woodland	1 : many
Multiple Ecological Systems: **Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)** **North American Arid West Emergent Marsh (CES300.729)**				

Table 11. Map classes used in the final (post-AA) DINO vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. DINO vegetation map classes are arranged using the NatureServe ecological systems classification (shaded boxes).

Map Class #	Map Class Code	Map Class Name	Associations Assigned to Map Class	Relation
95	C-MXDW	Mixed Wetland/Riparian Vegetation	*Betula occidentalis* Shrubland in part; see map class 79 *Betula occidentalis* / Mesic Graminoids Shrubland (in part; see map class 79) *Carex pellita* Herbaceous Vegetation *Carex praegracilis* Herbaceous Vegetation *Eleocharis palustris* Herbaceous Vegetation *Equisetum hyemale* Herbaceous Vegetation *Equisetum laevigatum* Herbaceous Vegetation *Juncus balticus* Herbaceous Vegetation *Phragmites australis* Western North America Temperate Semi-natural Herbaceous Vegetation *Salix exigua* / *Barren* Shrubland *Salix exigua* / Mesic Forbs Shrubland *Salix exigua* / Mesic Graminoids Shrubland *Schoenoplectus acutus* Herbaceous Vegetation *Schoenoplectus pungens* Herbaceous Vegetation *Spartina gracilis* Herbaceous Vegetation *Spartina pectinata* Western Herbaceous Vegetation *Tamarix* spp. Temporarily Flooded Shrubland (in part; see map class 85)	1 : many
Non-Vegetated (Anderson Land Use) Map Classes:				
101-126	G-XXXX	Geologic	Unvegetated exposures and talus of various geologic units at DINO: River Channel, Eolian Sands, Browns Park Formation, Bishop Conglomerate, Mancos Shale, Frontier Sandstone, Mowry Shale, Cedar Mountain Formation, Morrison Formation, Stump Formation, Entrada Sandstone, Carmel Formation, Glen Canyon Sandstone, Chinle Formation, Gartra Conglomerate, Moenkopi Formation, Park City Formation, Weber Sandstone, Morgan Formation, Round Valley Sandstone, Madison Limestone, Lodore Formation, Uinta Mountain Formation	N/A
201	L-RESI	Rural Residential	Smaller buildings and surrounding landscaped buildings in the environs and in private inholdings within the Monument	N/A
202	L-RANC	Ranch Developments	Private buildings and associated parking and storage areas in the mapping area environs	N/A
204	L-TANK	Stock Ponds and Tanks	Small catchments along minor drainages designed to hold runoff for livestock use	N/A
205	L-QUAR	Quarries and Gravel Pits	Small areas scattered throughout the mapping area where gravel was removed. Most are in the environs	N/A
210	L-FIEL	Agricultural Fields	Areas under active cultivation in the mapping area environs	N/A
221	L-PAFA	NPS Buildings and Yards	Larger NPS buildings and associated parking and storage areas, such as visitor centers, maintenance yards and ranger cabins. Includes the Jones Hole National Fish Hatchery administered by the USFWS	N/A
230	L-UTIL	Utility Right-of-Way	Corridors of clearly altered vegetation where utility lines have been buried or cleared beneath telephone lines	N/A
231	L-TRAN	Transportation	Highways, paved park roads and major (graded) dirt park roads	N/A
232	L-AIRS	Airstrips	Active and abandoned airstrips in the mapping area environs	N/A

Map Class Descriptions

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

- a summary of the ecological concept of the map class. Reference is made to the ecology, abundance and distribution of the map class within the 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 DINO vegetation map consists of 30,297 polygons totaling 161,169 hectares (398,258 acres). Average polygon size is 5.3 ha (13.1 acres). Lands within the monument make up 85,096 ha (210,278 acres) or 52.8% of the total project area. Of the total, 27,772 polygons (91.7%) represent natural or semi-natural vegetation map classes covering 95.3% of the mapping project area. Map classes representing non-vegetated roads, facilities and borrow pits account for the remaining 2,525 polygons (8.3% of polygons and 4.7% 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 Sagebrush-Rabbitbrush Shrubland (SSAGE) with 5,019 polygons covering 19.8% of the mapping area. The largest average polygon size belongs to Sagebrush-Spiny Hopsage-Black Greasewood Shrubland (S-WSSG) and Pinyon-Juniper / Herbaceous Woodland (W-PJHE) at 13.2 ha (33 acres) per polygon.

Hanging gardens at DINO occupy vertical sites on cliff faces or alcoves under cliff overhangs and are generally not visible on aerial imagery. All stands within the monument are also much smaller than the 0.5 ha MMU. This vegetation type was therefore mapped as a point layer based on observations made in the field.

Figure 23 is an example of a map of the vegetation of DINO created from the spatial database. Because we used a geodatabase to store and organize mapping 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 12 provides summary statistics for DINO vegetation map polygons.

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

Map Code	Map Class Common Name	Polygons			Area (hecrares)		
		Monument	Environs	Total Area*	Monument	Environs	Total Area*
Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)							
W-DOFI	Douglas-fir Forest	681	97	778	1838.2	296.0	2134.2
	Subtotal	*681*	*97*	*778*	*1838.2*	*296.0*	*2134.2*
Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)							
W-POPI	Ponderosa Pine Woodland	170	308	478	603.7	3427.7	4031.4
	Subtotal	*170*	*308*	*478*	*603.7*	*3427.7*	*4031.4*
Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland (CES306.819)							
W-LIPI	Limber Pine Woodland	0	4	4	0	4.0	4.0
	Subtotal	*0*	*4*	*4*	*0*	*4.0*	*4.0*
Rocky Mountain Aspen Forest and Woodland (CES306.813)							
W-ASPE	Aspen Forest	91	118	209	106.9	142.5	249.4
	Subtotal	*91*	*118*	*209*	*106.9*	*142.5*	*249.4*
Colorado Plateau Pinyon-Juniper Woodland (CES304.767)							
W-PJSP	Pinyon-Juniper / Sparse Understory Woodland	956	766	1722	7125.4	4162.9	11288.3
W-PJMM	Pinyon-Juniper / True Mountain Mahogany Woodland	680	417	1097	4443.7	2218.6	6662.3
W-PJHE	Pinyon-Juniper / Herbaceous Woodland	1381	873	2254	17824.2	10107.6	27931.8
W-PJMD	Pinyon-Juniper / Mixed Desert Shrub Woodland	68	29	97	2071.4	57.6	2129.0
W-PJSC	Pinyon-Juniper / Soil Crust Woodland	572	197	769	3643.2	909.3	4552.5
W-PJBS	Pinyon-Juniper / Black Sagebrush Woodland	127	120	247	1021.5	735.1	1756.6
W-PJWS	Pinyon-Juniper / Sagebrush Woodland	1452	2209	3661	6077.7	8005.7	14083.4
W-PJCM	Pinyon-Juniper-Curlleaf Mountain Mahogany Woodland	15	22	37	86.0	140.1	226.1
W-PJBB	Pinyon-Juniper / Basin Big Sagebrush Woodland	59	32	91	79.8	36.7	116.5
W-JSBB	Rocky Mountain Juniper / Sagebrush Woodland	3	4	7	3.7	4..1	7.8
W-JSRT	Rocky Mountain Juniper / Three-leaf Sumac Woodland	1	0	1	0.2	0	0.2
	Subtotal	*5314*	*4669*	*9983*	*42376.8*	*26377.7*	*68754.5*
Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)							

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

Map Code	Map Class Common Name	Polygons			Area (hecrares)		
		Monument	Environs	Total Area*	Monument	Environs	Total Area*
W-PJLM	Pinyon-Juniper / Littleleaf Mountain Mahogany Shrubland and Woodland	1375	232	1607	7033.2	1004.1	8037.7
	Subtotal	*1375*	*232*	*1607*	*7033.2*	*1004.1*	*8037.7*
1. Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland (CES304.772)							
W-CELE	Curlleaf Mountain Mahogany Woodland	60	203	263	396.1	1486.1	1882.1
	Subtotal	*60*	*203*	*263*	*396.1*	*1486.1*	*1882.1*
Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785)							
S-SAPT	Sagebrush-Antelope Bitterbrush Shrubland	33	37	70	776.0	720.7	1496.7
	Subtotal	*33*	*37*	*70*	*776.0*	*720.7*	*1496.7*
Multiple Ecological Systems: Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777) Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785) Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788) Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784) Inter-Mountain Basins Active and Stabilized Dune (CES304.775) Inter-Mountain Basins Semi-Desert Grassland (CES304.787) Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762)							
S-SAGE	Sagebrush / Rabbitbrush Shrubland	2395	2973	5368	10778.5	20916.6	31695.1
	Subtotal	*2395*	*2973*	*5368*	*10778.5*	*20916.6*	*31695.1*
Multiple Ecological Systems: Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777) Inter-Mountain Basins Greasewood Flat (CES304.780)							
S-BOTT	Bottomland Shrubland	562	476	1038	1913.6	1563.7	3477.3
	Subtotal	*562*	*476*	*1038*	*1913.6*	*1563.7*	*3477.3*
Multiple Ecological Systems: Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762) Inter-Mountain Basins Semi-Desert Grassland (CES304.787)							

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

Map Code	Map Class Common Name	Polygons			Area (hecrares)		
		Monument	Environs	Total Area*	Monument	Environs	Total Area*
S-BSCU	Black Sagebrush Shrubland and Cushion Plant Herbaceous	453	771	1224	1006.9	1619.5	2626.4
	Subtotal	*453*	*771*	*1224*	*1006.9*	*1619.5*	*2626.4*
Multiple Ecological Systems: Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784) Inter-Mountain Basins Shale Badland (CES304.789) Inter-Mountain Basins Greasewood Flat (CES304.780)							
S-MXDD	Mixed Desert Shrubland	274	517	791	1259.5	2934.0	3293.5
	Subtotal	*274*	*517*	*791*	*1259.5*	*2934.0*	*3293.5*
Multiple Ecological Systems: Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777) Inter-Mountain Basins Active and Stabilized Dune (CES304.775)							
S-WSSG	Sagebrush-Spiny Hopsage-Black Greasewood Shrubland	13	106	119	70.0	1477.2	1547.2
	Subtotal	*13*	*106*	*119*	*70.0*	*1477.2*	*1547.2*
Multiple Ecological Systems: Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777) Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)							
S-CANY	Canyon Wall Mixed Shrubland	147	7	154	754.0	22.4	776.4
	Subtotal	*147*	*7*	*154*	*754.0*	*22.4*	*776.4*
Multiple Ecological Systems: Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822) Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818) Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)							
S-MXDM	Mixed Mountain Shrubland	1006	1630	2636	2720.9	4177.9	6898.8
	Subtotal	*1006*	*1630*	*2636*	*2720.9*	*4177.9*	*6898.8*
2. Great Basin Semi-Desert Chaparral (CES304.001)							
S-MANZ	Greenleaf Manzanita Shrubland	2	41	43	1.6	54.9	56.5

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

Map Code	Map Class Common Name	Polygons			Area (hecrares)		
		Monument	Environs	Total Area*	Monument	Environs	Total Area*
	Subtotal	*2*	*41*	*43*	*1.6*	*54.9*	*56.5*
Inter-Mountain Basins Shale Badland (CES304.789)							
S-MATS	Mat Saltbush Shrubland	14	191	205	65.4	672.7	738.1
	Subtotal	*14*	*191*	*205*	*65.4*	*672.7*	*738.1*
Inter-Mountain Basins Wash (CES304.781)							
H-COBB	Cobble Bar Mixed Herbaceous Vegetation	30	7	37	33.0	8.5	41.5
H-RIVE	Active River Channel	3	6	9	1149.2	492.4	1641.6
G-ALLU	Alluvial Deposits (Small Streams)	30	32	62	71.2	64.6	135.8
	Subtotal	*63*	*45*	*108*	*1253.4*	*565.5*	*1818.9*
Multiple Ecological Systems: Inter-Mountain Basins Semi-Desert Grassland (CES304.787) Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821) Inter-Mountain Basins Shale Badland (CES304.789)							
H-WEED	Weedy Herbaceous Vegetation	288	308	596	1150.4	1283.8	2434.2
	Subtotal	*288*	*308*	*596*	*1150.4*	*1283.8*	*2434.2*
Multiple Ecological Systems: Inter-Mountain Basins Semi-Desert Grassland (CES304.787) Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788) Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765) Inter-Mountain Basins Greasewood Flat (CES304.780) Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821) Inter-Mountain Basins Active and Stabilized Dune (CES304.775)							
H-GRAS	Native Grassland	862	1121	1983	6608.2	5955.1	12563.3
	Subtotal	*862*	*1121*	*1983*	*6608.2*	*5955.1*	*12563.3*
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)							
W-COTT	Broadleaf Cottonwood Woodland	116	87	203	137.3	126.5	263.8
W-BOEL	Box Elder Woodland	307	50	357	273.9	38.6	312.5
W-BOHA	Box Elder / Netleaf Hackberry Woodland	9	0	9	5.8	0	5.8

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

Map Code	Map Class Common Name	Polygons			Area (hecrares)		
		Monument	Environs	Total Area*	Monument	Environs	Total Area*
W-TARU	Tamarisk Thicket and Russian Olive Woodland	205	82	287	183.3	75.6	259.9
S-SUMA	Threeleaf Sumac Riparian Thicket	20	17	37	7.7	9.1	16.8
	Subtotal	*657*	*236*	*893*	*608.0*	*249.8*	*857.8*
MAPPED AS POINTS ONLY, NOT POLYGONS Colorado Plateau Hanging Garden (CES304.764) Park Special (unclassified)							
H-HANG	Hanging Garden	N/A	N/A	N/A	N/A	N/A	N/A
F-FUEL	Concentrations of 1000-hour fuels	N/A	N/A	N/A	N/A	N/A	N/A
	Subtotal	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
Multiple Ecological Systems: Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821) Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)							
W-NARR	Narrow Canyon Mesic Woodland	34	6	40	42.8	7.4	50.2
	Subtotal	*34*	*6*	*40*	*42.8*	*7.4*	*50.2*
Multiple Ecological Systems: Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821) North American Arid West Emergent Marsh (CES300.729)							
C-MXDW	Mixed Wetland/Riparian Vegetation	248	148	396	189.3	127.5	316.8
	Subtotal	*248*	*148*	*396*	*189.3*	*127.5*	*316.8*
LAND USE MAP CLASSES							
G-XXXX	Geologic Exposures	1454	572	2026	3303.6	590.7	3894.3
L-RESI	Rural Residential	1	20	21	0.7	17.5	18.2
L-RANC	Ranch Developments	16	41	57	8.6	58.6	67.2
L-TANK	Stock Ponds and Tanks	29	162	191	8.6	49.4	58.0
L-QUAR	Quarries and Gravel Pits	5	8	13	2.6	11.5	14.1
L-FIEL	Agricultural Fields	13	32	45	66.3	922.5	988.8
L-PAFA	NPS Buildings and Yards	13	2	15	12.1	9.9	22.0
L-UTIL	Utility Right-of-Ways	0	5	5	0	25.2	25.2

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

Map Code	Map Class Common Name	Polygons			Area (hecrares)		
		Monument	Environs	Total Area*	Monument	Environs	Total Area*
L-TRAN	Transportation	6	18	24	229.1	110.8	339.9
L-AIRS	Airstrips	0	1	1	0	2.1	2.1
	Subtotal	*1537*	*861*	*2398*	*3631.6*	*1798.2*	*5429.8*
	Total All Map Classes	**16279**	**15105**	**31384**	**85185**	**75985**	**161170**

Discussion

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

Things that worked well: Descriptive information provided by field and project ecologists was an extremely important ancillary data source for the photointerpreters. Narrative information recorded on field forms as well as thorough descriptions of associations helped provide information to model map classes and delineate polygons. 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 are essential to high quality mapping. For the vegetation mapping at DINO, high quality aerial and orthophotography allowed for confident photo interpretation and provided a solid basis for determining vegetation density. The geologic data were detailed and had high horizontal spatial accuracy, both of which are important in GIS applications.

Areas for Improvement: One area that posed difficulties for mapping in this project was shadows cast by cliffs in the major river canyons. The shadowing affected interpretation of canyon walls and floors. Photointerpretation efforts could have been better informed by collecting either additional observation points within shadowed areas.

Many of the original shrubland map classes had to be combined following accuracy assessment because it was found that they could not be distinguished consistently. monument staff in most cases asked that the original line work be retained even after the map classes were combined. Accuracy also suffered because of significant phenologic and climatic differences between the year of photography (2002, the driest year ever recorded in the region), and 2005, a year of average precipitation when the accuracy assessment data were collected. The distribution and density of cheatgrass was much greater in 2005 than in 2002, necessitating the merging of map classes originally separated by the presence or absence of cheatgrass.

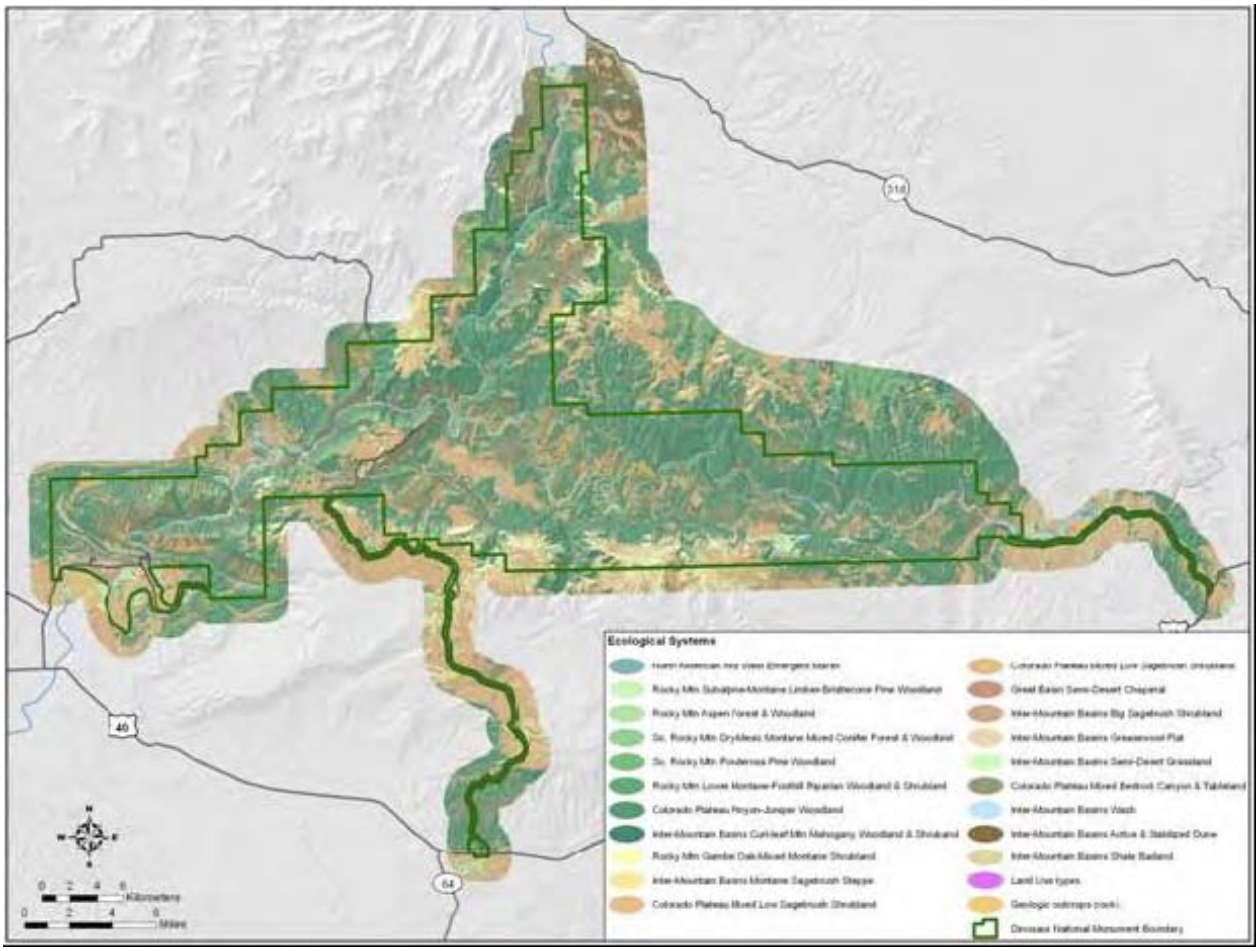


Figure 23. The DINO vegetation map based on ecological system groups of map classes.

Accuracy Assessment

Methods

Introduction

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

Sampling Design

A stratified random sampling approach was used to determine AA sampling locations. The AA included most vegetation map classes and was limited to lands within the DINO boundary; private and federal outside of the monument were not included in the accuracy evaluation. Sample sizes for each evaluated map class were selected using the USGS-NPS Vegetation Characterization Program guidelines (TNC and ESRI 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), it is impossible to estimate a statistically meaningful confidence interval for the sample and the accuracy of the class can only be confirmed through a census.

Of the original set of 101 map classes, 34 map classes were excluded from the accuracy assessment. The nine land-use map classes (L-XXXX) and 20 geologic map classes (G-XXXX) were excluded because they are essentially unvegetated. Of the vegetated map classes, the hanging garden map class (H-HANG) was excluded from the AA because it consists of points based on field data and known locations; resampling would have been redundant. Map classes W-JSBB, W-JSRT, and S-SAPT were mapped only where they had been documented in the field; these were also excluded to prevent redundancy. The map class describing limber pine woodlands (W-LIPI) was not accuracy assessed because it occurs only in the environs. The 29 unvegetated map classes total 2,525 polygons (8%) covering 7,602 ha (18,784 acres, 4.7%). The 94 polygons of non-accuracy-assessed vegetated map classes total 519 ha (1,283 acres).

Accuracy assessment sampling points were selected for each of the 67 remaining map classes using guidelines A–E. The primary set of AA evaluation sites included 1,537 points. Secondary and tertiary sets of points were generated in case some of the points in the primary set could not be accessed safely. A 40 m (131 ft) interior buffer from polygon edges was generated for the map coverage to help ensure that 0.5 ha sampling points would fall cleanly within the polygon. The 40 m buffer worked in most situations; however, for small or linear polygons the buffer was reduced or eliminated. Sheer cliffs, and steep talus were excluded from the AA point selection pool due to poor or dangerous access. Location (UTM) coordinates for all AA points were downloaded to GPS units 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 DINO 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 5,000m^2 centered on the AA point coordinates (Appendix B). Environmental data collected in the field included elevation, slope, aspect, topographic position, landform, unvegetated surface elements, and descriptive comments. Vegetation data included leaf type and physiognomic class, as well as height and canopy cover for the dominant species in each stratum. The illustrated field key was used to identify the plant association that best described the plot. In most cases, only one plant association name was recorded. When vegetation relationships were unclear, secondary and tertiary plant association names were recorded. Plant associations occurring within 50 m of the AA point boundary were also noted in some cases. 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 1,543 AA points (Figure 24). AA point data were manually entered into the plots database and the data were subjected to a thorough quality assessment / quality check (QA/QC) 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.

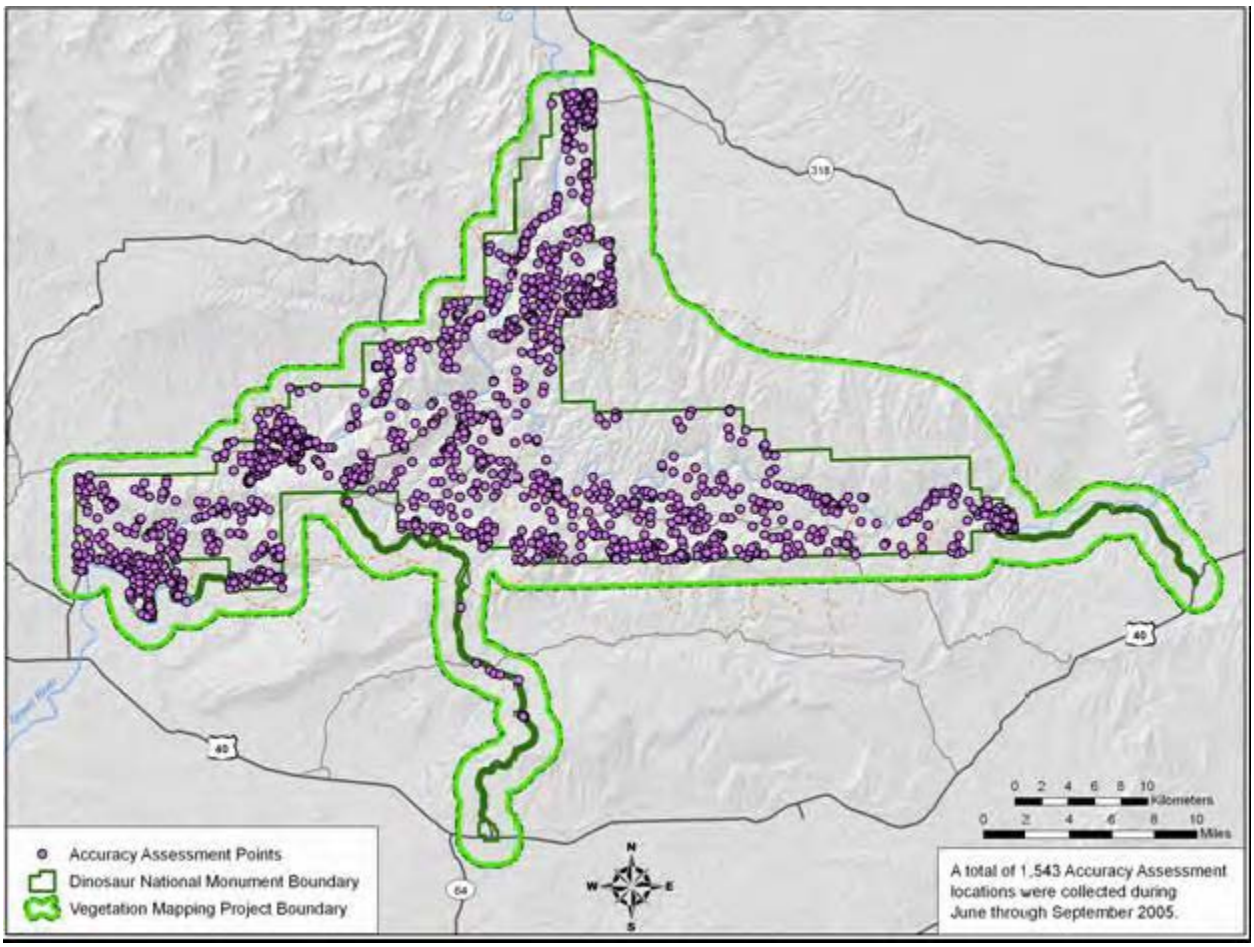


Figure 24. Location of accuracy assessment points sampled within DINO. The accuracy of the map outside of the park boundary was not assessed.

Data Analysis

Of the 1,543 AA sample points collected in 2005, 1,530 were used in the 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.

The results of this analysis were arrayed in a preliminary contingency table and producer's and user's accuracy were calculated for each map class. Producer's accuracy was calculated by dividing the number of samples that agreed with their corresponding map class by the total number of samples in that class. User's accuracy was calculated by dividing the number of

samples that agreed with their corresponding map class by the total number of samples whose field call belonged to that category.

The primary photointerpreter and 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 vegetation within larger map polygons). Mismatches were corrected when a false error was identified. All other mismatches were deemed true errors. Patterns of true error were analyzed and possible solutions for raising map class accuracy formulated.

In December 2005, a meeting was held among the monument 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. A final contingency table was produced by project cartographers (Table 13). The spatial database was revised to reflect the final combinations of map classes. The original set of 101 map classes was ultimately reduced to a final set of 66 vegetation, geology, and land-use map classes.

Table 13. Final contingency table for the map classes used at DINO. This table represents the 34 map classes retained following the accuracy assessment and revision process1. 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 81% (Kappa statistic = 79%). User's and producer's accuracy values for each map class appear in Tables 11 and 12.

Map Class	1	2	4	8	9	10	11	13	14	15	16	17	19	22	31	32	37	40	44	47	53	54	56	59	67	68	73	76	79	80	83	85	92	95	Total	% Correct
1	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**30**	100%
2	3	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**25**	88%
4	0	0	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	**34**	85%
8	0	0	0	31	2	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**37**	84%
9	0	0	0	3	19	1	1	1	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**31**	61%
10	0	0	0	13	3	63	1	1	0	4	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**90**	70%
11	0	0	0	2	1	3	15	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**22**	68%
13	0	0	0	0	1	2	0	30	2	1	6	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**43**	70%
14	0	0	0	3	1	2	0	1	45	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	**54**	83%
15	0	0	0	0	0	7	0	0	0	28	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**40**	70%
16	1	0	0	0	0	1	0	3	0	5	43	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	**57**	75%
17	1	0	0	0	0	0	0	0	0	0	2	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**12**	75%
19	0	0	0	0	0	0	0	0	0	0	2	0	11	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**15**	73%
22	0	0	0	0	0	1	0	0	0	0	2	2	0	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**27**	81%
31	0	0	0	0	0	1	0	0	0	0	1	0	0	0	130	1	7	0	3	6	0	4	0	0	0	5	7	0	0	0	0	0	0	0	**165**	79%
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**	100%
37	0	0	0	0	0	0	0	0	0	0	2	0	0	0	7	0	142	0	1	1	0	0	0	0	0	2	0	0	0	0	0	0	1	0	**156**	91%
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**57**	88%
44	0	0	0	1	0	0	0	0	0	0	0	0	0	0	8	0	2	0	34	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	**49**	69%
47	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	2	0	0	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**27**	81%
53	0	0	0	0	0	2	0	0	0	0	1	0	0	0	1	0	0	0	0	0	22	2	0	0	0	0	0	0	0	0	0	0	0	0	**28**	79%
54	0	0	0	1	0	1	0	0	0	0	3	0	0	2	11	0	0	0	0	0	0	110	0	0	0	2	1	0	0	0	0	0	0	0	**131**	84%
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	**2**	100%
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	7	0	1	0	0	0	0	0	0	0	0	**11**	64%
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	**6**	83%
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	0	0	0	0	1	0	0	0	63	7	1	0	0	0	0	0	0	**76**	83%
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	0	4	0	0	0	0	1	0	0	0	0	54	0	0	0	0	0	0	1	**79**	68%
76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34	0	1	0	0	0	0	**35**	94%
79	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	**9**	100%
80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	66	0	0	0	0	**66**	100%
83	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0	0	0	**5**	80%
85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	26	0	6	**34**	76%
92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	**5**	100%
95	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	1	3	2	0	2	1	0	5	0	51	**68**	75%
Total	**37**	**22**	**29**	**54**	**27**	**86**	**17**	**36**	**50**	**38**	**76**	**13**	**12**	**24**	**189**	**3**	**164**	**50**	**41**	**29**	**22**	**125**	**2**	**7**	**6**	**81**	**73**	**36**	**12**	**69**	**4**	**31**	**7**	**58**	1530	
% Corr.	81	100	100	57	70	73	88	83	90	74	57	69	92	92	69	67	87	100	83	76	100	88	100	100	83	78	74	94	75	96	100	84	71	88		

[1]Vegetation map classes 3, 20, 21, 32, and 99 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 DINO map class accuracy. Final overall map accuracy is 81% (Kappa correction = 79%). Individual map class accuracy ranges from 57% to 100% (Table 14 and Table 15). 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; the smaller the sample size, the wider the confidence interval.

Table 14. Final DINO vegetation map classes that met or exceeded the 80% program standard for both user's and producer's accuracy.

Map Class Code	Map Class #	Map Class Name	Producer's Accuracy (±90% CI)	User's Accuracy (±90% CI)
W-DOFI	1	Douglas-fir Forest	100%	81% ± 11%
W-POPI	2	Ponderosa Pine Woodland	88% ± 11%	100%
W-ASPE	4	Aspen Forest	85% ± 10%	100%
W-PJLM	14	Pinyon-Juniper / Littleleaf Mountain Mahogany Shrubland and Woodland	83% ± 8%	90% ± 7%
W-CELE	22	Curlleaf Mountain Mahogany Woodland	81% ± 12%	92% ± 9%
S-BOTT	37	Bottomland Shrubland	91% ± 4%	87% ± 4%
S-BSCU	40	Black Sagebrush Shrubland and Cushion Plant Herbaceous	88% ± 7%	100%
S-MXDM	54	Mixed Mountain Shrubland	84% ± 5%	88% ± 5%
S-MANZ	56	Greenleaf Manzanita Shrubland	100%	100%
H-COBB	67	Cobble Bar Mixed Herbaceous Vegetation	83% ± 25%	83% ± 25%
W-COTT	76	Broadleaf Cottonwood Woodland	94% ± 6%	94% ± 6%
W-BOEL	80	Box Elder Woodland	100%	96% ± 4%
W-BOHA	83	Box Elder / Netleaf Hackberry Woodland	80% ± 29%	100%

Table 15. DINO vegetation map classes where either the user's or producer's accuracy did not meet the 80% program standard.

Map Class Code	Map Class #	Map Class Name	Producer's Accuracy (±90% CI)	User's Accuracy (±90% CI)	Confused with Map Class #
W-PJSP	8	Pinyon-Juniper / Sparse Understory Woodland	84% ± 10%	57% ± 11%	10
W-PJMD	11	Pinyon-Juniper / True Mountain Mahogany Woodland	68% ± 16%	88% ± 13%	8, 10
W-PJSC	13	Pinyon-Juniper / Mixed Desert Shrub Woodland	70% ± 11%	83% ± 10%	16
W-PJBB	19	Pinyon-Juniper / Basin Big Sagebrush Woodland	73% ± 19%	92% ± 13%	16
S-SPAT	32	Sagebrush – Antelope Bitterbrush Shrubland	100%	67% ± 45%	31
S-MXDD	44	Mixed Desert Shrubland	69% ± 11%	83% ± 10%	31, 59

Table 15. DINO vegetation map classes where either the user's or producer's accuracy did not meet the 80% program standard.

Map Class Code	Map Class #	Map Class Name	Producer's Accuracy (±90% CI)	User's Accuracy (±90% CI)	Confused with Map Class #
S-WSSG	47	Sagebrush-Spiny Hopsage-Black Greasewood Shrubland	81% ± 12%	76% ± 13%	31, 37
S-CANY	53	Canyon Wall Mixed Shrubland	79% ± 13%	100%	54
S-MATS	59	Mat Saltbush Shrubland	64% ± 24%	100%	44
H-WEED	68	Weedy Herbaceous Vegetation	83% ± 7%	78% ± 8%	31, 73
W-NARR	79	Narrow Canyon Mesic Woodland	100%	75% ± 21%	95
S-TARU	85	Tamarisk Thicket and Russian Olive Woodland	76% ± 12%	84% ± 11%	95
S-SUMA	92	Threeleaf Sumac Riparian Thicket	100%	71% ± 28%	37
C-MXDW	95	Mixed Wetland/Riparian Vegetation	75% ± 9%	88% ± 7%	85

As shown in Table 15, fourteen map classes were retained in the final vegetation map for DINO when either user's or producer's accuracy did not meet the 80% program standard. However, in every case but one (Pinyon-Juniper / Sparse Understory Woodland, W-PJSP), the 90% confidence interval includes 80%, so monument staff deemed the results to be acceptable. Map class W-PJSP was retained because its primary confusion is with the closely related map classes Pinyon-Juniper / Herbaceous Woodland (W-PJHE) and Pinyon-Juniper / Mixed Desert Shrub Woodland (W-PJMD). Associations from all three map classes tend to occur in a mosaic whose parts are impossible to separate.

Seven map classes did not achieve the 80% standard for either user's or producer's accuracy (Table 16). Reasons for retaining each map class are detailed below.

Table 16. DINO vegetation map classes where neither the user's nor producer's accuracy met the 80% program standard.

Map Class Code	Map Class #	Map Class Name	Producer's Accuracy (±90% CI)	User's Accuracy (±90% CI)	Confused with Map Class #
W-PJMM	9	Pinyon-Juniper / True Mountain Mahogany Woodland	61% ± 14%	70% ± 14%	8, 10, 14, 16
W-PJHE	10	Pinyon-Juniper / Herbaceous Woodland	70% ± 8%	73% ± 8%	8, 15
W-PJBS	15	Pinyon-Juniper / Black Sagebrush Woodland	70% ± 12%	74% ± 12%	10, 16
W-PJWS	16	Pinyon-Juniper / Sagebrush Woodland	75% ± 9%	57% ± 9%	13, 15
W-PJCM	17	Pinyon-Juniper-Curlleaf Mountain Mahogany Woodland	75% ± 21%	69% ± 21%	22
S-SAGE	31	Sagebrush / Rabbitbrush Shrubland	79% ± 5%	69% ± 6%	37, 44, 47, 54, 73
H-GRAS	73	Native Grassland	68% ± 9%	74% ± 8%	31

***W-PJMM (Map Class 9) – Pinyon - Juniper / True Mountain Mahogany Woodland*:** This map class was problematic, but monument staff wanted to retain it because it represents a relatively

diverse woodland community with values for wildlife. The primary photointerpreter agreed to re-map the map class to a more narrowly defined model, which improved accuracy somewhat. The map class in its final form retains some accuracy issues with closely related map classes.

***W-PJHE (Map Class 10) – Pinyon - Juniper / Herbaceous Woodland*:** Confusion in this map class occurred with closely related map classes W-PJSP and W-PJBS, which are all confused with each other to some extent. However, combining the three map classes would have resulted in a tremendous loss of detail, as the three map classes account for 13% of the polygons and 25% of the mapping project area. Monument staff preferred to retain the map classes as separate entities, even with their somewhat lower accuracy.

W-PJBS (Map Class 15) – Pinyon - Juniper / Black Sagebrush Woodland: See explanation for Map Class W-PJHE.

W-PJWS (Map Class 16) – Pinyon-Juniper / Sagebrush Woodland: This type is significantly undermapped, and mostly confused with the closely related W-PJSC and W-PJBS. W-PJWS often occurs in a mosaic with the other two woodland types. However, because this type is common and abundant and the other two types are relatively rare and specialized, monument staff chose to retain them as separate map classes.

W-PJCM (Map Class 17) – Pinyon-Juniper –Curlleaf Mountain Mahogany Woodland: This type is rare within the mapping area. The errors arise primarily from confusion with W-CELE, which lacks the pinyon and juniper in the canopy, but is otherwise very similar. Because the presence or lack of pinyon and juniper are significant for management and because the accuracy values were close to the standard, these map classes were maintained as separate entities.

S-SAGE (Map Class 31) – Sagebrush / Rabbitbrush Shrubland: This type is the result of post-accuracy assessment combinations of all other upland big sagebrush and rabbitbrush shrublands. On the margins of floodplains and draws, the boundary between upland sagebrush and basin big sagebrush communities can be difficult to discern; accounting for a portion of the error. Other errors were due to the inclusion of sparse big sagebrush communities on shale substrates; these polygons occurred in a zone of habitat overlap with S-MXDD. A third source of error is because some burned areas mapped as rubber rabbitbrush shrublands were in reality primarily bunchgrasses and therefore should have been mapped as H-GRAS (see below). There was no good way to deal with the sources of error; combination with other map classes was undesirable; S-SAGE is already diverse due to having absorbed a number of low-accuracy map classes. monument staff chose to accept the combined map class and attempt to correct polygons in the field as resources permit.

H-GRAS (Map Class 73) – Native Grassland: Most of the confusion in this map class occurs in burned areas that take the form of a native grass - rubber rabbitbrush shrub herbaceous community. The shrubs tend to be patchy, and the dominant signature of these areas is that of a grassland. A number of points landed in sites with higher shrub cover within the grassland polygons. This map class is retained because it is fundamentally correct.

References

Alexander, J.S., J.C. Schmidt, and M.L. Scott. 2005. Evaluating channel change at tamarisk removal and control reaches following a prescribed flood on the upper Green River, Lodore Canyon, Dinosaur NM. Abstract, Geological Society of America annual meeting, October 16-19, Salt Lake City, UT.

Anderson, J.R., E. Hardy, J. Roach, and R. Witter. 2002. A land use and land cover classification system for use with Remote Sensor Data. Geological Survey Professional Paper 964. U.S. Government Printing Office, Washington, D.C.

Athearn, F.J. 1982. An Isolated Empire: A History of Northwestern Colorado, 3rd edition. BLM Cultural Resource Series No. 2. Bureau of Land Management, Denver, CO. 134 pp.

Avery, T.E. 1978. Forester's guide to aerial photo interpretation. Agriculture Handbook 308. U.S. Department of Agriculture, U.S. Forest Service, U.S. Government Printing Office, Washington, D.C.

Bailey, R.G. 2001. Descriptions of the ecoregions of the United States. 2d ed. Rev. and expanded (1st ed. 1980). Misc. Publ. No. 1391 (rev.), Washington, D.C.: USDA Forest Service. 108 p. with 1:7,500,000-scale map.

Beidleman, R.G. 1957. An annotated checklist of the flora and fauna of Dinosaur NM. File report to the National Park Service. University of Colorado, Boulder, CO. 163 pp.

Belnap, J., J.H. Kaltenecker, R. Rosentreter, J. Williams, S. Leonard, and D. Eldridge. 2001. Biological Soil Crusts: Ecology and Management. USDI, Bureau of Land Management Technical Reference TR-1730-2. Denver, CO. 119 p.

Cogan, D., M. Reid, K. Schulz, and M. Pucherelli. 2004. Zion National Park, Utah, 1999-2003 Vegetation Mapping Project. U.S. Bureau of Reclamation Technical Memorandum 8260-03 01. Remote Sensing and GIS Group, Technical Service Center, Denver, CO.

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow, and J. Teague. 2003. Ecological Systems of the United States: A Working Classification of U.S. Terrestrial Systems. NatureServe, Arlington, VA.

Cooper, D.J. and D.M. Merritt. 1995. Comparative ecosystem dynamics: Green and Yampa rivers. Unpublished report, Colorado State University, Fort Collins, CO.

Dewey, S.A. and K.A. Andersen. 2005. An Inventory of Invasive Non-native Plants in Dinosaur National Monument – Addendum Report. Prepared for the NPS, Northern Colorado Plateau Network, by Utah State University. Weed Science Research Project Report No. SD0517A, 43 pp. + appendices.

Dewey, S.A., K.A. Andersen, M. Ballard, E. LaMalfa, M. Pokorny, R. Richards, J. Simonsen, and S. Wood. 2003. Field Survey of Invasive Non-Native Weeds and Designated Rare Plants in the Green River and Colorado Districts of Dinosaur NM – Final report. UT State Univ.

Driscoll, R.S., D.L. Merkel, R.L. Radloff, D.E. Snyder, and J.S. Hagihara. 1984. An ecological land classification framework for the United States. United States Department of Agriculture, Forest Service Miscellaneous Publication Number 1439. Washington, D.C. 56 pp.

Dufrêne, M. and P. Legendre. 1997. Species assemblages and indicator species: the need for a flexible asymmetrical approach. Ecological Monographs 67:345-366.

Eldridge, D.J. and R. S.B. Greene. 1994. Microbiotic soil crusts: a review of their roles in soil and ecological processes in the rangelands of Australia. Australian Journal of Soil Research 32: 389-415.

Environmental Systems Research Institute, National Center for Geographic Information and Analysis, and The Nature Conservancy. 1994. Final draft accuracy assessment procedures. NBS/NPS Vegetation Mapping Program. Prepared for the United States Department of Interior, Biological Resources Division and National Park Service.

Evenden, A. 2004. Guidelines for photo interpreters working on vegetation mapping in Northern Colorado Plateau Network Parks, January 21, 2004. Northern Colorado Plateau Network, National Park Service, Moab, UT. 20 p.

Evenden, A. 2001. Vegetation mapping and classification project proposal: eleven Northern Colorado Plateau Network Parks, September 2001. Northern Colorado Plateau Network, National Park Service, Moab, UT. 10 p.

Fanning, C.M. and Dehler, C.M., 2005, Constraining depositional ages for Neoproterozoic siliciclastic sequences through detrital zircon ages–a ca. 770 Ma maximum age for the lower Uinta Mountain Group [abs.]: Geological Society of America Abstracts with Programs.

Federal Geographic Data Committee, Vegetation Subcommittee. 1997. Vegetation classification standard [online]. Available from: http://www.fgdc.gov/standards/projects/FGDC-standards-projects/vegetation/vegclass.pdf [Cited April 29, 2008].

Federal Geographic Data Committee, Vegetation Subcommittee. 2006. National vegetation classification standard, version 2 – working draft. Public review draft available from: http://www.fgdc.gov/standards/projects/FGDC-standards-projects/vegetation/Draft_FGDC_Std_November_edits3.pdf [Cited April 29, 2008].

Federal Geographic Data Committee. 1998a. Content standard for digital geospatial metadata, FGDC-STD-001-1998. Available from: http://www.fgdc.gov/metadata/contstan.html.

Federal Geographic Data Committee. 1998b. Spatial data transfer standard, FGDC-STC-002. Available from: http://www.fgdc.gov/standards/status/textstatus.html.

Fenneman, N.M., and Johnson, D.W., 1946, Map of physical divisions of the United States: U.S. Geological Survey, Physiographic Committee, scale 1:7,000,000.

Fischer, N.T., M.S. Toll, A.C. Cully, and L.D. Potter. 1983. Vegetation along Green and Yampa rivers and response to fluctuating water levels, Dinosaur National Monument. Unpublished report, University of New Mexico, Albuquerque, NM.

Fischer, W.C. 1981. Photo Guide for Appraising Downed Woody Fuels in Montana Forests: Interior Ponderosa Pine, Ponderosa Pine-Larch-Douglas-fir, Larch-Douglas-fir, and Interior Douglas-fir Cover Types. USDA-Forest Service General Technical Report INT-97. Intermountain Forest and Range Experiment Station, Ogden, UT. 133 pp.

Flahault, C., and C. Schroter. 1910. Rapport sur la nomenclature phytogeopraphique. Proceedings of the Third International Botanical Congress, Brussels 1:131-164.

Foos, A. and J. Hannibal. 2000. Geology of Dinosaur National Monument. Geology Department, University of Akron and Cleveland Museum of Natural History. Akron and Cleveland, OH.

Goodrich, S. and E. Neese. 1986. Uinta Basin Flora. USDA Forest Service Intermountain Region, Ogden, UT. 320 pp.

Graham, E.H. 1937. Botanical studies in the Uinta Basin of Utah and Colorado. Carnegie Institute, Pittsburgh, PA.

Grams, P.E. and J.C. Schmidt. 1999. Geomorphology of the Green River in the eastern Uinta Mountains, Dinosaur National Monument, CO and UT. Pp 81-111 i*n:* Varieties of Fluvial Form, A.J. Miller and A. Gupta, eds. John Wiley & Sons, NY, 1999.

Grams, P.E. and J.C. Schmidt. 2002. Streamflow regulation and multilevel floodplain formation: channel narrowing on the aggrading Green River in the eastern Uinta Mountains, CO and UT. Geomorphology 44:337-360.

Gregson, J. D. and D. J. Chure. 2003. Dinosaur National Monument. In: D.A. Sprinkel, T.C. Chidsey, Jr., and P.B. Anderson, eds. Geology of Utah's Parks and Monuments. 2003. Utah Geological Assn. Pub. 28. UT Geological Assn. and Bryce Canyon Natural History Assn.

Grossman, D.H., D. Faber-Langendoen, A.S. Weakley, M. Anderson, P. Bourgeron, R. Crawford, K. Goodin, S. Landaal, K. Metzler, K.D. Patterson, M. Pyne, M. Reid, and L. Sneddon. 1998. International Classification of Ecological Communities: Terrestrial Vegetation of the United States. Volume I. The National Vegetation Classification System: Development, Status, and Applications. The Nature Conservancy, Arlington, VA.

Hop, K., S. Lubinski, and S. Menard. 2005. USGS-NPS Vegetation Mapping Program: Effigy Mounds National Monument, Iowa. USGS, Upper Midwest Environmental Sciences Center. La Crosse, WI. January 2005. 62 pp + Appendices A-I.

Kartesz, J. 1999. A synonymized checklist and atlas with biological attributes for the vascular flora of the United States, Canada, and Greenland. First Edition. In: Kartesz, J.T., and C.A. Meacham. Synthesis of the North American Flora, Version 1.0. North Carolina Botanical Garden, Chapel Hill, NC.

McCormick, K. 2003. Lithostratigraphic Column of Dinosaur National Monument and Vicinity, Utah and Colorado. Available online at: http://www.ux1.eiu.edu/~cfrbj/parks/dino/dinostratcolfinal2.pdf. Accessed March 20, 2008.

McCune, B. and J.B. Grace. 2002. Analysis of Ecological Communities. MjM Software Design, Gleneden Beach, OR.

McCune, B. and M.J. Mefford. 1999. PC-ORD. Multivariate analysis of ecological data, ver. 4. MjM Software Design. Gleneden Beach, OR.

Merritt, D.M. 1997. Riparian vegetation and geomorphic features on regulated and unregulated rivers: Green and Yampa, NW Colorado. MS thesis, CO State University, Fort Collins, CO.

Mueller-Dombois, D., and H. Ellenberg. 1974. Aims and Methods of Vegetation Ecology. John Wiley and Sons, New York, NY. 546 pp.

National Park Service [NPS]. 1999. Natural Resource Challenge: The National Park Service's Action Plan for Preserving Natural Resources. In-house publication. U.S. Department of Interior, National Park Service, Washington, D.C. 21p.

National Park Service. 2005. Dinosaur National Monument Invasive Plant Management Plan and Environmental Assessment. Dinosaur National Monument, Colorado and Utah.

National Park Service. 2008. Dinosaur National Monument – Park Statistics. Available online at: http://www.nps.gov/dino/parkmgmt/statistics.htm.

Natural Resources Conservation Service [NRCS]. 2007. Soil Survey of Dinosaur National Monument, Colorado and Utah. In cooperation with Colorado State University, Colorado Agricultural Experiment Station, Utah State University, Utah Agricultural Experiment Station, and USDI-NPS.

NatureServe. 2003a. International Ecological Classification Standard: International Vegetation Classification. Natural Heritage Central Databases, NatureServe, Arlington, VA.

NatureServe. 2003b. International Ecological Classification Standard: Terrestrial Ecological Systems of the United States. Natural Heritage Central Databases. NatureServe. Arlington, VA. Available at http://www.natureserve.org/explorer.

NatureServe Explorer. 2008. An online encyclopedia of life [Web application]. Version 7.0. Arlington, VA. Available at http://www.natureserve.org/explorer.

Naumann T. 2008. Personal communication with the Dinosaur National Monument botanist .

Naumann, T. S. 1990. Inventory of Plant Species of Special Concern and the General Flora of Dinosaur National Monument, 1987-1989. Unpublished Report to the NPS Rocky Mountain Region. Colorado Natural Areas Program, Denver, CO.

Neuhold, J.M. 1981. An ecological characterization of the Yampa and Green rivers in Dinosaur National Monument. Unpublished report, Utah State University Ecology Center.

Omernik, J.M. 1987. Ecoregions of the coterminous United States. Annals of the Association of American Geographers 77(1): 118-125.

Ottmer, R.D., R.E. Vihnanek, and C.S. Wright. 2000a. Stereo Photo Series for Quantifying Natural Fuels. Volume III: Lodgepole Pine, Quaking Aspen and Gambel Oak Types in the Rocky Mountains. PMS 832. Boise, ID, National Wildfire Coordinating Group, National Interagency Fire Center. 85 pp.

Ottmer, R.D., R.E. Vihnanek, and J.C. Regelbrugge. 2000b. Stereo Photo Series for Quantifying Natural Fuels. Volume IV: Pinyon-Juniper, Chaparral, and Sagebrush Types in the Southwestern United States. PMS 833. Boise, ID, National Wildfire Coordinating Group, National Interagency Fire Center. 97 pp.

Petersburg, S. 2004. Personal communication with the Dinosaur NM Chief of Resources.

Ponzetti, J., B. Youtie, D. Salzer, and T. Kimes. 1998. The effects of fire and herbicides on microbiotic crust dynamics in high desert ecosystems. Unpublished report submitted to the USGS, Biological Resources Division, Forest and Rangeland Ecosystem Science Center. Portland, OR. 89 pp.

Reid, M. and P. Comer. 1998. Vegetation Alliance Descriptions of the Western U.S. Available at http://www.gap.uidaho.edu/bulletins/7/VADWUS.htm.

Rosentreter, R. 1986. Compositional patterns within a rabbitbrush (*Chrysothamnus*) community of the Idaho Snake River Plain. In: McArthur, E. D., and B. L. Welch, comps. Proceedings – Symposium on the biology of *Artemisia* and *Chrysothamnus*. General Technical Report INT 200. USDA Forest Service, Intermountain Research Station. Ogden, UT. pp. 273-277.

The Nature Conservancy and Environmental Systems Research Institute.1994a. NBS/NPS Vegetation Mapping Program: Final Draft, Standardized National Vegetation Classification System. Prepared for USDI – National Biological Survey and NPS. Arlington, VA.

The Nature Conservancy and Environmental Systems Research Institute.1994b. NBS/NPS Vegetation Mapping Program: Final Draft, Field Methods for Vegetation Mapping. Prepared for USDI – National Biological Survey and National Park Service. Arlington, VA.

The Nature Conservancy. 1997. PLOTS database system 1.1. Arlington, VA.

The Nature Conservancy. 1996. Final Draft Methodology for Assessing the Utility of Existing Data for Vegetation Mapping. NBS/NPS Vegetation Mapping Program. Prepared for the USGS-Biological Resources Division and National Park Service.

United Nations Educational, Scientific, and Cultural Organization. 1973. International classification and mapping of vegetation. UNESCO, Paris, France.

U.S. Fish and Wildlife Service. 1994. Endangered and Threatened Wildlife and Plants; Determination of Critical Habitat for the Colorado River Endangered Fishes: Razorback Sucker, Colorado Squawfish, Humpback Chub, and Bonytail Chub. Final Rule. Federal Register, Vol. 59, #54, Monday, March 21, 1994.

U.S. Forest Service. 2008. Digital Photo Series (Natural Fuels Photo Series in digital format). Pacific Northwest Research Station, Pacific Wildland Fire Sciences Laboratory, Fire and Environmental Research Applications Team. Seattle, WA. [accessed April 22, 2008]

U.S. Geological Survey. 2008. National Water Information System: Streamflow Gauge Data from the Yampa River at Deerlodge Park, Colorado. Available at http://nwis.waterdata.usgs.gov/nwis/uv?09260050 [accessed April 2008]

U.S. Geological Survey. 1999. Map accuracy standards. Fact sheet FS-171-99 (November 1999). Available at http://mac.usgs.gov/mac/isb/pubs/factsheets/fs17199.html.

Wathen and Friedlander. 1983. Dinosaur Vegetation Associations Inventory. NPS file report, Dinosaur National Monument.

Weber, W.A. and R.C. Wittmann. 2001. Colorado Flora: Western Slope, 3rd ed. University Press of Colorado, Boulder, CO. 488 pp.

Welsh, S. 1957. An ecological survey of the vegetation of the Dinosaur National Monument. MS thesis, Brigham Young University, Provo, UT. 86 pp.

Welsh, S.L., N.D. Atwood, S. Goodrich and L.C. Higgins. 2003. A Utah Flora. Third Edition, revised. Brigham Young University Print Services, Provo, UT. 912 p.

West, N.E. 1988. Intermountain Deserts, Shrub Steppes, and Woodlands. In North American Terrestrial Vegetation. eds. Barbour, M.G. and W.D. Billings. Cambridge University Press.

West, L. and D. Chure. 1984. Dinosaur: The Dinosaur National Monument Quarry. Dinosaur Nature Association, 40 pp.

Western Regional Climate Center. 2008. Dinosaur National Monument Station. Available at http://www.wrcc.dri.edu/summary/Climsmco.html. [Accessed April 20, 2008]

Appendix A

Ecological Systems of Dinosaur National Monument

Introduction

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

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

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 (Treed); 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 north into Canada. In California, this system is only found on the east side of the Sierra Nevada adjacent to the Great Basin. Large stands are found in the Inyo and White mountains, while small stands occur on the Modoc Plateau. Elevations generally range from 1525 to 3050 m (5,000-10,000 feet), but occurrences can be found at lower elevations in some regions. Distribution of this ecological system is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand. Secondarily, it is limited by the length of the growing season or low temperatures. These are upland forests and woodlands dominated by *Populus tremuloides* without a significant conifer component (<25% relative tree cover). The understory structure may be complex with multiple shrub and herbaceous layers, or simple with just an herbaceous layer. The herbaceous layer may be dense or sparse, dominated by graminoids or forbs. In California, *Symphyotrichum spathulatum* is a common forb. Associated shrub species include *Symphoricarpos* spp., *Rubus parviflorus, Amelanchier alnifolia,* and *Arctostaphylos uva-ursi*. Occurrences of this system originate and are maintained by stand-replacing disturbances such as avalanches, crown fire, insect outbreak, disease and windthrow, or clearcutting by man or beaver, within the matrix of conifer forests.

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 (5000-10,000 feet), 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 (Treed); Ravine; Stream terrace; Toeslope; Mesotrophic Soil; Ustic; Long Disturbance Interval; F-Patch/Low Intensity; F-Landscape/Low Intensity; Needle-Leaved Tree; RM Montane Dry-Mesic Mixed Conifer

Concept Summary: These are mixed conifer forests of the Rocky Mountains west into the ranges of the Great Basin, occurring predominantly in cool ravines and on 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). Such sites include lower and middle slopes of ravines, along stream terraces, moist, concave topographic positions and north- and east-facing slopes which burn somewhat infrequently. *Pseudotsuga menziesii* and *Abies concolor* are most common canopy dominants, but *Picea engelmannii, Picea pungens*, or *Pinus ponderosa* may be present. This system includes mixed conifer/*Populus tremuloides* 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 parviflora, Osmorhiza berteroi, Packera cardamine, Thalictrum occidentale*, and *Thalictrum fendleri*. Naturally occurring fires are of variable return intervals and mostly 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: Lower Montane; Forest and Woodland (Treed); Aridic; Intermediate Disturbance Interval; F-Patch/Medium Intensity; F-Landscape/Medium Intensity; Needle-Leaved Tree; RM Montane Mesic Mixed Conifer; Moderate (100–500 yrs) Persistence
Concept Summary: This is a highly variable ecological system of the Rocky Mountains montane zone. It occurs throughout the southern Rockies, north and west into Utah, Nevada, western Wyoming, and Idaho. It consists of mixed-conifer forests occurring on all aspects at elevations ranging from 1,200 m to 3,300 m. Rainfall averages less than 75 cm per year (40 cm–60 cm) with summer "monsoons" during the growing season contributing substantial moisture. The composition and structure of the overstory depends on the temperature and moisture conditions at the site, and the successional status of the stand. *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 higher elevations, canyon sideslopes, ridgetops, and north- and east-facing slopes that 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 may be a number of common cold-deciduous shrub and graminoid species, 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," characterized by a high degree of variability in lethality and return interval.
Range: This system occurs throughout the southern Rockies, north and west into Utah, Nevada,

eastern Wyoming (very southern in the Laramie Range and possibly on Sheep Mountain) and Idaho. Although not common, it does occur in southeastern Oregon but does not extend farther west into the Cascades.
Subnations: AZ, CO, ID, NM, 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 [Periodicity/Polycyclic Disturbance]; F-Patch/Medium Intensity; Needle-Leaved Tree; *Pinus ponderosa* with shrubby understory
Concept Summary: This widespread ecological system is most common throughout the Rocky Mountain cordillera, from the Greater Yellowstone region south. It is also found in the Colorado Plateau region, west into scattered locations in the Great Basin. These woodlands typically occur on dry slopes at the lower treeline/ecotone between grasslands or shrublands and more mesic coniferous forests. 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 igneous, metamorphic, and sedimentary material derived soils, with characteristic features of good aeration and drainage, coarse textures, circumneutral to slightly acid 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,* 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 oreophilus, Prunus virginiana, Amelanchier alnifolia,* and *Rosa* spp. common species. *Pseudoroegneria spicata* 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.
Range: This system is found throughout the Rocky Mountain cordillera, from northwestern Wyoming south through the Rocky Mountains of Colorado and into New Mexico. In Arizona, it occurs on the Mogollon Rim north into the Colorado Plateau region and west into scattered locations of the Great Basin.
Subnations: AZ, CO, ID?, NM, NV, UT, WY

CES306.819 ROCKY MOUNTAIN SUBALPINE-MONTANE LIMBER-BRISTLECONE PINE WOODLAND WOODLAND

Division 306 (Rocky Mountain); Forest and Woodland

Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Ridge/Summit/Upper Slope; Calcareous; Very Shallow Soil; Mineral: W/ A-Horizon <10 cm; Aridic; W-Patch/High Intensity; Needle-Leaved Tree; *Pinus flexilis, P. aristata*; Upper Treeline
Concept Summary: This ecological system occurs throughout the central and southern Rocky Mountains south of Montana, on dry, rocky ridges and slopes near upper treeline above the matrix spruce-fir forest. It extends down to the lower montane in the northeastern Great Basin where dominated by *Pinus flexilis*. Sites are rocky and harsh, exposed to desiccating winds and a short growing season that limits plant growth. Occurrences extend into the subalpine-alpine transition on wind-blasted, mostly west-facing slopes and exposed ridges. Calcareous substrates are important for *Pinus flexilis* communities in the northern Rocky Mountains and possibly elsewhere. The open tree canopy is often patchy and is strongly dominated by *Pinus flexilis* or *Pinus aristata;* the latter is restricted to southern Colorado, northern New Mexico and northern Arizona. In the Wyoming Rockies and northern Great Basin, *Pinus albicaulis* is sometimes found, but is a minor component. *Juniperus* spp., *Pinus contorta, P. ponderosa*, or *Pseudotsuga menziesii* are occasionally present. *Arctostaphylos uva-ursi, Cercocarpus ledifolius, Juniperus communis, Mahonia repens, Purshia tridentata, Ribes montigenum*, or *Vaccinium* spp. may form an open shrub layer in some stands. The herbaceous layer, if present, is generally sparse and composed of xeric graminoids, such as *Calamagrostis purpurascens, Festuca arizonica, Festuca idahoensis, Festuca thurberi*, or *Pseudoroegneria spicata*, or more alpine plants.
Comments: This system is distinct from lower montane and foothill limber pine stands in Wyoming and Montana. The foothill system (Rocky Mountain Foothill Limber Pine-Juniper Woodland (CES306.955)) is found at lower treeline, below the zone of continuous *Pinus ponderosa* or *Pseudotsuga menziesii* woodlands and forest, and extends into the eastern portions of these states in the foothill zones of mountain ranges, along rock outcrops, breaks along rivers, and on sheltered sites where soil moisture is slightly higher than surrounding grasslands.

This system needs to be distinguished from the Northern Rocky Mountain Subalpine Dry Parkland (CES306.807), which also includes woodlands of *Pinus flexilis* and *P.albicaulis* and occurs in similar environmental settings of the northern Rocky Mountains, particularly northwestern Wyoming, Montana, and north into Alberta and British Columbia.
Range: This system occurs throughout the Rocky Mountains, south of Montana, on dry, rocky ridges and slopes near upper treeline, including the Uinta and northern Wasatch mountains, and the Jarbidge Mountains in northeastern Nevada.
Subnations: CO, ID?, MT?, NM, NV, OR?, UT, WA?, WY

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: 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 mountains and foothills of the Colorado Plateau region including the Western Slope of Colorado to the Wasatch Range, south to the Mogollon Rim and east into the northwestern corner of New Mexico. It is typically found at lower elevations ranging from 1,500 m to 2,440 m. These woodlands occur on warm, dry sites on mountain slopes, mesas, plateaus, and ridges. Severe climatic events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to relatively narrow altitudinal belts on mountainsides. Soils supporting this system vary in texture ranging from stony, cobbly, gravelly sandy loams to clay loam or clay. *Pinus edulis* and/or *Juniperus osteosperma* dominate the tree canopy. In the southern portion of the Colorado Plateau 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 where sympatric.
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 lower elevations ranging from 1,500 m–2,440 m.
Subnations: AZ, CO, NM, UT

CES304.772 INTER-MOUNTAIN BASINS CURL-LEAF 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: Lower Montane; Lowland [Foothill]; Aridic; *Cercocarpus ledifolius*
Concept Summary: This ecological system occurs in hills and mountain ranges of the Intermountain basins from the eastern foothills of the Sierra Nevada northeast to the foothills of the Big Horn 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*, or *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: Occurs in hills and mountain ranges of the Intermountain basins from the eastern

foothills of the Sierra Nevada northeast to the foothills of the Big Horn Mountains.
Subnations: CA, CO, ID, MT, NV, OR, 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: Lower Montane; Lowland [Foothill]; Shrub-dominated; 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 extending north into Wyoming, and west into the Intermountain region. These shrublands occur between 1500-2900 m elevations and are usually associated with exposed sites, rocky substrates, and dry conditions, which 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 north into adjacent Montana, *Cercocarpus ledifolius*, usually with *Artemisia tridentata*, is the common dominant shrub. Grasses are represented as species of *Muhlenbergia, Bouteloua, Hesperostipa*, and *Pseudoroegneria spicata*. Fires play an important role in this system as the dominant shrubs usually have a severe die-back, although some plants will stump sprout. *Cercocarpus montanus* requires a disturbance such as fire to reproduce, either by seed sprout or root crown sprouting. Fire suppression may have allowed an invasion of trees into some of these shrublands, but in many cases sites are too xeric for tree growth.
Range: 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 extending north into Wyoming, and west into the Intermountain region.
Subnations: CO, MT, NE?, NM, SD, WY

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

Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Shrub-dominated; 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 most commonly found along dry foothills, lower mountain slopes, and at the edge of the western Great Plains from approximately 2,000 m to

2,900 m in elevation, and are often situated above pinyon-juniper woodlands. Substrates are variable and include soil types ranging from calcareous, heavy, 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 codominant 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 relatively minor component. This ecological system intergrades with the lower montane-foothills shrubland system and shares many 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

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; Shrub-dominated); 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 broad basins between mountain ranges, plains, and foothills between 1,500 m and 2,300 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 1,500 m to 2,300 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: Montane [Upper, Lower Montane]; Woody-Herbaceous
Concept Summary: This ecological system includes sagebrush communities occurring at montane and subalpine elevations 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*. Most stands have an abundant perennial herbaceous layer (over 25% cover), but this system also includes *Artemisia tridentata ssp. vaseyana* shrublands. Common graminoids include *Festuca arizonica, Festuca idahoensis, Hesperostipa comata, Poa fendleriana, Elymus trachycaulus, Bromus carinatus, Poa secunda, Leucopoa kingii, Deschampsia caespitosa, Calamagrostis rubescens,* and *Pseudoroegneria spicata*. 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 the moisture providing equally high grass and forb cover.
Range: This system is found at montane and subalpine elevations 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 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 intermountain western U.S., typically at lower elevations on alluvial fans and flats with moderate to deep soils. This semi-arid shrub-steppe is typically dominated by graminoids (>25% cover) with an open shrub layer. Characteristic grasses include *Achnatherum hymenoides, Bouteloua gracilis, Distichlis spicata, Hesperostipa comata, Pleuraphis jamesii, Poa secunda,* and *Sporobolus airoides*. The woody layer is often a mixture of shrubs and dwarf-shrubs. Characteristic species include *Atriplex canescens, Artemisia tridentata, Chrysothamnus greenei, Chrysothamnus viscidiflorus, Ephedra* spp., *Ericameria nauseosa, Gutierrezia sarothrae,* and *Krascheninnikovia lanata*. *Artemisia tridentata* may be present but does not dominate. Occurrences may be either open shrubland with patchy grasses or patchy open herbaceous layer. Disturbance may be important in maintaining the woody component. Biological soil crusts are very important in some stands.
Range: Occurs throughout the Intermountain western U.S., typically at lower elevations.
Subnations: AZ, CA, CO, ID, MT?, NM, NV, OR, UT, WA, WY

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]; Shrub-dominated; 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 at elevations generally below 1800 m. 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* codominant. 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 over 25% cover.
Range: Occurs in the Colorado Plateau, Tavaputs Plateau and Uinta Basin in canyons, gravelly draws, hilltops, and dry flats at elevations generally below 1800 m.
Subnations: AZ, CO, NM

CES304.001 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: Lower Montane; Lowland [Foothill]; Shrub-dominated; Temperate Xeric; Broad-Leaved Evergreen Shrub
Summary: This system includes chaparral on sideslopes transitioning from low-elevation desert landscapes up into pinyon-juniper woodlands of the western and central Great Basin. There are limited occurrences extending as far west as the inner Coast Ranges in central California. These are typically fairly open-canopy shrublands with open spaces either bare or supporting patchy grasses and forbs. Characteristic species may include *Arctostaphylos patula, Arctostaphylos pungens, Ceanothus greggii, Ceanothus velutinus, Cercocarpus montanus var. glaber, Cercocarpus intricatus, Eriogonum fasciculatum, Garrya flavescens, Quercus turbinella, Purshia stansburiana,* and *Rhus trilobata*. *Cercocarpus ledifolius* is generally absent. Typical fire regime in these systems varies with the amount of organic accumulation.
Range: Western and central Great Basin
Subnations: CA, NV, UT

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; Shrub-dominated; Toeslope/Valley Bottom; Alkaline Soil; Deep Soil; Xeromorphic Shrub
Concept Summary: This ecological system occurs throughout much of the western U.S. in Intermountain basins and extends onto the western Great Plains. It typically occurs near drainages on stream terraces and flats or may form rings around more 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; Shrub-dominated; Alluvial flat; Alluvial plain; Plain; Alkaline Soil; Saline Substrate Chemistry; Calcareous; Silt Soil Texture; Clay Soil Texture; Xeromorphic Shrub; Dwarf-Shrub; *Atriplex* spp.
Concept Summary: This extensive ecological system includes open-canopied shrublands of typically saline basins, alluvial slopes and plains across the Intermountain western 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 codominate 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 does not codominate. The herbaceous layer varies from sparse to moderately dense and is dominated by perennial graminoids such as *Achnatherum hymenoides, Bouteloua gracilis, Elymus lanceolatus, Pascopyrum smithii, Poa secunda, Pleuraphis jamesii, Pleuraphis rigida,* or *Sporobolus airoides*. Forbs are also present.
Range: Intermountain western U.S., with limited extensions into the southern Great Plains.
Subnations: AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY

CES304.775 INTER-MOUNTAIN BASINS 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 (Landform); Dune field; Dune (Substrate); Temperate Continental; Sand Soil Texture; Aridic; W-Landscape/High Intensity
Concept Summary: This ecological system occurs in Intermountain West basins and is composed of unvegetated to moderately vegetated (<10-30% plant cover) active and stabilized dunes and sandsheets. 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., *Coleogyne ramosissima, Ericameria nauseosa, Leymus flavescens, Psoralidium*

lanceolatum, Purshia tridentata, Redfieldia flexuosa, Sporobolus airoides, Sarcobatus vermiculatus, Tetradymia tetrameres, or *Tiquilia* spp.
Range: This system occurs in intermountain basins of the western U.S.
Subnations: AZ, CO, ID, 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; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Lowland; Badlands; Badland; Alkaline Soil; Shale and Mudstone; Silt Soil Texture; Clay Soil Texture
Concept Summary: This widespread ecological 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 includes substrates derived 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

CES304.781 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; Shrub-dominated; 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 western U.S. extending east into the western Great Plains.
Subnations: AZ, CA, CO, ID, MT, NV, OR, UT, WA, 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 1,450 m to 2,320 m (4,750–7,610 ft) elevation. These grasslands occur in lowland and upland areas and may occupy swales, playas, mesa tops, 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 codominated 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 1,450 m to 2,320 m (4,750–7,610 ft) in elevation.
Subnations: AZ, CA, CO, ID, MT?, NM, NV, OR, UT, WA, WY

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: Lower Montane; Lowland [Foothill]; Shrub-dominated; 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 include *Pinus edulis, Pinus ponderosa, Juniperus* spp., *Cercocarpus intricatus,* and other short-shrub and herbaceous species, utilizing moisture from cracks and pockets where soil accumulates.
Comments: Geographically restricted and distinct from the related, but broader 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

RIPARIAN, WETLAND, AND MESIC ECOLOGICAL SYSTEMS

CES306.821 ROCKY MOUNTAIN LOWER MONTANE–FOOTHILL RIPARIAN WOODLAND AND SHRUBLAND

Division 306 (Rocky Mountain); Woody Wetland

Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)
Diagnostic Classifiers: Lower Montane; Riverine / Alluvial; Mineral: W/ A-Horizon <10 cm; Unconsolidated; Short (<5 yrs) Flooding Interval; Short (50–100 yrs) Persistence
Concept Summary: This system is found throughout the Rocky Mountain and Colorado Plateau regions within a broad elevation range from approximately 900 m to 2,800 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 stream banks. 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, Symphoricarpos* spp., or *Shepherdia argentea*. *Elaeagnus angustifolia* and *Tamarix* spp. are common in some stands. The upland vegetation surrounding this riparian system ranges from grasslands to forests.
Range: Found throughout the Rocky Mountain and Colorado Plateau regions from approx. 900 m to 2,800 m. It is also found in the island mountain ranges of central and eastern Montana.
Subnations: AZ, CO, ID, MT, NM, NV, OR, SD, UT, WY

CES300.729 NORTH AMERICAN ARID WEST EMERGENT MARSH

Division 306 (Rocky Mountain); 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 (ponds, kettle ponds), as fringes around lakes, and along slow-flowing streams and rivers (such riparian marshes are also referred to as sloughs). 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 or semi-alkaline situations, but the alkalinity is highly variable even within the same complex of wetlands. Marshes have distinctive soils that are typically mineral, but can also accumulate organic material. Soils have characteristics that result from long periods of anaerobic conditions in the soils (e.g., gleyed

soils, 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 (*Lemna, Potamogeton*, 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, where semipermanently flooded habitats are found as small patches in the matrix of a relatively dry landscape.

DISTRIBUTION
Range: Occurs throughout much of the arid and semi-arid regions of western North America.
Divisions: 301:C, 302:C, 303:C, 304:C, 305:C, 306:C
TNC Ecoregions: 6:C, 7:C, 8:C, 9:C, 11:C, 17:C, 18:C, 19:C, 20:C, 21:C, 23:C, 24:C, 26:C, 27:C, 28:C, 29:?, 30:C, 68:C
Subnations: AB, AZ, BC, CA, CO, ID, MT, MXBC, MXCH, MXSO, 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 (Landform, Substrate); 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 canyonlands with perennial water sources (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 at all exposures of the canyon walls, but they are always shaded for much to most of each day. Temperature and humidity are relatively stable compared to the surrounding environment. Most hanging gardens are dominated by herbaceous plants, and a number of these 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. 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 monument. 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 DINOSAUR NATIONAL MONUMENT

A Basic Guide for Field Work

Revision of May 28, 2002

This document is intended to assist you in conducting fuels and vegetation sampling at Dinosaur National Monument. Detailed, field-by-field coding conventions for the Plot Survey Forms you'll be completing in the field are provided. These are abbreviated on a 'cheat sheet' at the end of this document.

OVERVIEW

The vegetation data that you collect in Dinosaur this year will be combined with data collected in 2003 and used to create a classification of the vegetation in the monument and its environs. The fuels data will be used by monument staff to construct fire behavior models specific to Dinosaur. The understanding of finer-scale, ecologically distinct vegetation types that you help create may be used by the monument staff to guide management planning, monitor the results of management, track long-term changes in vegetation, direct searches for rare species, and portray the wealth of natural diversity on NPS lands to the public.

Establishing a field sampling strategy that captures—in only two field seasons—sufficient data on the full range of vegetation types in an area as large, diverse, and rugged as Dinosaur is a challenge. To make the sampling as efficient as possible, we identified the key environmental variables thought to be driving the distribution of vegetation at Dinosaur. These factors were geology/soils, elevation, solar budget, and fire history. The park surface was classified into polygons corresponding to these factors; e.g., there are four elevation classes: 5500-6500 feet, 6500-7500 feet, >7500 feet, <5500 feet. The factors were layered, creating a mosaic of polygons with unique combinations of factors called biophysical units or BPUs. The basic idea is that if we sample the full range of

BPUs we would capture a majority of the vegetation types. During this field season, we will be concentrating on clusters of BPUs in close proximity to each other *and* close to roads or trails. In 2003, we will fill in the gaps, regardless of difficulty of access.

To help guide you in choosing areas to sample within the BPUs, you will be provided with maps of the area as well as copies of the aerial photos. Wherever possible, please note the vegetation and its condition on the photos, both in areas you sample and areas you pass through. The aerial photos will help you identify the different vegetation types available in each BPU to sample – similar color, pattern, and texture usually indicate similar vegetation. The photo interpreters may occasionally mark a particular feature of interest on a photo and ask you to make an effort to identify it for them.

We will also keep a running tally of plant associations we have sampled, in order to prevent over- or under-sampling of different types. We have a list of potential plant alliances, but not enough is known of the vegetation in the monument to create a valid list of plant associations.

The ultimate goal is to sample a minimum of three and a maximum of ten stands of each plant association that occurs in the monument. Every two weeks or so we will compile your completed plot forms and field notes and use them to expand the list of plant associations. Meanwhile, we will begin with the goal of at least five samples within each alliance, well distributed throughout the project area.

At the end of each field trip, allow time to evaluate the field data, assign a preliminary alliance or association to each sample, and update the tally of plant associations and alliances sampled.

GETTING THERE

You will have a DRG (Digital Raster Graphic) map with the BPUs you are to sample indicated on it. You and your partner will navigate towards each selected BPU using your park and BLM maps, topographic maps, and aerial photos.

Before you leave on a trip... check that you have all the field gear and more than enough forms needed to complete your work (please see the checklist and "considerations for mission planning" at the end of this document).

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

Along the way...look around. You will collect better data and do a better job if you stay awake and pay attention on your way to the BPU of the moment. Context is everything – you will have a much better sense of how your plots represent the landscape if you are always in analysis mode. Keep in mind that the goal of this field work is to sample **all** the different vegetation types that occur at Dinosaur. If, on the way to a BPU or plot, you see an assemblage of plants that seems unique and that is not included on the list of vegetation types, **please** sample if time allows, or at least do an observation form or make note of it in your field notes and on the aerial photo. You will be better able to recognize new plant alliances and associations as the season progresses and you become more familiar with the vegetation.

ONCE THERE

Establishing a Plot

1) Deciding where to place your plot is a subjective process. You'll want to place your plots in areas that seem to be both relatively **homogenous** and **representative** of the vegetation of the polygon as a whole. In other words, avoid areas where the vegetation appears to be transitioning from one type to another and areas with anomalous or heterogeneous structure or species composition. Take some time and do this carefully, because some of the plots you set up may be resampled over time in order to determine responses to management. Look at *all* the vegetation layers to determine if the area is structurally and floristically uniform and generally try to place your plots **at least** 30 m (100 feet) from what you see as the 'boundary' between this vegetation type and neighboring, different types. The exception to this rule is when you are sampling a unique type that is always going to occur in small patches, such as a spring seep. The rule-of-thumb is to conduct a reconnaissance of the entire stand if time and topography allow. Using the aerial photos can also help you to locate yourself within a stand.

Note: When a BPU is heterogeneous, more than one plot may be needed. Again, look around;

use your acquired knowledge and judgment.

2) Although the plots will not be permanently marked, Dinosaur staff very much want to be able to relocate them for long-term vegetation monitoring purposes. Careful documentation of the stand characteristics, access route, and vegetation is therefore extremely important.

3) Using your GPS receiver, record the UTM 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. If you cannot get a GPS reading, estimate the UTM from the USGS topographic map and note on the form that you had to resort to this method. It may make more sense to establish rectangular plots in linear vegetation types (e.g. riparian or ridgeline types). Changing the shape of the plot to fit it into a homogeneous sample area is fine, but please try not to make a plot smaller than the sizes listed below. Use the measuring tapes and/or flagging to delineate the plot's edges. Note the plot's shape and dimensions on the field form. If the plot is a rectangle or square, record the azimuth of the long side (any side if square) to help relocate the plot.

If you're in a ...	**You should 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., stands of trees with crowns usually not touching. Canopy tree cover is 10-60% or exceeds total 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 dominant, usually with more than 10% cover or exceeding tree, dwarf-shrub, herb, and nonvascular cover).	5.65 m radius OR 10 m x 10 m	100 m^2 400 m^2
Dwarf-shrubland (i.e., shrubs less than 0.5 m tall are dominant, usually with more than 10% 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
Shrub Herbaceous (i.e., forb and/or grass cover roughly equal to shrubs or dwarf shrubs).	5.65 m radius OR 10 m x 10 m	100 m^2 100 m^2
Herbaceous (i.e., herbs or grasses dominant, usually forming more than 10 percent cover).	5.65 m radius OR 10 m x 10 m	100 m^2 100 m^2
Nonvascular (i.e., lichen or moss cover dominant, usually forming more than 10% cover).	2.82 m radius OR 5 m x *5* m	25 m^2 25 m^2

4) 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
Take two color slides of each plot. The purpose is to get a good representation of the vegetation

of the plot, not individual species. Take the photos diagonally across the plot from adjacent corners, or at adjacent cardinal points of a circular plot; select the corners that give you the best view of the vegetation. The Olympus Stylus cameras have the option of including the date in the photo – it is fine to put the date in plot photos, but **please don't put dates in your scenic and other non-plot photos**. Attach the clear plastic sheet protector with a white piece of paper inside it to your clipboard and use your dry erase marker on the plastic (not the paper!) to create a sign board for each plot photo. On the sign board write the plot number, the corner and the direction of the photo. Thus for plot 241, the board in the photo taken from the SE corner of the plot will read "DINO-241, SE⇗NW". Take the photograph looking across the contour if plot is on a

As each roll is exposed, label it clearly with your name and the roll # and get it to Janet, who will have it developed and return it to you for labeling. Each field team is responsible for labeling and organizing its slides.



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

Taking 'movies on a stick'
Mount your digital camera on the monopod and extend the monopod to the standard length (center of the lens is 5 feet above the ground). Point the camera toward true north and rotate the monopod clockwise in a slow 360 degree pan. Spend between 30 and 40 seconds on the pan. When you begin the pan, make sure the map board with the plot info is visible. Keep yourself out of the image and keep the camera lens parallel to the ground – otherwise on steep slopes you'll get a nice view of the sky on half the pan.

DATA COLLECTION
Environmental Description andVegetation Description
See the coding instructions later in this document for instructions on how to fill out each field.

As you begin to collect the species, DBH, 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. Remember that these plot data are to be used to classify the monument's vegetation, not to make a complete species list for it. If you had to spend much more than 20 minutes to *find* a species, it probably isn't going to be important in characterizing the vegetation type. For diverse plots with more than 25 taxa you may take up to 30 minutes on the listing process.

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

a. If you need the species identified right away because it appears to be dominant (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, if present. Place the sample in a baggie, and label it with the plot code, the date and the name you gave it on the data form.

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

Store bagged specimens in a 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. 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 cover value of more than 1% it is a priority to identify. Field teams should mark the specimen tag with its cover class estimate as well as the plot number. If pressed specimens begin to build up, let Janet know. She can take steps to have some of them identified.

Observation Point Form

Occasionally, you will need to collect some data outside of a plot, such as when the photo interpreters ask you to identify or describe a vegetation type or feature with a unique photo signature or the photo interpreters were wrong about what kind of vegetation is in a polygon *and* sufficient plot data has already been collected for the kind of vegetation that is actually there.

In these situations, there is no need to establish a plot. However, you will help the photo interpreters immensely if you collect some data. Navigate to the polygon as usual, scout out the polygon briefly to get a feel for it, and record some general data to characterize it on an Observation Point form. This is an abbreviated version of the Plot Survey form, and the same cheat sheet can be used to help with filling it out. GPS points may be taken at any part of the polygon as long as it is >30 m from its edge, to verify its location. **Make sure the type you are describing occupies an area of <u>at least</u> ½ hectare** (a circle approximately 40m in radius!!). This is because the standard plot is about the size of a pencil point to the photo interpreter – even ½ hectare is only the size of a pea.

Most of all, have a blast working in this gorgeous place. Good luck!

INSTRUCTIONS FOR FILLING OUT FIELDS IN THE PLOT SURVEY FORM DINOSAUR NATIONAL MONUMENT
Version of May 28, 2002

Note: Occasionally you may be pressed for time while doing plots – it's getting late or a huge black cloud is heading your way or the gnats are just too terrible. In this case, you can leave the fields marked with an asterisk (*) blank while you are in the field. HOWEVER, be sure to fill them in before you file them at the end of your trip. Also, PLEASE don't get into the habit of leaving them blank in general – it creates a headache for whoever enters the data (maybe YOU!).

Plot Code
This is a unique identifier you give each sample plot using the format "DINO.XXX". Begin with DINO.0101 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 they can use even numbers only while you use odd, or they can start with the next 100 (0201 instead of 0101). Please don't use numbers like 202A – this creates headaches when the data are entered into the computer. Use the same numbering convention for observation points.

***BPU Code**
The biophysical unit identified is the polygon identifier on the DRG map. If the plot is outside a BPU, enter "None".

***Provisional Community Name**
Using the list of potential Alliances and Associations with which you've been provided, assign the name of the vegetation type which 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' will be used to update the central tally of plots.

***State** CO or UT.

Park Name The standard abbreviation is DINO.

***Park Site Name**
A name that describes the general location where the data were collected. It should represent a nearby feature on a topographic map.

***Quad Name**
Use the name of the 7.5-minute quadrangle.

***Quad Code**
USGS code of 7.5 minute quadrangle map. I've written the code on the map, above the name in the lower and upper right hand corners. All you need to fill in on the form is the last two digits.

***Aerial Photo Number**
The photo number is in the upper right hand corner of the photo in the format FLIGHTLINE

FRAME #. Record this number on the form. Mark the plot number on the photo if you can.

GPS File Name
Enter the waypoint name from the GPS unit. If using a Garmin 76, please give the waypoint the same name as the plot number (e.g., DP241 for Dinosaur plot #0241). If doing an observation point, give the point a name that indicates that -DO101 for Dinosaur observation point #9101).

Field UTM X
Use GPS if at all possible. If you can't get a GPS reading, estimate the coordinates from the topo map and note on the form that this method was used.

Field UTM Y
Use GPS if at all possible. If you can't get a GPS reading, estimate the coordinates from the topo map and note on the form that this method was used.

GPS Error
Note the "Estimated Position Error" (EPE) displayed on your GPS unit.

Datum
ALWAYS check this on your GPS unit. It should **always** be NAD83. This information is **CRITICAL** for correctly applying your waypoints to the final vegetation map. If it is anything other than NAD83, please, please, please record this on the form. This step will keep your work from being wasted. (Keystroke sequence: MENU-MENU-SETUP-Location Tab-MAP DATUM)

UTM Zone
Circle the value displayed on your GPS. It should be either 13S or 12S.

Survey Date
Date the survey was taken in this format: year-month-day (2002-07-21).

Surveyors
Names of the field team members present. Use full last names with first initial.

Directions to Plot
Give complete directions to the plot beginning with a landmark (e.g., a named point on the topo map, a major highway) readily locatable on a 7.5 minute topo map as the starting point. Use clear sentences that will be understandable to someone who is unfamiliar with the area and has only your directions to follow. Give distances to the nearest 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. Be aware of the ambiguity of words like "above", "near", beyond", "on the back side of", "past". Don't describe the location of one plot relative to another.

Plot Length and Width
Enter diameter for circular plots and width and length dimensions for square or rectangular plots. Choose the appropriate plot size based on the dominant vegetation class. Other plot shapes are acceptable as long as the area is the same as in this table:

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	5.65 m radius or 10 m x 10 m	100 m^2
Dwarf-shrubland	5.65 m radius or 10 m x 10m	100 m^2
Shrub Herbaceous	5.65 m radius or 10 m x 10 m	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 were taken of the plot, and record the roll and frame numbers. Roll numbers should be a team member's initials plus a sequential number. Also record the azimuth of the photo(s). Record the image number of the digital pan of the plot.

Plot Permanent
Since none of the plots at Dinosaur will be permanently marked, this field is already filled in.

Plot Representativeness
a. Representativeness of association. Does this plot fit within the established concept of the association in the entire mapping area? How does it differ? It is better to leave this blank than to guess; as you gain experience you will have a better feel for how to answer this.
b. Representativeness of plot in stand. Does this sample represent the variability within the surrounding stand or polygon? If not, were additional plots taken? Note additional species occurring outside the plot but characteristic of the stand. In order to complete this field, you need to have done a brief reconnaissance of the stand.

ENVIRONMENTAL DESCRIPTION

***Elevation**
Elevation of the plot. Take this measurement from the topo map, not the GPS unit. The reading you get from a topo map, provided you are certain where you are, is often more accurate than the average reading from the GPS unit. **Specify whether in feet or meters.**

Slope
Measure the slope in **degrees** using a clinometer.

Aspect
Measure the plot aspect using a compass (set for local magnetic declination). Set your compass each day to the declination indicated on the topo sheet you are using and leave it there.

Topographic Position
You may only choose from the following:

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

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

Landform

Enter the landform(s) that describes the site where the plot was sampled. Referring to the topo map for the landscape context may help you decide what landform(s) to choose. Note that the landform choices describe different scales, thus one can select more than one for a plot (e.g., mountain for the macro scale and ridge for the meso scale. As much as possible choose from the list below. (Source: http://www.statlab.iastate.edu/soils/nssh/629.htm.)

Alluvial fan. A low, outspread mass of loose and/or rock material, commonly with gentle slopes, shaped like an open fan or a segment of a cone, deposited by a stream 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 upstream apex and slopes gently and convexly outward (downstream) with a gradual decrease in gradient.
Alluvial flat. A nearly level, graded, alluvial surface in a closed or nearly-closed basin which commonly does not manifest traceable channels, terraces or floodplain levels.
Arroyo. The channel of a flat-floored, ephemeral stream, commonly with very steep banks cut in unconsolidated material; sometimes called a wash. It is usually dry but can be transformed into a temporary watercourse or short-lived torrent after heavy rain within the watershed. Where arroyos intersect zones of ground-water discharge, they are classed as intermittent stream channels.
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 (usually clays and silts) sometimes with soluble minerals such as gypsum or halite.
Bajada. 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.
Bank. The steep outer edge of an active channel system.
Basin. A general term for the nearly level to gently sloping bottom 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 outer piedmont slopes.
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, and do not represent a stage of flood-plain development following an episode of valley trenching.

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 vegetation is disturbed or destroyed; the adjoining accumulation of sand derived from the depression, where recognizable, is commonly included.

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 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.

Butte. An isolated, generally flat-topped hill or mountain with relatively steep slopes and talus or precipitous cliffs and characterized by summit width that is less than the height of bounding escarpments, commonly topped by a caprock of resistant material and representing an erosion remnant carved from flat-lying strata.

Canyon. A long, deep, narrow, very steep-sided valley cut primarily in bedrock with high walls in mountainous terrain or in a high plateau, often with a perennial stream at the bottom; larger than a gorge.

Channel. The bed of a single or braided watercourse that is generally barren of vegetation and 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.

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

Colluvial Slope. A slope formed of material or by processes associated with transportation and/or deposition by mass movement and local, unconcentrated runoff.

Cuesta. An asymmetric ridge capped by resistant rock layers of slight to moderate dip (usually 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.

Debris flow. The process, associated sediments (debris flow deposit) or resultant landform characterized by 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.

Dike. A tabular igneous intrusion that cuts across the bedding or grain of the country rock.

Dune. A low mound, ridge, bank or hill of loose, windblown, 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.

Eolian deposit. Sand, silt or clay-sized material transported and deposited primarily by wind, commonly in the form of a dune or a sheet of sand or loess.

Escarpment. A continuous and steep slope or cliff produced by erosion or faulting that topographically interrupts the general continuity of more gently sloping land surfaces.

Fan remnant. A general term for landforms that are the remaining parts of older landforms such as alluvial fans, fan aprons, inset fans, and fan skirts, that either have been dissected or partially buried. 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.

Floodplain. 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.

Gap. A break or opening in a mountain ridge, or a short pass through a mountain range.

Gorge. 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.

Hill. A generic term for an area of the land surface rising at least 30 m to as much as 300 meters 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. Informal distinctions between a hill and a mountain are often arbitrary.

Hogback. A sharp-crested ridge or highly tilted resistant rock layers; produced by differential erosion of interlayered resistant and weak rocks with dips greater than about 25°.

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 and whose channel is generally below the local water table; it flows only a) during wet periods, or b) as a result of ground-water discharge or protracted contributions from melting snow or other erratic surface and subsurface sources.

Knob. 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.

Landslide. A general 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. Landslide types generally reflect the dominant process and/or the resultant landform. The main operational categories of mass movement are *fall* (rockfall), *slide* (rotational landslide, debris slide), *flow* (especially debris avalanche, debris flow), and *complex landslides*.

Meander scroll. One of a series of long, parallel, 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.

Mesa. A broad, nearly flat-topped, and usually isolated landmass bounded by steep slopes or cliffs and capped by layers of resistant, nearly horizontal, rocky summit width greater than the height of bounding escarpments.

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 bedrock 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.

Mud flat. A level area of fine grained material (e.g. silt) along a shore or around an island, alternately covered and uncovered by shallow water, and barren of vegetation.

Overflow stream channel. A watercourse that is generally dry but conducts flood waters that have overflowed the banks of a river during large storms or meltwater events.

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 developed 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.

Piedmont. (Noun) An area, plain, slope, or other feature at the base of a mountain; e.g., a foothill or a bajada. (Ad.j) Lying or formed at the base of a mountain or range; e.g., a piedmont terrace or a piedmont pediment.

Plain. A general term referring to any flat lowland area at a low elevation. Specifically, any extensive region of comparatively level to gently undulating land. A plain has few or no prominent hills or valleys but sometimes has considerable slope. 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 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. Temporary flooding occurs in response to precipitation-runoff events. Playa deposits are fine grained and may or may not have a high water table and saline conditions.

Ravine. A small stream channel; narrow, steep-sided, commonly V-shaped in cross section and larger than a gully, cut in unconsolidated materials.

Ridge. A long elevation of the land surface forming an extended upland between valleys, usually sharp crested with steep sides. The term is used in both hill and mountain areas.

Rim. The border, margin or edge of a landform; specifically the rim of a plateau or canyon.

River. A general term for a natural surface stream of some volume and generally with a permanent base flow,

moving in a defined channel toward a larger river or lake.
Rockfall. The process, associated sediments 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.
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.
Saddle. A low point on a ridge or interfluve, generally a divide (pass, col) between the heads of streams flowing in opposite directions.
Scree slope. A portion of a hillside or mountain slope mantled by scree and lacking an up-slope rockfall source (i.e. cliff).
Seep. An area, generally small, where water percolates slowly to the land surface.
Slide. A category of mass movement processes, associated sediments (slide deposit) or resultant landforms (e.g., rotational slide, translational slide, and snowslide) characterized by a failure of earth 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, or human agencies.
Slot canyon. A long, narrow, deep and tortuous channel or drainageway with sheer rock walls eroded into sandstone or other sedimentary rocks subject to flash flood events; depth to width ratios exceed 10:1 over most of its length and can approach 100:1.
Slough. A small marsh, or marshy area lying in a local, shallow, closed depression on a piece of dry land.
Stream terrace. One or a series of platforms in a stream valley, flanking and more or less parallel to the stream channel, originally formed near the level of the stream, and representing the remnants of an abandoned flood plain, stream bed, or valley floor produced during a former state of fluvial erosion or deposition (i.e., now rarely or never floods). Remnants of constructional valley floors thickly mantled with alluvium are called alluvial terraces.
Swale. 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 (cumulic) compared to surrounding soils.
Talus slope. A portion of a hill slope or mountain slope mantled by talus and lying below a rock source.
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, floodplain 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.

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 may help, but if you can't tell the geology at all, put a general description, such as "coarse sandstone", "green shale", "thin-bedded limestone" "soil obscures geology".

The table below describes the geologic stratigraphy of Dinosaur NM. It is derived from the Dinosaur geology map and from Foos 2000. Units are in stratigraphic order, with youngest deposits on the top of the list.

Age & Map Symbol	Name	Appearance	Where to Find It
Quaternary Qa	Alluvium	Sand and silt on a valley floor near a stream	Floodplains & terraces of Yampa & Green rivers
Qe	Eolian sands	Sandy upland areas, often with Stipa comata	West Cactus Flat, Yampa Bench.

Q1 and Qtc	Talus and landslide deposits	Lumpy surface; fine and coarse materials mixed	Warm Springs Cedars
Qoa	Older alluvium	Alluvial sands and gravels isolated from valley floors	McKee Bench, Douglas Mountain
Tertiary Tbp	Browns Park Formation	White cross bedded sandstone with chert & conglomerate	Benches around Gates of Lodore campground
Tb	Bishop Conglomerate	Coarse pink to gray sandstone & conglomerate	Mitten Park, Bear Valley; summit of Diamond Mtn
Unconformity			
Cretaceous Kms (Mancos Group)	Mancos Shale (aka Cedar Mountain)	Dark gray to yellowish shale with thin sandstone lenses.	Utah monument entrance station; slopes ringing Deerlodge Park
Kmf (Mancos Group)	Frontier Sandstone	Limy sandstone with dark shale & coal beds.	Slopes west of Calico Draw
Kmm (Mancos Group)	Mowry Shale	Dark gray marine siliceous shale with abundant fish scales	Narrow exposures; e.g., hogback on west edge of Deerlodge Park
Kd	Dakota Sandstone	Conglomeratic sandstone with carbonaceous shale	Hogback south of HQ (Colorado side)
Unconformity			
Jurassic Jm and KJcm	Morrison Formation, Cedar Mountain Form.	Green, maroon & gray marls & dinosaur-bearing conglomeratic sandstone	Dinosaur Quarry (Utah side)
Jsr and Jsc (San Rafael Group)	Stump Formation: Curtis Memb & Redwater Memb	Greenish gray, sandy at base, with shale & oolitic limestone in the upper part	Narrow belts below Morrison
Je (San Rafael Group)	Entrada Sandstone	Mostly pink, cliff-forming, crossbedded sandstone	Mouth of Split Mountain Canyon; rare
Jca (San Rafael Group)	Carmel Formation	Red siltstone & shale with gypsum.	Mouth of Split Mountain Canyon; rare
Unconformity			
Jurassic Jn (Glen Canyon Group)	Navajo Sandstone Glen Canyon SS	Buff to red medium grained, crossbedded sandstone.	Boone Ridge; Redrock Bench (Yampa Bench)
Unconformity			
Triassic Trc	Chinle Formation	Red shale, marl & siltstone with sandstone & conglomerate	Upper Franklin Draw
Trcg	Shinarump Conglomerate	Light buff to yellow, coarse sandstone & conglomerate.	The Billiard Table
Unconformity			
Trm	Moenkopi Formation	Red, limy & gypsiferous shale & sandstone with abundant ripple marks.	The White Sage Flats; western Yampa Bench
Unconformity			
Permian Ppc	Park City Formation	Light gray, thin bedded fossiliferous limestone, limy sandstone & gray, red & yellowish shale with phosphate nodules	Pearl Park; SW face of Diamond Mountain
Pennsylvanian Pw	Weber Sandstone	White to light gray or buff crossbedded sandstone.	Stuntz Ridge
Pmu, Prv	Morgan Formation, Round Valley Limestone	Interbedded gray limestone & white to red sandstone, limy shale, & limestone at the base.	Round Top Mountain, outer layers of Split Mountain

Unconformity			
Mississippian Mu, Mdh,	Manning Canyon Shale, Madison, & Humbug limestone	Limestone, dolomite & carbonaceous shale.	Summit and south flank of Douglas Mountain
Unconformity			
Cambrian C1	Lodore Formation	White to red, coarse grained, quartzitic & arkosic sandstone with silty shale interbeds.	Whirlpool Canyon (Green River), Jones Hole
Unconformity			
Precambrian Yu, Yus	Uinta Mountain Group	Red to white, coarse grained quartzitic & arkosic sandstone & conglomerate with thin beds of shale.	Gates of Lodore

Use the gradsect lumped types if you can't determine the Dinosaur geology map type:

1. **Recent alluvium** in canyon bottoms.
2. **Semi-consolidated sediments on uplands**, including Browns Park Fm, dune sand, eolian sand, sediments of East Cactus Flats
3. **Semi-consolidated sediments**, including debris fans, dissected fans older debris fans, pediments, river-terraces, talus, alluvial fans, other undifferentiated colluvium, terrace deposits.
4. **Landslide** deposits.
5. **Red sandstones** (Entrada and Glen Canyon).
6. **Madison limestone**
7. **Brightly colored, badland-forming shales** (Chinle, Doughnut, Moenkopi, Carmel, Park City)
8. **Morrison and Mowry shales;** thin acid shales.
9. **Thinner bedded white sandstones and limestones**, often interbedded with layers of shale (Morrison Fm, Castlegate Sandstone, Cedar Mountain Fm, Buckhorn Conglomerate, Chinle Fm, Dakota Sandstone, Iles Formation, Frontier Sandstone, Mesa Verde Group, Stump Formation, Curtis Fm, Stump Fm
10. **Mancos shale**, thick gray shale.
11. **Older white sandstones and limestones** (Weber, Morgan, Round Valley)
12. **Lodore Formation and Uinta Mountain Group** of Precambrian quartzites and massive red, pink or gray sandstones.

Cowardin System

If the system is a wetland, check off the name of the USFWS system which best describes its hydrology and landform. Use “upland” if the system is not a wetland. Assess the hydrologic regime of wetland plots using the descriptions below (from Cowardin et al. 1979).

Permanently flooded. Water covers the land surface at all times of the year in all years.
Semipermanently flooded. Surface water persists throughout growing season in most years except during periods of drought. Land surface is normally saturated when water level drops below soil surface.
Seasonally flooded. Surface water is present for extended periods during the growing season, but is absent by the end of the growing season in most years. The water table after flooding

ceases is very variable, extending from saturated to a water table well below the ground surface.
Saturated. Surface water is seldom present, but substrate is saturated to surface for extended periods during the growing season.
Temporarily flooded. Surface water present for brief periods during growing season, but water table usually lies well below soil surface. Often characterizes flood-plain wetlands.
Intermittently flooded. Substrate is usually exposed, but surface water can be present for variable periods without detectable seasonal periodicity. Inundation is not predictable to a given season and is dependent upon highly localized rain storms. This modifier was developed for use in the arid West for water regimes of playa lakes, intermittent streams, and dry washes but can be used in other parts of the U.S. where appropriate. This modifier can be applied to both wetland and non-wetland situations.
Unknown. The water regime of the area is not known. The unit is labeled a non-tidal wetland.

Environmental Comments
Enter any additional noteworthy comments on the environmental setting and its effect on the vegetation (e.g. shallow soils=stunted trees). This field can also be used to describe site history such as fire events (evidence of severity) as well as other disturbance or reproduction factors.

Soil Taxon/Description
We will not be keying soils for this project. Use this space to note whether or not the soil is rocky and whether or not large rocks or rock outcrops are present on the surface.

Unvegetated Surface
Estimate the approximate percentage of the *total* surface area covered by each category to the nearest 5%. Put a zero (0) in fields that have no cover. Live veg counts as litter or as wood. The sum of the cover values should equal 100%.

Soil Texture
Using the key below, assess average soil texture (Brewer and McCann 1982) from a sample taken a few inches below the surface. An abbreviated version of this key is on the cheat sheet.

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

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

Squeeze the ball between your thumb and forefinger, attempting to make a ribbon that you push up over your finger.
2a. Soil makes no ribbon but leaves your fingers dirty..... **loamy sand**
2b. Soil makes at least a very short ribbon 3

3a. Ribbon extends less than 1 inch before breaking..... 4

3b. Ribbon extends 1 inch or more before breaking 5

4a. Add excess water to small amount of soil. Soil feels at least slightly gritty ..... **loam or sandy loam**
4b. Soil feels smooth ..... **silt loam**

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

6a. Add excess water to small amount of soil; soil feels at least slightly gritty ..... **sandy clay loam or clay loam**
6b. Soil feels smooth ..... **silty clay loam or silt**

7a. Add excess water to a small amount of soil; soil feels at least slightly gritty ..... **sandy clay**
7b. Soil feels smooth ..... **silty clay or clay**

Soil Drainage

Soil drainage classes are defined in terms of (1) actual moisture content in excess of field moisture capacity and (2) the extent of the period during which excess water is present in the plant-root zone. Permeability, level of groundwater, and seepage are factors affecting moisture status. However, because these are not easily observed or measured in the field, they cannot generally be used as criteria of moisture status. 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 precipitation. Nearly all of the soils at Dinosaur outside of wetlands, springs and floodplains will fall into this category. Rapidly drained soils are commonly coarse textured or soils on steep slopes located well above the water table. ***These soils are characterized by strictly upland species.***

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

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

Somewhat poorly drained. The soil moisture in excess of field capacity remains in subsurface horizons for moderately long periods during the year. Soils are commonly mottled in the B and C horizons; the Ae horizon, if present, may be mottled. The matrix generally has a lower chroma than in the well-drained soil on similar parent material.
Poorly drained. The soil moisture in excess of field capacity remains in all horizons for a large part of the year. The soils are usually very strongly gleyed. Except in high-chroma parent materials the B, if present, and upper C horizons usually have matrix colors of low chroma. Faint mottling may occur throughout.
Very poorly drained. Free water remains at or within 12 inches of the surface most of the year. The soils are usually very strongly gleyed. Subsurface horizons usually are of low chroma and yellowish to bluish hues. Mottling may be present but at the depth in the profile. Very poorly drained soils usually have a mucky or peaty surface horizon.

VEGETATION DESCRIPTION

Leaf Phenology

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

Evergreen. Greater than 75% of the total woody cover is never without green foliage. This class includes sagebrush as well as conifers.
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 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 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). E.g., mountain mahogany, Fremont cottonwood, big sagebrush.
Needle-leaved. Woody vegetation primarily needle-leaved (generally contributes greater than 50 percent cover). E.g., common juniper, juniper, pinyon, Douglas-fir.
Microphyllous. Woody cover primarily microphyllous, e.g., Ephedra spp.
Graminoid. Herbaceous vegetation composed of more than 50 percent graminoid species (grasses, sedges, rushes).
Forb (broad-leaf-herbaceous). Herbaceous vegetation composed of more than 50% broad-leaf forb species. E.g., rockmat, dandelion, *Petradoria*, *Phlox*.
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.

Physiognomic Class

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 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 5% 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, respectively
Shrub Herbaceous. Low or taller shrubs forming approximately equal cover with a grass or forb component. Individuals or clumps of shrubs generally not touching and usually forming more than 25% cover; trees less than 10% cover. Spaces between shrubs are generally mostly occupied by grasses and/or forbs.
Herbaceous. Perennial herbs (graminoids or forbs) dominant (generally forming at least 25% cover; trees, shrubs, and dwarf-shrubs generally with less than 10% cover). Herb cover may be less than 25% where it exceeds tree, shrub, dwarf-shrub, and nonvascular cover.
Nonvascular. Nonvascular cover (bryophytes, non-crustose lichens, and algae) dominant (generally forming at least 10% cover). Nonvascular perennial vegetation cover may be less than 10% , as long as it exceeds tree, shrub, dwarf-shrub, and herb cover.
Sparse Vegetation. 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% and greater than 0%. Badlands or sand dunes supporting communities of annual plants should be included in this category, regardless of cover.

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 12-point 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. The exception is mature pinyon and juniper plants, which are considered trees regardless of height.

Herbaceous layers are **Ht** = total, **H1** = Graminoids, **H2** = Forbs, **H3** = Ferns and Fern allies, and **H4** = tree seedlings. List the dominant species in each stratum.

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	l-2 m
2	15-25%	04	2-5 m
3	25-35%	05	5-10 m
4	35-45%	06	l0-l5 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 evidence of use of the plot/polygon by non-domestic animals (i.e., tracks, scat, gopher or prairie dog mounds, etc.). Domestic animal use should be made in the next field.

Natural and Anthropogenic Disturbance
Comment on any evidence of natural or anthropogenic disturbance and specify the source, severity and effects on the vegetation.

Other Comments
Any other comments, or continue comments from other sections. Describe the landscape context of the community. What are the adjacent communities? Are there any other landscape features or processes influencing this community?

Species Percent Cover Table
Starting with the uppermost stratum, list all the species present and their 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 E (epiphyte).

For plots with trees (ponderosa or Douglas-fir), 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 trees with vertical stems less than 1.5 m tall, but that may vary by species. Saplings are taller than 1.5m but less than 10 cm in diameter.

DBH and Fuels Data Form
Using Photo Series Guides (Sagebrush, Pinyon-juniper, Ponderosa and Douglas-fir plots). Record the page number of the photo that most closely resembles your plot in terms of

vegetation structure and fuel on the ground.

Litter and Duff Loading (Ponderosa Pine and Douglas-fir plots only). Within each plot, take five measurements of the litter and duff layers: at the plot center and at 20m north, east, south and west of the origin. Use a trowel to expose a profile of the forest floor and measure the depth of the litter and duff layers.

Canopy Fuel Loading (Ponderosa Pine and Douglas-fir plots only). Information on stand structure and canopy characteristics is needed to model the potential for crown fire behavior. This information is of great importance in making fire management decisions. For each tree within a plot, record this information on the data sheet:

- **Diameter at breast height** (4.5 feet)
- **Tree species**
- **Tree height** in meters. Only representative trees need be measured. Others can be estimated.
- **Crown ratio** (ocular estimate of the ration of crown length to total tree height)
- **Crown base height** (in meters, the height of the lowest live branch which can cause vertical movement of fire into the crown).
- **Tree structural stage:**
    a. **Dominant** (we call this "emergent"). Trees with crowns extending above the general level of the canopy, receiving full light from above and partly from the side; significantly larger than the average tree in the stand.
    b. **Codominant** (we call this "canopy"). Trees with crowns forming the general level of the canopy, receiving full light from above but comparatively little from the sides.
    c. **Intermediate** (we call this "subcanopy"). Trees shorter than those in preceding classes with crowns below or extending into the canopy, receiving little light from above.
    d. **Suppressed** (we call these seedlings and saplings). Trees with crowns below the general level of the canopy, receiving no direct light from above.

IMPORTANT!! When you encounter a concentration (>5 trees) of 1000-hour fuels (>3" in diameter) ANYWHERE in the project area, please GPS the center of the occurrence and take a photograph of it.

In plots containing pinyon and/or juniper trees, record the species and diameter at root crown (ground level) of all stems belonging to trees taller than 4.5 feet. Also record crown width and crown height in meters. If there are more than about 25 trees more than 4.5 feet tall, divide the plot into quarters and measure the DBH of trees in the southeast quadrant. NOTE on the form that this is what you've done.

Pinyon-juniper Age Class. If you are in a plot that contains pinyon and/or juniper trees (whether or not you have placed the plot in a P-J alliance/association), check the box that best describes the age class of the stand based on these criteria:

Old-growth (>500 years). Ancient trees with flat crowns, much dead wood, dead trees on

ground, some younger trees occupying canopy gaps. "You know it when you're in it". Is extremely rare in Dinosaur.

Mature (350-500 years). Large old trees with flat crowns, some with gnarled trunks, lightning scars and dead wood, others without. Tends not to have much understory, depending on soils.

Young (100-500 years). Developed canopy of large trees, but some or all junipers have pointed crowns. Generally there tends to be a well-developed understory of shrubs and sometimes forbs and grasses.

Invasive (<80 years). Scattered smaller trees, all with pointed crowns, in a community clearly dominated by shrubs or grasses.

******CONGRATULATIONS! YOU'VE COMPLETED A PLOT FORM!******

CONSIDERATIONS FOR MISSION PLANNING

Planning for the day:

1. Safety and sustenance: Plenty of food, water, first-aid kit, raingear.
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 Tamara or Janet know the general 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? Needs new batteries?).
5. Plan the day's mission before departing using a) USGS quads, b) aerial photo, c) park/BLM maps.
6. Considerations for mission planning:
   a. Plan travel based on topography, best access routes, density and complexity of vegetation (more time for forest and woodland plots, less for herbaceous and scrub).
   b. Plan data collection based on priority needs; new types get higher priority.
   c. Communicate with the other team(s) to make sure you aren't duplicating effort.

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

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

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

1. Clean, recharge and repair equipment.
2. QC and complete field forms and file them in a manila folder labeled with the dates of the trip, the names of the team members, and the plot numbers the file contains. File observation points in a separate folder labeled appropriately.
3. Re-file the photos you no longer need.
4. Key unknown plants (go to BLM in Vernal if necessary).
5. Download GPS waypoints, onto laptop. Give the download file a name following this format: DINO_initials of the team member doing the download_PLOTS+sequential number starting with 1 for the first download. (E.g., DINO_jjc_PLOTS1). Save observation points in a separate file with a name based on the model DINO_jjc_OBS1.
6. Download digital images onto CDs as jpg images.

Communicate among teams

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 to Janet 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
- Maps of BPU locations
- Geology map
- Aerial photos
- DBH tape
- 2 tape measure(s)
- Compass with adjustable declination
- Clinometer
- GPS
- Plenty of AA batteries for GPS and walkie talkie
- Radio or walkie talkie and/or cell phone
- 35 mm camera & film (allow at least 2 exposures per plot plus general and scenic photos)
- Digital camera with extra battery and memory card.
- Monopod for digital camera
- Baggies for temporary storage of unknown plants
- Plant press & paper
- Flora(s)
- Masking tape for labeling baggies/plants
- Pens / sharpies / dry erase marker
- Forms: (1) plot survey, (2) fuels inventory, (3) observation point
- Clipboard/forms holder and clear page protector sleeve
- Pens and pencils and dry-erase markers (for map board)
- Most recent version of provisional classification of the park, with the number of plots still needed per type (updated approx. every 2 weeks)
- All ancillary information (cheat sheet, species list, floras, sampling priority list for zone, fuels protocol, main sampling protocol).

DINOSAUR PLOT CHEATSHEET

LANDFORM
Alluvial fan
Alluvial flat
Arroyo
Badlands
Bajada
Bank
Basin
Bench
Blowout
Box canyon
Butte
Canyon
Channel
Cliff
Colluvium Slope
Cuesta
Debris flow
Deflation basin
Depression
desert pavement
Dike
Draw
Dune
Eolian deposit
Escarpment
Fan remnant
Flood plain
Gap
Gorge
Gully
Hill
Hogback
Interfluve
Intermitt. stream
Knob
Knoll
Landslide
Meander scroll
Mountain
Mud flat
Overflow channel
Peak
Piedmont
Plain
Plateau
Playa
Ravine
Rim
River

LANDFORM
Rockfall
Rotational slide
Saddle
Scree slope
Seep
slide
Slot canyon
Slough
Stream terrace
Swale
Talus slope
Terrace
Valley floor
Valley side
Wash

ASPECT
Flat
Azimuth (deg.)
Variable

PLOT SIZE
400m^2 (11.3m r):
Forests
Woodlands
Shrublands

100m^2 (5.6 m r):
Dwarf Shrublands
Shrub-Herbaceous
Herbaceous

25m^2 (2.8m r):
Non vascular

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

TOPOGRAPHIC POSITION

Designation	Synonym(s)
• Interfluve	crest, summit, ridge
High slope	shoulder slope, upper slope
High level	mesa, plateau
Midslope	transportational midslope,
Backslope	dipslope, cliff
Step in slope	ledge, bench
Lowslope	lower slope, foot slope
Toeslope	alluvial toeslope
Low level	terrace, valley floor, floodplain

SEE ALSO THE DIAGRAM OTHER SIDE

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

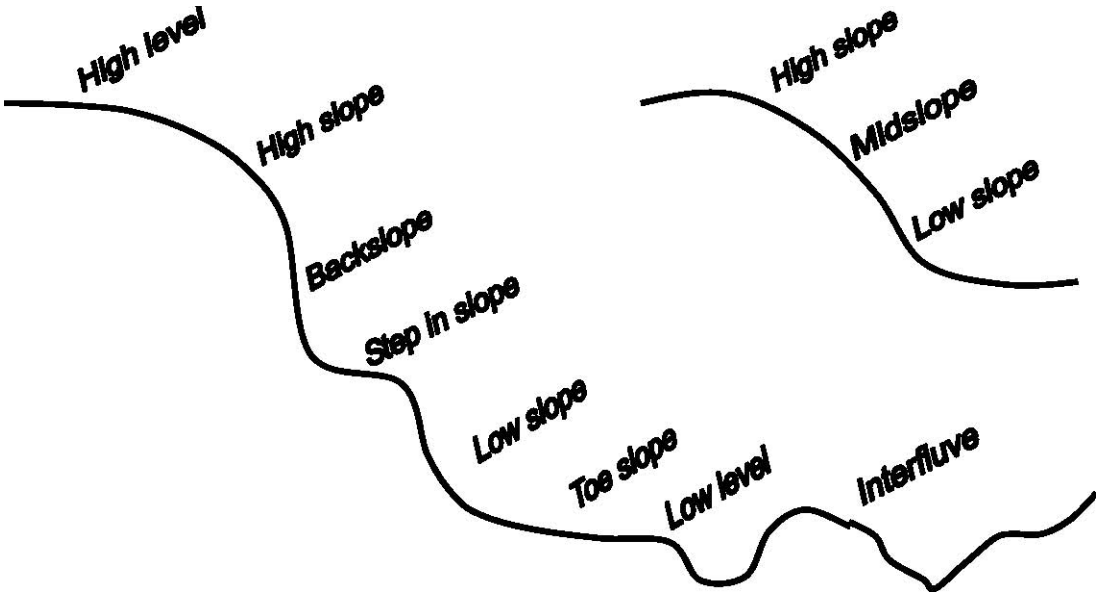
PARK SPECIALS (keep an eye out for)
Hackberry stands
Rare plants
Raptor nesting sites
Hanging gardens
Upland springs and seeps
Flammable historic/archaeologic sites
Invasive weeds (ignore cheatgrass, dandelions)
Abandoned agricultural fields (e.g., old alfalfa)

Physiognomic Class
Forest: Crowns touching
Woodland: Trees>25%, crowns not touching
Shrubland: Shrubs> grass, forbs or trees
Dwarf Shrubland: Shrubland <0.5 m tall
Shrub Herbaceous: Shrubs = Forbs/grasses
Herbaceous: Grass/forbs > trees or shrubs

SOIL TEXTURE
Sand: clean, no ball
Loamy sand: ball, no ribbon
Sandy loam: gritty weak ribbon
Silt loam: smooth weak ribbon
Clay loam: long ribbon, no ring
Clay: smooth ribbon/ring, edible
Sandy Clay; gritty ribbon & ring
Silty Clay: smooth ribbon/ring
Peat: still has plant parts
Muck: smelly black ooze

IMPACTS
Recent fire suppression activity
Fire
Mountain pine beetle damage
Mistletoe (specify tree species)
Grazing evidence
Ground squirrel/prairie dog
Development
ORV use, off road
Recreation (campsites, etc.)
Wildlife concentration effects

SURFICIAL GEOLOGY
Obscured by soil
Eolian sands
New alluvium
Talus/colluvium/landslides
Old alluvium
Browns Park Formation
Bishop Conglomerate
Mancos shale
Frontier Sandstone
Mowry Shale
Dakota Sandstone
Morrison/Cedar Mountain Fm
Curtis/Stump Fm
Entrada Sandstone
Carmel Shale
Glen Canyon Sandstone
Chinle Shale
Shinarump Cg
Moenkopi Shale
Park City Formation
Weber Sandstone
Morgan/Round Valley Form.
Humbug/Doughnut shale
Madison Limestone
Lodore Formation
Uinta Mountain Group


High level
High slope
Backslope
Step in slope
Low slope
Toe slope
Low level
Interfluve
High slope
Midslope
Low slope

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 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 can't be classified 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 mark the location of the AA points and 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 truck so you can find your way back!*

Use the GPS unit to navigate 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). 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 crew will key the vegetation to plant association within half a hectare around each point. If a map unit key is available, 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 contains field-by-field instructions for AA point data collection and completing the AA Point Data Form. Upon arrival at an AA point, 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 (see 3D differential, below). If a Trimble unit is used, 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 appear at the end of this section to assist 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. An example of 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:
Record the full name of the 7.5 minute quadrangle.

County, State:
These fields will be completed in the office.

Park Site Name:
This is best determined from the topographic map. Select a nearby feature that is an obvious landmark, such as the name of a canyon, road, arch, etc. 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.

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.

Primary, Secondary Map Unit (DINO only):
For Dinosaur National Monument only, a key to map units will be provided. Use this key to determine the map unit of the AA point being sampled, and enter this under Primary Map Unit. If borderline, enter one map unit under Primary Map Unit, and the other under Secondary Map Unit.

Map Unit Comments (DINO only):
Provide a brief description of any difficulties in assigning the AA point/polygon to a map unit in the key.

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 would be useful to assign a name that incorporates the AA point number.

Field UTMX, Field UTMY
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 ±50m), 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 UTMs 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 manually derived from a NAD27 USGS topographic map please check the appropriate 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 accurately on the topo map, using triangulation from a high point.
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 code of the AA point, 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 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 UTMs record 'none' here and be sure to complete the 'GPS Comments' field below.

GPS Error
Note the PDOP (or "Estimated Position Error" (EPE), if 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 the location coordinates are as accurate as possible. It is in geosynchronous orbit in the

southern sky, so if the southern sky is visible, one will generally be able to get 3D differential. This system is known as the Wide-Area Augmentation System, or WAAS. The Garmin and Trimble units have a field in their setup pages for turning WAAS on or off. Please make sure that WAAS is **always** on.

GPS Comments:
VERY IMPORTANT: If the field investigator resorted to estimating the AA point location UTMs 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 one or 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, log all photographs for photos taken outside of AA points. Crews are not expected to routinely take additional photos, however, if they encounter a new vegetation type or a scenic view, please document with a photograph.

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 after all the vegetation information has been collected. Use the environmental, stratum and cover data to 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 site is borderline between two associations, write another association name in the secondary association field. A tertiary name field exists for the few occasions where a third call is needed. If vegetation near point does not key well, make an 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 the vegetation does not fit anything in the key, create a new name based on the dominant species in each stratum (as would be done for a plot). Characterize the new association in the comments field.

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

Other Vegetation Associations Within 50 m
List other associations that are within 50m of the outer edge of the half-hectare AA plot 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 then 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 with a clinometer (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 rolling microtopography, 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, (refer to 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 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 cliffs.
Step in slope (ledge, terracette). Nearly level shelf in a steep slope, rock wall, or cliff face.
Lowslope (lower slope, foot slope, colluvial footslope). 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, 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, 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 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 are best 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, respectively.
Shrub Herbaceous. Low or taller shrubs forming approximately equal cover with a grass or forb component. Individuals or clumps of shrubs generally not touching and usually forming more than 25% cover; trees less than 10% cover. Spaces between shrubs are generally mostly occupied by grasses and/or forbs.
Wooded Herbaceous. Trees forming approximately equal 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.

PLANT SPECIES LIST (record information for *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 Douglas-fir or cottonwood trees would be a good example of T2"canopy", but if they are absent begin with the shrub stratum or herbaceous stratum if no shrubs are present. If the tree crowns at the AA point are mostly touching and similar in height, but a given tree species is much taller that species would be a T1"emergent." As another example, a sample area may be characterized by several tall scattered cottonwoods and then shorter scattered junipers. In this case, the cottonwoods would be the "canopy" and the junipers would be the "subcanopy". There may also be cottonwoods listed in the "subcanopy" layer, if there are a number of short saplings in addition to mature tall trees.

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 typically 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, 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" species. We want to avoid some crew members calling *Leptodactylon* a forb and some calling it a dwarf shrub; this goes 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 an asterisk '*'.

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.

DINOSAUR NATIONAL MONUMENT – AA CHEAT SHEET

LANDFORMS

alluvial fan
alluvial flat
alluvial plain
remnant
alluvial terrace
alluvium
artificial levee
backslope
badlands
bajada
ballena
ballon
basin
basin floor
bench
blowout
bluff
bolson
borrow pit
bottomland
box canyon
braided stream
break
butte
canyon
channel
cliff
climbing dune
closed depression
colluvium
crest
cuesta
debris flow
deflation basin
depression
desert pavement
dike
dip
ditch
divide
dome
drainageway
draw
dune
dune field
earthflow
eolian deposit
eolian sands
ephemeral stream
escarpment
falling dune
finger ridge
flat
flood plain
foothills
gorge
gravel pit
gully
hanging valley
hill
hillslope
hogback
hummock
interdune
interfluve
intermittent stream
island
knob
knoll
lakebed
lakeshore
landslide
ledge
levee
meander belt
mesa
mountain
natural levee
overflow channel
oxbow
pediment
perennial stream
plain
plateau
playa
point bar
pool
quarry
ravine
reef
ridge
rise
rim
rockfall
saddle
sand ramp
sand sheet
scarp
scree slope
shoulder
side slope
slope
slope alluvium
slot canyon
stream terrace
summit
swale
talus slope
tank
terrace
terracettes
toeslope
valley
valley floor
valley side
wash (dry wash)

TOPOGRAPHIC POSITION

SEE THE DIAGRAM ON THE OTHER SIDE

VEGETATIVE STRATA

T1 = emergent tree
T2 = tree canopy
T3 = tree sub-canopy
S1 = tall shrub > 2m
S2 = short shrub < 2m
S3 = dwarf shrub < 0.5m
H = herbaceous
H4 = Tree seedlings
N = nonvascular other than ferns

PARK SPECIALS (keep an eye out for)

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

PHYSIOGNOMIC CLASS

Forest: Crowns touching
Woodland: Trees>10%, crowns not touching
Shrubland: Shrubs > grass, forbs or trees
Dwarf Shrubland: Shrubland <0.5 m tall
Shrub Herbaceous: Shrubs = Forbs/grasses
Herbaceous: Grass/forbs > trees or shrubs
Wooded Herbaceous: Trees= grass/forbs
Sparsely Vegetated: Total veg<5-7%

ASPECT

Flat
Azimuth (deg.)
Variable

GPS SETTINGS

NAD1983
WAAS on (Trimble Units)

DO NOT HOLD DOWN OFF BUTTON ON TRIMBLE GEOXM GPS UNITS!

Instructions for entering waypoint into Trimble GPS unit

1. Open a Point_generic (don't log points)
2. Go to Map screen
3. Change arrow in pulldown menu to "digitize" mode
4. Under options, select "enter coordinates", then enter UTMs, hit OK
5. Go back to data screen, enter name for the waypoint and close it.

SURFICIAL GEOLOGY

Obscured by soil
Aeolian sands
Alluvial deposits (new)
Older Alluvium (pre Holocene)
Talus / Colluvium / Landslides
Carmel Shale
Cedar Mountain Formation
Chinle Shale
Curtis/ Stump Formations
Dakota Sandstone
Entrada Sandstone
Frontier Sandstone
Gartra Member/ Shinarump
Glen Canyon Sandstone
Humbug/ Doughnut Shale
Lodore Formation
Madison Limestone
Mancos Shale
Moenkopi Shale
Morgan/ Round Valley Formation
Morrison Formation
Mowry Shale
Park City Formation
Uinta Mountain Group
Weber Sandstone

DISTURBANCE

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

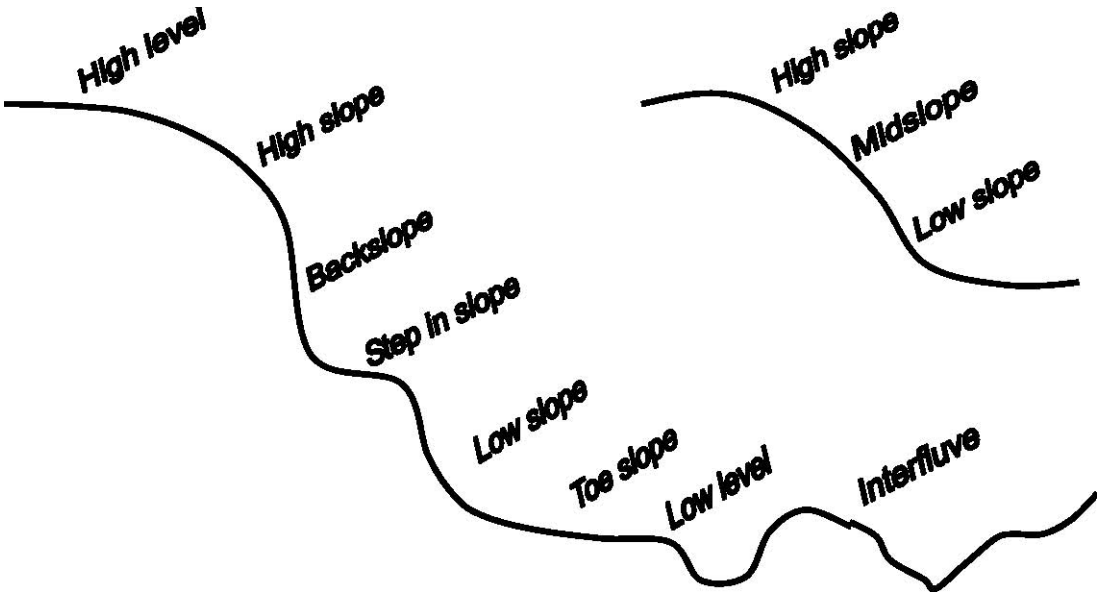
To select a Trimble waypoint

1. From data screen, change "collect" in pulldown menu to "update"
2. Under Options, select "Set Nav Target"

Go to navigation screen to navigate to your selected point

Note: You can also navigate by using the map screen on the Trimble GPS unit. If all the AA points are loaded ahead of time, they will appear on the screen along with a red X, which is your location.

TOPOGRAPHIC POSITION - CHEAT SHEET
BACK PAGE



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 B.3. Example of a Vegetation Plot Data Form

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

Plot Code DINO. 436 BPU Code 69226
Provisional Community Name WYOMING SAGE
State UT Park Name DINOSAUR NM Park Site Name THE REEF
Quad Name JENSEN RIDGE Quad Code 40108 Quad Code 40109 E3 Aerial Photo # 101 39
GPS file name DP436 Field UTM X 640270 m E Field UTM Y 4485073 m N
DATUM NAD 83 UTM Zone: (12T) / 13T (circle one) Error +/- 6.8 m 3D Differential? (Y) / N
Comments/GPS device used:

Survey Date 6 8 02 Surveyors BRUCE SARAH
Directions to Plot
FROM ISLAND PARK ROAD TAKE 2-TRACK NORTH FROM PIPELINE, FOLLOW 2-TRACK EAST ACCROSS PIPELINE. WHEN ROAD TURNS NORTH, PARK AND WALK S.E. TO PLOT

Plot length(m)_____ Azimuth _____ Plot width(m)_____ Diameter if circle 11.3 m Plot Photos (y/n) __ Roll # BS3 Frame # 23,24
Plot Permanent: NO Photo comments: Digital camera frame # _____

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

b. Representativeness of plot in stand: POLYGON SEEMS TO REPRESENT TRANSITION FROM STEEP NORTH ASPECT TO VALLY FLOOR. AS SUCH IT CONTAINS A MIX OF BOTH TYPES OF PLANTS. IN THIS REGARD IT IS CONSISTANT

ENVIRONMENTAL DESCRIPTION

Elevation: 5380 ft/m (circle one) Slope: 9 deg. Aspect: 308 (see cheat sheet)
Topographic Position (see cheat sheet): LOW SLOPE
Landform (see cheat sheet): VALLEY
Surficial Geology (see cheat sheet): MANCOS SHALE

Cowardin System
X Upland ___ Palustrine
___ Riverine ___ Lacustrine

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

Environmental Comments (dynamic stage, fire history, insect damage, etc.):
DROUGHT CONTINUES TO MANIFEST HERE. PLANTS VERY DRY. EROSION GULLIES CROSS AREA

Ground Cover: *(please estimate to the nearest percentage. Sum = 100%)*
92 Bare soil 10 Litter / duff 0 Wood (>1 cm)
0 Bedrock 0 Large rocks (>10 cm) 0 Small rocks (0.2-10 cm)
0 Sand (0.1-2 mm) 0 dune /alluvium 0 Water
0 Moss 0 Lichen 0 Cryptogam
___ Other (describe):

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

Soil Drainage:
X 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 X Evergreen __ Cold-deciduous __ Mixed evergreen-cold-deciduous Herbs __ Annual __ Perennial	X Broad-leaved __ Needle-leaved __ Microphyllous __ Graminoid __ Forb __ Pteridophyte __ Non-vascular __ Mixed (describe)	__ Forest __ Woodland __ Shrubland __ Dwarf Shrubland __ Shrub Herbaceous __ Herbaceous __ Nonvascular X Sparsely Vegetated	01 <0.5 m 02 0.5-1m 03 1-2 m 04 2-5 m 05 5-10 m 06 10-15 m 07 15-20 m 08 20-35 m 09 35 – 50 m 10 >50 m	T 0-1% P >1-5% 1 >5-15% 2 >15-25% 3 >25-35% 4 >35-45% 5 >45-55% 6 >55-65% 7 >65-75% 8 >75-85% 9 >85-95% 10 > 95%

	Height Class	Cover Class	Dominant Species (mark Diagnostic species with *)
T1 Emergent			
T2 Canopy			
T3 Sub-canopy			
S1 Tall shrub			
S2 Short Shrub	02	1	ART WYO, ATR CON
S3 Dwarf-shrub	01	P	ATR COR
Ht Herbaceous	01	T	
H1 Graminoids	01	T	ELY ELY
H2 Forbs			
H3 Ferns			
H4 Tree seedlings			
N Non-vascular			
V Vine/liana			
E Epiphyte			

Animal Use Evidence (including scat, browse, burrows, bedding sites, etc)
BADGER HOLE, COW PIE

Natural and Anthropogenic Disturbance Comments (please see cheat sheet for examples; list intensity as High, Med, or Low)
COW PATH THROUGH PLOT

Other Comments/Continuation from previous sections. Describe surrounding communities and how they relate to the plot.
PRETTY DARN BLEAK

Plot Code: DINO 436

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, mature 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 Class	Stratum	Species Name	Cover Class	Stratum	Species Name	Cover Class
S2	ARTN40	P						
1	ATRCON	P						
4	TETNUT	T						
S3	ATRCOR	P						
1	ATRGARCUN	T						
1	GUTSAR	T						
4	GHEGRE	T						
H1	ELYELY	T						
1	BROTEC	T						
1	PDASEC	T						
V								

Strata:	Cover Class 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	

Tree DBH and Fuels Form Units in cm / in (circle one) Subplot? (Y / N) Plot Code DINO . 436

Record the diameter at root crown (DRC) of all stems of trees more than 4.5 feet tall.
Record duff, depth and other tree crown characteristics only in Douglas-fir and ponderosa pine plots.

Fuels Photo Guides

Series	Page/Photo #
Ponderosa/Douglas-fir	
Pinyon-Juniper	
Sagebrush	5

P-J age class

- X Not P-J
- ___ Old-growth
- ___ Mature
- ___ Young
- ___ Invasive

PIPO/DF Litter & Duff Loading

Location	Litter Depth	Duff Depth
Origin		
10m N		
10m E		
10 m S		
10m W		

Canopy and Fuel Loading Characteristics

DRC	Species	Ht	Crown Ratio	Crown Base Height	Tree Structure Stage	DRC	Species	Ht	Crown Ratio	Crown Base Height	Tree Structure Stage	DRC	Species

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

NATIONAL PARK VEGETATION MAPPING PROGRAM: OBSERVATION POINT FORM

IDENTIFIERS/LOCATORS Thompson Williams 8-18-02

Plot Code: DINO . DO 148 **Polygon Code:** 47210

Provisional Community Name: Chr lin / Poa fen Dwarf-shrubland

State: CO **Park Name** DINOSAUR NM **Park Site Name:** Buck ridge

Quad Name: Greystone **Quad Code:** 3E6

GPS File Name: DO 148 **Field UTM X:** 690730 **mE Field UTM Y:** 4489081 **mN** +/-15.9m

Please do not complete the following information when in the field:

Corrected UTM X: **mE** **Corrected UTM Y:** **mN** **Zone:**

ENVIRONMENTAL DESCRIPTION

Elevation: 7260' **Slope:** 0 deg. **Aspect:** 0 deg.

Topographic Position: High level /

Landform: Ridge

Cowardin Wetland Classification System

- X Upland Aerial Photo #11632-206
- ___ Estuarine
- ___ Riverine
- ___ Palustrine PJ 14 Frame #4
- ___ Lacustrine

Hydrologic Regime - Non Tidal

- ___ Permanently Flooded
- ___ Semi-permanently Flooded
- ___ Seasonally/Temporarily Flooded
- ___ Saturated
- ___ Seasonally Flooded/Saturated
- ___ Intermittently Flooded

Environmental Comments:

Vegetation is extremely dessicated and browsed. CHLI seems to be the food of choice for deer, elk, or cows wherever present. Flat area, may hold water in spring that instigates vegetation here, but drought this summer has been its demise.

Unvegetated Surface (*please use cover scale below*)

- ___ Bedrock
- ___ Rocks >10 cm
- ___ Rocks 0.2-10 cm
- ___ Sand
- ___ Other (describe) Grasses difficult to ID
- 03 Bare Soil
- 03 Litter/Duff
- ___ Wood

VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	Leaf Type (of dominant stratum)	Physiognomic Class	Cover Scale for Strata and Unvegetated Surface
Trees and Shrubs	X Broad-leaved	___ Forest	01 = 0 - 10%
X Evergreen	___ Needle-leaved	___ Woodland	02 = 10 - 25%
___ Cold-deciduous	___ Microphyllous	___ Shrubland	03 = 25 - 60%
___ Drought-deciduous	___ Graminoid	X Dwarf shrubland	04 = 60 - 100%
___ Mixed evergreen/ cold-deciduous	___ Forb	___ Shrub Herbaceous	
	___ Pteridophyte	___ Herbaceous	
Herbs	___ Mixed (describe)	___ Nonvascular	
___ Annual		___ Sparsely vegetated	
___ Perennial			

NATIONAL PARK VEGETATION MAPPING PROGRAM: OBSERVATION POINT FORM

Stratum	Height	Cover Class	Dominant species (mark diagnostic spp with a *)	% cover
T1: Emergent				
T2: Canopy				
T3: Sub-canopy				
S1: Tall shrub				
S2: Short shrub	01	02	chr lin	20
H: Herbaceous	01	02	Poa fen	40
			spn coc	1
			Koe mac	2
			Pas smithii	10
N: Non-vascular				
V: Vine/liana				
E: Epiphyte				

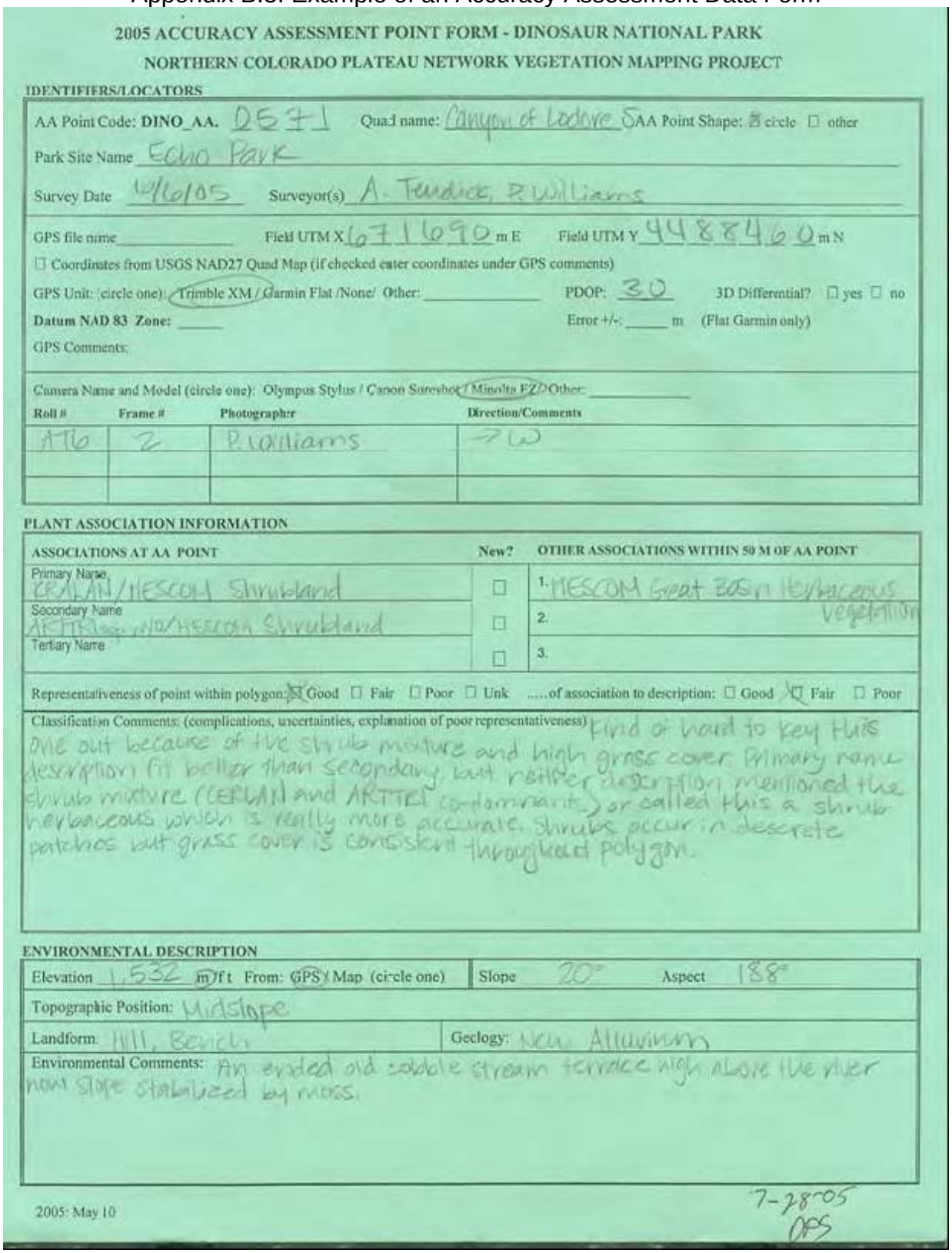
Height Scale for strata:

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

Cover scale for strata and Unvegetated Surface:

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

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



2005 ACCURACY ASSESSMENT POINT FORM - DINOSAUR NATIONAL PARK

NORTHERN COLORADO PLATEAU NETWORK VEGETATION MAPPING PROJECT

IDENTIFIERS/LOCATORS

AA Point Code: DINO_AA. 0571 Quad name: Canyon of Lodore SAA Point Shape: ☒ circle ☐ other

Park Site Name Echo Park

Survey Date 10/6/05 Surveyor(s) A. Tendick, P. Williams

GPS file name _____ Field UTM X 671690 m E Field UTM Y 4488460 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: 3.0 3D Differential? ☐ yes ☐ no

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

GPS Comments:

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

Roll #	Frame #	Photographer	Direction/Comments
ATO	2	P. Williams	→W

PLANT ASSOCIATION INFORMATION

ASSOCIATIONS AT AA POINT	New?	OTHER ASSOCIATIONS WITHIN 50 M OF AA POINT
Primary Name CERLAN/HESCOM Shrubland	☐	1. HESCOM Great Basin Herbaceous Vegetation
Secondary Name ARTTRI-wy/HESCOM Shrubland	☐	2.
Tertiary Name	☐	3.

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

Classification Comments: (complications, uncertainties, explanation of poor representativeness) Kind of hard to key this one out because of the shrub mixture and high grass cover. Primary name description fit better than secondary, but neither description mentioned the shrub mixture (CERLAN and ARTTRI co-dominants) or called this a shrub herbaceous which is really more accurate. Shrubs occur in discrete patches but grass cover is consistent throughout polygon.

ENVIRONMENTAL DESCRIPTION

Elevation 1,532 m/ft From: GPS / Map (circle one)	Slope 20° Aspect 188°
Topographic Position: Midslope	
Landform: Hill, Bench	Geology: New Alluvium
Environmental Comments: An eroded old caddole stream terrace high above the river now slope stabilized by moss.	

2005 May 10

7-28-05 OFS

2005 ACCURACY ASSESSMENT POINT FORM - DINOSAUR NATIONAL PARK

NORTHERN COLORADO PLATEAU NETWORK VEGETATION MAPPING PROJECT

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

—	Bedrock	16	Large rocks (cobbles, boulders > 10 cm)	—	Sand (0.1-2 mm)
02	Litter, duff	03	Small rocks (gravel, 0.2-10 cm)	16	Bare soil
—	Wood (> 1 cm)			02	Other: Moss

VEGETATION DESCRIPTION

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

Strata	Height Class	Cover Class	Dominant species (mark any known diagnostic species with a *)	% Cover
T1 Emergent	—	—		
T2 Canopy	—	—		
T3 Sub-canopy	—	—		
S1 Tall shrub	—	—		
S2 Short Shrub	02	1b	Krascheninnikovia lanata	5
			Artemisia tridentata ssp. wyomingensis	5
			Grayia spinosa	3
			Ephedra viridis	1
			Sarcobatus vermiculatus	1
S3 Dwarf-shrub	01	P	Opuntia polyacantha	1
H Herbaceous	01	02	Stipa comata	10
			Sporobolus cryptandrus	2
			Hilaria jamesii	1
			Bromus tectorum	8
H4 Tree Seedlings	—	—	Stipa hymenoides	1
N Non-vascular	—	—		

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

2005: May 10

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

Two database files are required to use DINO VegMapDB:

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

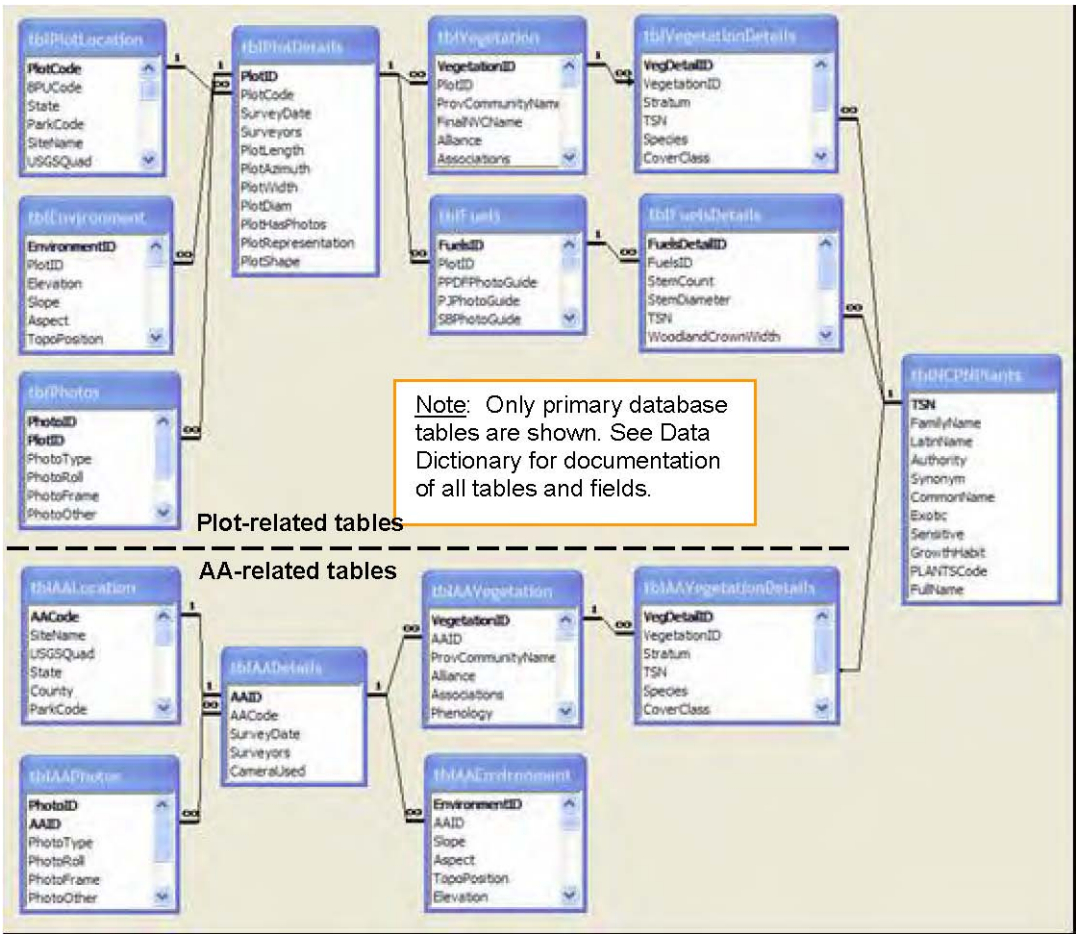


Figure 1. Entity Relationship Diagram for DINO VegMapDB

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 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 for environmental features / conditions of plot or observation point.

Field Name	Field Description	Field Type	Field Width
EnvironmentID	Unique record identifier	dbLong	4
PlotID	Foreign key; links record to tblPlotDetails	dbLong	4
Elevation	Elevation of plot in meters as estimated from either map or GPS unit	dbLong	4
Slope	Slope of plot measured in degrees	dbText	50
Aspect	Aspect of plot	dbText	50
TopoPosition	Topographic position of plot; value selected from tlkpTopography	dbText	50
Landform	Landform on which plot is located, any landform could be entered by crew	dbText	50
Geology	Geologic substrate influencing the plant community; value selected from tlkpGeology	dbText	50
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 cryptogram ground cover	dbText	3
SoilTexture	Assessment of average soil texture from sample taken a few inches below the surface; values selected from tlkpSoilTexture	dbText	50
SoilDrainage	Soil drainage class based on actual moisture content and extent period; values selected from	dbText	30

Field Name	Field Description	Field Type	Field Width
	tlkpSoilDrainage		
AnimalUseComments	Comments on evidence of use by non-domestic animals in plot area	dbMemo	0
DisturbanceComments	Comments on evidence of natural or anthropogenic disturbance in plot area, severity and effects on vegetation	dbMemo	0
OtherComments	Other general comments	dbMemo	0
LandscapeComments	Description of landscape context of plot, including any important landscape features influencing the community	dbMemo	0
SoilTaxonDesc	Field used for either identifying soils keyed, or to describe if large rocks or outcrops are present on the surface	dbText	255
LiveVegLitter	Estimate to the nearest percentage of live veg litter ground cover	dbDouble	8
LiveVegWood	Estimate to the nearest percentage of live veg wood ground cover	dbDouble	8
LichenRocks	Estimate to the nearest percentage of lichen covering rocks	dbDouble	8
LichenGround	Estimate to the nearest percentage of lichen ground cover (on the soil, associated with cryptogams)	dbDouble	8
MossPct	Estimate to the nearest percentage of moss ground cover	dbDouble	8
DarkCyanobacteria	Estimate to the nearest percentage of dark cyanobacteria ground cover	dbDouble	8
TotalPct	Calculated total percent ground cover (used as QC check)	dbInteger	2

Table Name: tblEnvironmentDetails
Description: Table containing values of environmental features / conditions of plot or observation point.

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

Table Name: tblFuels
Description: Table containing details of 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	For ponderosa pine and Douglas-fir plots, the page number of the photo that most closely resembles the plot in terms of vegetation structure and down fuel. Ref: W.C. Fischer 1981.	dbText	3
PJPhotoGuide	For pinyon-juniper plots, the page number of the photo that most closely resembles the plot in terms of vegetation structure and down fuel. Ref: Ottmar et al. 2000.	dbText	3
SBPhotoGuide	For sagebrush plots, the page number of the photo that most closely resembles the plot in terms of vegetation structure and down fuel. Ref: Ottmar et al. 2000.	dbText	3

Field Name	Field Description	Field Type	Field Width
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	Litter thickness at plot center	dbText	3
LitterNorth	Litter thickness 20m north of plot center	dbText	3
LitterEast	Litter thickness 20m east of plot center	dbText	3
LitterSouth	Litter thickness 20m south of plot center	dbText	3
LitterWest	Litter thickness 20m west of plot center	dbText	3
DuffOrigin	Duff thickness at plot center	dbText	3
DuffNorth	Duff thickness 20m north of plot center	dbText	3
DuffEast	Duff thickness 20m east of plot center	dbText	3
DuffSouth	Duff thickness 20m south of plot center	dbText	3
DuffWest	Duff thickness 20m west of plot center	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 of stem height, crown width, and other fuels 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	For pinyon-juniper plots, the width in meters of the live tree crown at its widest point	dbDouble	8
WoodlandCrownHeight	For pinyon-juniper plots, the height in meters of the live tree crown	dbDouble	8
ForestCrownBaseHeight	For ponderosa pine and Douglas-fir plots, the height in meters from the ground to the base of the live tree crown	dbDouble	8
ForestCrownHeight	For ponderosa pine and Douglas-fir plots, the height of the live crown from the crown base to the top of the tree	dbDouble	8
CrownRatio	For ponderosa pine and Douglas-fir plots, the ratio of live tree crown to overall tree height	dbText	12
StructureStage	Position of the tree in the canopy: Dominant=crown emerges above canopy, Co-dominant=crown forms the general level of the canopy, Intermediate=trees with partially shaded crowns, Suppressed=trees receiving no direct light from above.	dbText	12
Comments	[not used]	dbText	255

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

Field Name	Field Description	Field Type	Field Width

Field Name	Field Description	Field Type	Field Width
GenPhotoID	Unique record identifier	dbLong	4
GenPhotoParkCode	Four-letter abbreviation of park where photo was taken (if applicable)	dbText	50
GenPhotoDate	Date photo taken	dbDate	8
GenPhotographer	Name of photographer	dbText	75
GenFieldDesc	General description of photo contents	dbText	250
GenPhotoUTME	UTME of photo	dbLong	4
GenPhotoUTMN	UTMN of photo	dbLong	4
GenUTMZone	UTMZone of photo UTM coordinates	dbLong	4
GenPhotoRoll10	Roll number of photo	dbText	50
GenPhotoFrame	Frame number of photo	dbText	10
GenPhotoDigFile	Digital file name of photo	dbText	50
GenPhotoComments	General comments	dbText	250

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

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

Table Name: tblPhotos
Description: Details of 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
Photographer	Name of photographer	dbText	50
PhotoComments	Brief description of photo	dbText	255
NCPNImageFileID	Cross-reference for NCPN Photo Database 'ImageFileID' and 'PhotoOther'	dbText	50

Table Name: tblPlotDetails
Description: Information for 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	3
PlotAzimuth	Azimuth of plot; synonymous with aspect. One or the other, or both, can be used	dbText	3
PlotWidth	Width of plot, in meters	dbText	3
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 dbMemo 0stand, and in comparison to associations outside the park (if known)	dbMemo	0
PlotShape	Shape of plot	dbText	15

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

Field Name	Field Description	Field Type	Field Width
PlotCode	Identifier assigned to plot by survey crew	dbText	10
BPUCode	Biophysical unit code where plot is located	dbText	10
State	State where plot is located	dbText	2
ParkCode	Park unit where plot is located	dbText	4
SiteName	Short, descriptive name of site where plot is located	dbText	100
USGSQuad	USGS quadrangle (1:24K) where plot is located	dbText	50
AerialPhotoNo	Aerial photo number corresponding to plot location	dbText	10
Waypoint	Garmin plot code	dbText	7
UTMEasting	UTM easting of plot	dbText	50
UTMNorthing	UTM northing of plot	dbText	7
Datum	Datum of UTM coordinates	dbText	10
UTMZone	UTM zone of coordinates	dbText	4
UTMError	Error, in meters, of location data (based on reading from Garmin GPS unit)	dbText	5
DiffCorrected	Indicate if coordinates have been differentially corrected	dbText	3
DirectionsTo Plot	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

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
PhotoID	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	dbText	120

Field Name	Field Description	Field Type	Field Width
	training 04/04		
FinalNVCName	Final community name, provided by NatureServe	dbText	100
Alliance	Alliance corresponding to provisional community name	dbText	100
Associations	Association corresponding to provisional community name	dbText	100
Phenology	Leaf phenology of the dominant stratum. Field is blank for non-vascular plots	dbText	35
LeafType	Leaf form of the dominant stratum	dbText	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 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	Height class of emergent stratum (classes are in tlkpHeight)	dbText	2
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	2
TallShHt	Height class of tall shrub stratum	dbText	2
TallShCovTot	Cover class of tall shrub stratum	dbText	2
ShrubHt	Height class of short shrub stratum	dbText	2
ShrubCovTot	Cover class of short shrub stratum	dbText	2
DwarfHt	Height class of dwarf shrub stratum	dbText	2
DwarfCovTot	Cover class of dwarf shrub stratum	dbText	2
HerbHt	Height class of herbaceous stratum (all H layers)	dbText	2
HerbCovTot	Cover class of herbaceous stratum (all H layers)	dbText	2
GramHt	Height class of graminoid stratum	dbText	2
GramCovTot	Cover class of graminoid stratum	dbText	2
ForbHt	Height class of forb stratum	dbText	2
ForbCovTot	Cover class of forb stratum	dbText	2
FernHt	Height class of fern and fern ally stratum	dbText	2
FernCovTot	Cover class of fern and fern ally stratum	dbText	2
SeedlHt	Height class of seedling stratum	dbText	2
SeedlCovTot	Cover class of seedling stratum	dbText	2
NonvasHt	Height class of nonvascular stratum	dbText	2
NonvasCovTot	Cover class of nonvascular stratum	dbText	2
VineHt	Height class of vine stratum	dbText	2
VineTotCov	Cover class of vine stratum	dbText	2
EpiHt	Height class of epiphyte stratum	dbText	2
EpiTotCov	Cover class of epiphyte stratum	dbText	2

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

Field Name	Field Description	Field Type	Field Width
VegDetailID	Unique record ID	dbLong	4
VegetationID	Foreign key; links to tblVegetation	dbLong	4
Stratum	Strata class from tlkpStrata	dbText	2
TSN	Taxonomic Serial Number - unique taxon identifier assigned by ITIS	dbDouble	8
Species	Latin name of species, from tblNCPNPlants	dbText	100

Field Name	Field Description	Field Type	Field Width
CoverClass	Cover class to describe species and strata (from tlkpCover)	dbText	2
SpecimenCollected	Check yes if a specimen of the species was collected	dbBoolean	1
CollectedBy	Name of person making collection	dbText	50
SpecimenNumber	Enter the collector's reference number for the specimen collected	dbText	50
NPSAccessionNumber	Number provided by park curator for all specimens collected under research permit	dbText	50
NPSCatalogNumber	Unique number provided by park curator for specimen	dbText	50
Diagnostic	Check yes if the species is known to be diagnostic of the vegetation type	dbBoolean	1

Accuracy assessment-related tables

Table Name: tblAADetails
Description: Information for 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 for environmental features / conditions of an AA point.

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

Field Name	Field Description	Field Type	Field Width
Moss	Estimate to the nearest percentage of moss ground cover	dbText	4
Other	Estimate to the nearest percentage of other type of ground cover	dbText	4
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	4
Rocks	Estimate to the nearest percentage of rocks >10cm wide ground cover	dbText	4
Lichen	Estimate to the nearest percentage of lichen ground cover	dbText	4
Gravel	Estimate to the nearest percentage of gravel <10cm wide ground cover	dbText	4
LiveVegLitter	Estimate to the nearest percentage of live veg litter ground cover	dbText	4
LiveVegWood	Estimate to the nearest percentage of live veg wood ground cover	dbText	4
Wood	Estimate to the nearest percentage of wood >1cm ground cover	dbText	4
LichenRocks	Estimate to the nearest percentage of lichen covering rocks	dbText	4
LichenGround	Estimate to the nearest percentage of lichen covering ground	dbText	4
DarkCyanobacteria	Estimate to the nearest percentage of dark cyanobacteria ground cover	dbText	4
Water	Estimate to the nearest percentage of water ground cover	dbText	4

Table Name: tblAAEnvironmentDetails
Description: Table containing values for environmental features / 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 for AA point location.

Field Name	Field Description	Field Type	Field Width
AACode	Identifier assigned to AA point by survey crew	dbText	13
SiteName	Short, descriptive name of site where point is located	dbText	100
USGSQuad	USGS quadrangle (1:24K) where point is located	dbText	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

Field Name	Field Description	Field Type	Field Width
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 point is within park boundaries	dbBoolean	1
GPSComments	Any brief comments on GPS data collection	dbText	255
PrimaryMapUnit	[not used]	dbText	50
SecondaryMapUnit	[not used]	dbText	50
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 of 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	Cross-reference for NCPN Photo Database 'ImageFileID' and 'PhotoOther'	dbText	50

Table Name: tblAAVegAssociation
Description: Vegetation association at AA location.

Field Name	Field Description	Field Type	Field Width
VegAssocID	Unique record identifier	dbLong	4
AAID	Foreign key; provides link to tblAADetails	dbLong	4
VegAssocCode	Identification code of vegetation association; provided by NatureServe	dbText	25
FieldKey	Was name obtained from field key?	dbBoolean	1
NewName	New classification name?	dbBoolean	1
Post_Field_Name	Post-field name?	dbBoolean	1
VegAssocRank	Rank of vegetation association (primary, secondary, tertiary)	dbText	15
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	100
Associations	Association corresponding to provisional community name	dbText	100
Phenology	Leaf phenology of the dominant stratum.	dbText	35
LeafType	Leaf form of the dominant stratum.	dbText	35
LeafTypeComments	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 herbaceous stratum	dbText	2
HTotalCovTot	Cover class of herbaceous stratum	dbText	15
HTotalCovPercent	[not used]	dbText	50
H4Ht	Height class of tree seedling stratum	dbText	2
H4CovTot	Cover class of tree seedling stratum	dbText	15
H4CovPercent	[not used]	dbText	50
NonvasHt	Height class of nonvascular stratum	dbText	2
NonvasCovTot	Cover class of nonvascular stratum	dbText	15
NonvasCovPercent	[not used]	dbText	50
VineHt	Height class of vine stratum	dbText	2
VineTotCov	Cover class of vine stratum	dbText	15
VineTotPercent	[not used]	dbText	50
EpiHt	Height class of epiphyte stratum	dbText	2
EpiTotCov	Cover class of epiphyte stratum	dbText	15
EpiTotPercent	[not used]	dbText	50

Field Name	Field Description	Field Type	Field Width
PlantSpeciesComments	Comments on plant species list	dbMemo	0
MultipleAssoc	List represents 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 tllkStrata	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 the 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	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	100

Table Name: tlkpAssociations
Description: Look-up of association names.

Field Name	Field Description	Field Type	Field Width
Associations	Association names from NatureServe classification	dbText	100

Table Name: tlkpCamera
Description: Lookup of Camera make/models used for plot photos.

Field Name	Field Description	Field Type	Field Width
CameraType	Model and make of camera used for photographs of plot	dbText	50
CameraComments	Additional comments on camera, including default focal length	dbText	50

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

Field Name	Field Description	Field Type	Field Width
CoverClass	For Plots: T >0-1%, P >1-5%, 1a >5-10%, 1b >10-15%, 02 >15-25%, 03 >25-35%, 04 >35-45%, 05 >45-55%, 06 >55-65%, 07 >65-75%, 08 >75-85%, 09 >85-95%. 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	T =0-1%, P >1-5%, 1a >5-10%, 1b=10-15%, 02=15-25%, 03=25-35%, 04=35-45%, 05=45-55%, 06=55-65%, 07=65-75%, 08=75-85%, 09=85-95%	dbText	50

Table Name: tlkpCowardin
Description: Look-up of Cowardin system categories for Environment descriptions.

Field Name	Field Description	Field Type	Field Width
CowardinSystem	Cowardin system descriptors for environmental description of plot	dbText	50

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

Field Name	Field Description	Field Type	Field Width
ELCode	Vegetation association code; assigned by NatureServe	dbText	50

Field Name	Field Description	Field Type	Field Width
CommunityName	Final vegetation association name; assigned by NatureServe	dbText	255

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	50

Table Name: tlkpHeightClass
Description: Look-up of height classes assigned to strata in VegetationDetails.

Field Name	Field Description	Field Type	Field Width
HeightClass	01<.5m 02=.5-1m 03=1-2m 04=2-5m 05=5-10m 06=10-15m 07=15-20m 08=20-35m 09=35-50m 10=>50m	dbText	2

Table Name: tlkpHydrology
Description: Look-up of hydrology types from Cowardin et al. 1979.

Field Name	Field Description	Field Type	Field Width
Hydrology	Hydrology descriptors for plots that are in a wetland or upland with intermittent flooding (dry wash)	dbText	50

Table Name: tlkpLandform
Description: Look-up of landforms in Veg Mapping Manual (from http://soils.usda.gov/technical/handbook/contents/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 Veg Mapping 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 Veg Mapping 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 of parks in the Northern Colorado Plateau network of I&M.

Field Name	Field Description	Field Type	Field Width
ParkCode	Four-letter abbreviation for park name	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, ARCH, and NABR	dbText	15

Table Name: tlkpStates
Description: Look-up of all states in the USA.

Field Name	Field Description	Field Type	Field Width
StateCode	Two-letter abbreviation for each state	dbText	2
StateName	Full name of each state in the USA	dbText	50

Table Name: tlkpStrata
Description: Look-up of strata classes in VegetationDetails (from Veg Mapping 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
Name	Stratum class name	dbText	50

Table Name: tlkpStrataAA
Description: Look-up of strata classes in VegetationDetails (from Veg Mapping 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 DINO field data collection.

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

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

Table Name: tlkpUTMZone
Description: Look-up for UTM zone of DINO.

Field Name	Field Description	Field Type	Field Width
UTMZone	UTM zone where all DINO 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 DINO 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.

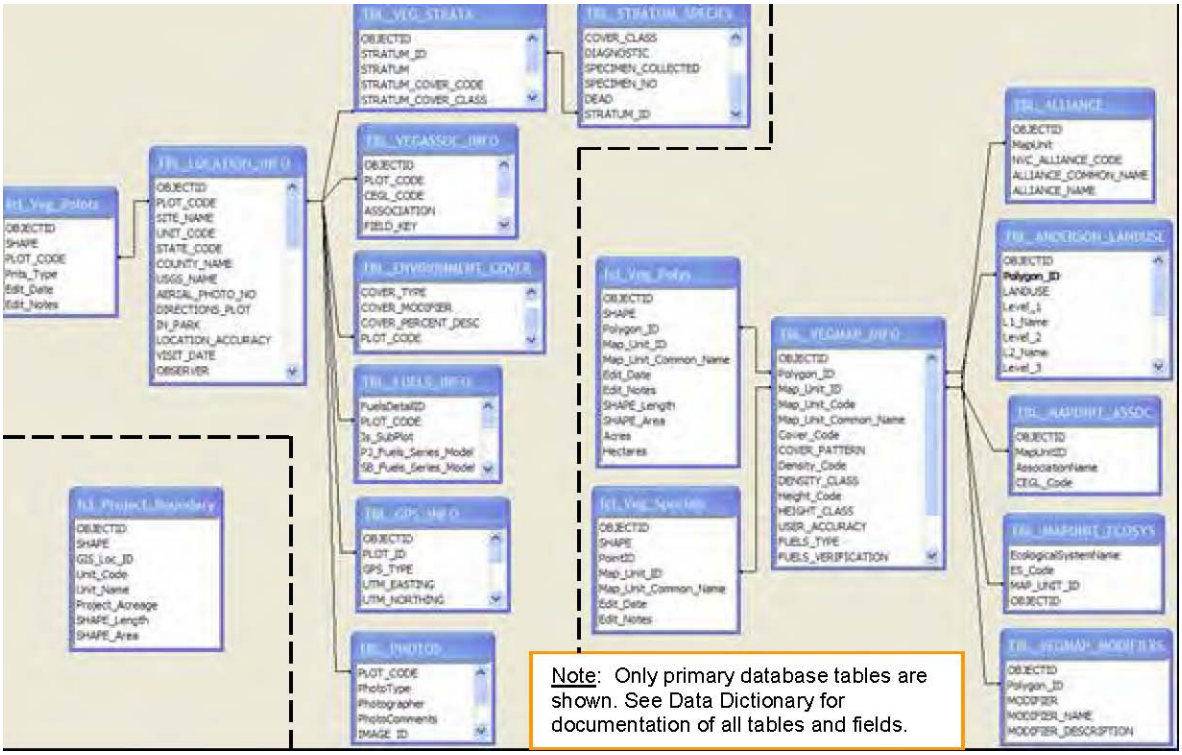


Figure 2. Entity Relationship Diagram for DINO Geodatabase

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

Field Name	Field Description	Field Type	Field Width
Unit_Code	Four-letter park code (DINO)	dbText	10
Unit_Name	Full name of national park (Dinosaur National Monument)	dbText	255
Project_Acreage	Acreage of project area	dbLong	4
SHAPE_Length	ESRI generated	dbDouble	8
SHAPE_Area	ESRI generated	dbDouble	8

Table Name: fcl_Veg_Points
Description: The feature class containing all point data associated with the vegetation project (Plots, Observations, Fuels, AA).

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
SHAPE	ESRI generated	dbLongBinary	0
PLOT_CODE	Unique Plot code, used for relating tables and feature class (TBL_LOCATION_INFO)	dbText	20
Pnts_Type	Type of point (fuels, plot, observation, aa, misc)	dbLong	4
Edit_Date	Date of any edits to the point or data	dbText	10
Edit_Notes	Notes regarding any edits.	dbText	255

Table Name: fcl_Veg_Polys
Description: The feature class displaying the vegetation mapping units for the park.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
SHAPE	ESRI generated	dbLongBinary	0
Polygon_ID	Unique polygon code, used for relating tables (TBL_VEGMAP_INFO)	dbText	128
Map_Unit_ID	The map unit identifier, used by the mappers (aka: grid_code or map class code)	dbText	10
Map_Unit_Common_Name	The name of the map unit (or map class)	dbText	250
Edit_Date	Date of any edits to the polygon or its attributes	dbDate	8
Edit_Notes	Notes regarding any edits to the polygon or its attributes	dbText	250
Acres	Acres per polygon, generated using ArcMap	dbDouble	8
Hectares	Hectares per polygon, generated using ArcMap	dbDouble	8
SHAPE_Length	ESRI generated	dbDouble	8
SHAPE_Area	ESRI generated	dbDouble	8

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

Field Name	Field Description	Field Type	Field Width
Edit_Date	Date of any edits to the polygon or its attributes	dbText	20
Edit_Notes	Notes regarding any edits to the polygon 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)	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_MODIFIER	Estimate to the nearest percentage of ground cover type	dbText	10
COVER_PERCENT_DESC	Description of cover	dbText	255
PLOT_CODE	Unique Plot code, used for relating tables	dbText	12

Table Name: TBL_ENVIRONMENT_LANDFORM
Description: Contains landform data for the veg points feature class.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
LANDFORM	Landform on which plot is located, any landform could be entered by crew.	dbText	100
PLOT_CODE	Unique Plot code, used for relating tables (TBL_LOCATION_INFO)	dbText	20

Table Name: TBL_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_INFO
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
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
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
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

Field Name	Field Description	Field Type	Field Width
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

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 and model of GPS unit (e.g., Garmin Etrex)	dbText	30
UTM_EASTING	UTM easting of plot	dbDouble	8
UTM_NORTHING	UTM northing of plot	dbDouble	8
UTM_ZONE	UTM zone of coordinates	dbText	3
DATUM	Datum of UTM coordinates (NAD83)	dbText	10
GPS_ERROR	Error, in meters, of location data (based on reading from Garmin GPS unit)	dbText	5
DIFF_CORRECTED	Indicates if coordinates have been differentially corrected (from Garmin screen)	dbText	3
GPS_COMMENTS	Any brief comments on GPS data collection at plot.	dbText	255
GPS_QUALITY	Indicates the quality of the GPS unit used (recreational, mapping grade)	dbText	35
PDOP	Positional Dilution Of Precision reading (from Garmin screen)	dbText	30
ERROR_RANGE	General error range, in meters, of the type of GPS unit used.	dbText	20

Table Name: TBL_LOCATION_INFO
Description: Contains data about the location of the point and general observations about the area for the veg points feature class.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
PLOT_CODE	Unique Plot code, used for relating tables and feature class (fcl_Veg_Points)	dbText	20
SITE_NAME	General Site name given by field crew	dbText	255
UNIT_CODE	4 letter park code (DINO)	dbText	10
STATE_CODE	State (Colorado, Utah)	dbText	2
COUNTY_NAME	County where plot is located (Moffat County, Uintah County)	dbText	100
USGS_NAME	USGS 1:24k Topo Name	dbText	100
AERIAL_PHOTO_NO	9X9 photo name on which the point most directly falls	dbText	30
DIRECTIONS_PLOT	Directions to the location of the plot	dbText	255
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
LOCATION_ACCURACY	Indicates general range of locational error of	dbText	45

Field Name	Field Description	Field Type	Field Width
	the point coordinates.		
VISIT_DATE	Date the location was visited	dbText	10
OBSERVER	The names of the field crew member(s) observing the site.	dbText	50
PLOT_WIDTH	The width of the point	dbText	3
PLOT_LENGTH	The length of the point	dbText	3
PLOT_DIAMETER	The diameter of the point	dbText	5
PLOT_AZIMUTH	The azimuth of the point	dbText	5
PLOT_SHAPE	The shape of the area observed as a point	dbText	20
REPRESENTATIVENESS	The representativeness of the vegetation	dbText	255
ASPECT	Aspect of plot	dbText	50
ELEVATION	Elevation of plot in meters, created from 10 meter DEMs	dbDouble	8
SLOPE	Slope of plot measured in degrees	dbText	15
TOPO_POSITION	Topographic position of plot	dbText	50
SOIL_TEXTURE	Assessment of average soil texture from sample taken a few inches below the surface	dbText	50
COWARDIN_SYSTEM	If the plot is in a wetland system, select term that best describes its hydrology (Upland, Palustrine, Riverine, Lacustrine)	dbText	50
HYDROLOGY	Describes hydrology of plot	dbText	50
GEOLOGY	Geologic substrate influencing the plant community	dbText	50
SOIL_DRAINAGE	Soil drainage class based on actual moisture content and extent period	dbText	30
ENV_COMMENTS	Comments on environmental setting and its effect on the vegetation; also comments on any disturbance or reproduction factors	dbText	255
ANIMAL_USE_COMMENTS	Comments on evidence of use by non-domestic animals in plot area	dbText	255
DISTURBANCE_COMMENTS	Comments on evidence of natural or anthropogenic disturbance in plot area, severity and effects on vegetation	dbText	255
LANDSCAPE_COMMENTS	Description of landscape context of plot, including any important landscape features influencing the community	dbText	255
OTHER_COMMENTS	Other general comments	dbText	255
SOIL_TAXON_DESC	Field used for either identifying soils keyed, or to describe if large rocks or outcrops are present on the surface	dbText	255
ALLIANCE	Alliance corresponding to provisional community name	dbText	100
PROVISIONAL_COMM_NAME	Community name (provisional) assigned by field crews by following naming protocols as described in field manual and training (2004).	dbText	200
PHENOLOGY	Leaf phenology of the dominant stratum. Field is blank for non-vascular plots	dbText	200
LEAF_TYPE	Leaf form of the dominant stratum.	dbText	100
LEAF_TYPE_COMMENTS	If Leaf Type is "mixed," this field describes the multiple leaf types found in the dominant stratum.	dbText	255

Field Name	Field Description	Field Type	Field Width
PHYSIOGNOMIC_NAME	Physiognomic class of plot	dbText	100
PLANT_SPECIES_COMMENTS	Comments about the plant species observed.	dbText	200

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	dbText	250
AssociationCommonName	The NVC Association Common name	dbText	250

Table Name: TBL_MAPUNIT_ECOSYS
Description: Contains ecological system data for the vegetation polygons by map unit ID.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
MAP_UNIT_ID	The map unit identifier, used by the mappers (aka: grid_code or map class code)	dbText	10
ES_Code	Ecological System code	dbText	30
EcologicalSystemName	Ecological system name (mid-scale classification, larger than associations or alliances, smaller than ecoregions).	dbText	255

Table Name: TBL_PHOTOS
Description: Details on individual photos taken of a point.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
PLOT_CODE	Unique Plot code, used for relating tables (TBL_LOCATION_INFO)	dbText	50
PhotoType	Type of photo being referenced.	dbText	16
Photographer	Name of photographer.	dbText	50
PhotoComments	Brief description of photo.	dbText	255
IMAGE_ID	NCPN Photo Database (unique) file name.	dbText	50
PHOTO_PATH	Path to photos	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

Field Name	Field Description	Field Type	Field Width
SPECIMEN_COLLECTED	"yes" if a specimen of the species was collected.	dbInteger	2
SPECIMEN_NO	Collector's reference number for the specimen	dbText	10
DEAD	Percent coverof 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	12

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 (only AA points)	dbText	128
CEGL_CODE	CEGL (association) code	dbText	10
ASSOCIATION	Association corresponding to provisional community name	dbText	100
FIELD_KEY	Name was chosen from field key	dbInteger	2
NEW_NAME	When no name really fits from the field key, the surveyor will create a new name.	dbInteger	2
POST_FIELD_NAME	Name assigned post field work, based on species lists and comments fields -- during AA meetings.	dbInteger	2
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 (X-DINO)	dbText	10

Field Name	Field Description	Field Type	Field Width
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/Bunched, Linear, Gadational/Transitional, Regularly alternating, Homogenous (default)) per 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)	dbText	3
FUELS_TYPE	Fuels vegetation types	dbText	50
FUELS_VERIFICATION	Fuels verification	dbText	255
VEGMAP_COMMENTS	Any comments about the particular polygon or map class.	dbText	255
MAP_UNIT_PDF	File name of pdf describing map unit (class)	dbText	50
MAP_UNIT_PDF_PATH	Hard-coded link to Map Unit description PDF document - path name (e.g. C:/DINO/Vegetation/MapClassDescriptions/MU4.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

Five hundred seventy-two vascular plant species representing 73 families were noted during plot, observation point and accuracy assessment point data collection at Dinosaur National Monument (DINO). 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 DINO 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 DINO 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.

Family	Scientific Name (Welch et al. 1993)	Scientific Name (Kartez 1999)	Common Name	TSN
Aceraceae	Acer glabrum L.	Acer glabrum	Rocky Mountain Maple	28742
Aceraceae	Acer negundo L.	Acer negundo	Box-elder	28749
Anacardiaceae	Rhus aromatica var. trilobata (Nutt.) A. Gray ex S. Watson	Rhus trilobata	Threeleaf Smac	539586
	Toxicodendron rydbergii (Small) Greene	Toxicodendron rydbergii	Western Poison-ivy	28822
Apiaceae	Cymopterus lemmonii (Coult. & Rose) Dorn	Pseudocymopterus montanus	False Mountain-parsley	511931
	Cymopterus purpureus S. Wats.	Cymopterus purpureus	Purple Spring-parsley	29654
	Cymopterus Raf.	Cymopterus	Spring-parsley	29625
	Ligusticum L.	Ligusticum	Wild Lovage	29523
	Ligusticum porteri Coult. & Rose	Ligusticum porteri	Porter's Wild Lovage	29532
	Lomatium grayi (Coult. & Rose) Coult. & Rose	Lomatium grayi	Mountain Desert-parsley	29707
	Lomatium juniperinum (M.E. Jones) Coult. & Rose	Lomatium juniperinum	Juniper Desert-parsley	29715
	Lomatium Raf.	Lomatium	Desert-parsley	29677
	Lomatium triternatum (Pursh) Coult. & Rose	Lomatium triternatum	Nineleaf Desert-parsley	29754
	Osmorhiza chilensis Hook. & Arn.	Osmorhiza berteroi	Mountain Sweet-cicely	29788
	Osmorhiza depauperata Phil.	Osmorhiza depauperata	Blunt-fruit Sweet-cicely	29790
	Osmorhiza Raf.	Osmorhiza	Sweet-cicely	29784
Apocynaceae	Apocynum cannabinum L.	Apocynum cannabinum	Indian-hemp	30157
Asclepiadaceae	Asclepias asperula (Dcne.) Woods.	Asclepias asperula	Spider Milkweed	30247
	Asclepias cryptoceras S. Wats.	Asclepias cryptoceras	Humboldt Milkweed	30257
	Asclepias sp. L.	Asclepias	Milkweed	30240
	Asclepias speciosa Torr.	Asclepias speciosa	Showy Milkweed	30304
	Asclepias subverticillata (Gray) Vail	Asclepias subverticillata	Horsetail Milkweed	30308
Asteraceae	Achillea millefolium L.	Achillea millefolium	Common Yarrow	35423
	Agoseris glauca (Pursh) Raf.	Agoseris glauca	Pale Goat-chicory	36490
	Agoseris glauca (Pursh) Raf. var. laciniata (D.C. Eat.) Smiley	Agoseris glauca var. laciniata	Pale Goat-chicory	182410
	Ambrosia L.	Ambrosia	Ragweed	36495
	Antennaria dimorpha (Nutt.) Torr. & Gray	Antennaria dimorpha	Cushion Pussytoes	36727
	Antennaria Gaertn.	Antennaria	Pussytoes	36716
	Antennaria microphylla Rydb.	Antennaria microphylla	Small-leaf Pussytoes	35452
	Antennaria parvifolia Nutt.	Antennaria parvifolia	Littleleaf Pussytoes	185162
	Antennaria rosulata Rydb.	Antennaria rosulata	Kaibab Pussytoes	36745
	Arctium L.	Arctium	Burrdock	36544
	Arctium minus Bernh.	Arctium minus	Lesser Burdock	36546
	Artemisia arbuscula Nutt.	Artemisia arbuscula	Dwarf Sagebrush	35449
	Artemisia biennis Willd.	Artemisia biennis	Biennial Wormwood	35451
	Artemisia cana Pursh	Artemisia cana	Silver Sagebrush	35454
	Artemisia dracunculus L.	Artemisia dracunculus	Dragon Wormwood	35462

Family	Scientific Name (Welch et al. 1993)	Scientific Name (Kartez 1999)	Common Name	TSN
	Artemisia frigida Willd.	Artemisia frigida	Fringed Sagebrush	35465
	Artemisia L.	Artemisia	Tall Oatgrass	35431
	Artemisia ludoviciana Nutt.	Artemisia ludoviciana	White Sagebrush	35474
	Artemisia ludoviciana ssp. candicans (Rydb.) Keck	Artemisia ludoviciana ssp. candicans	White Sagebrush	183735
	Artemisia nova A. Nels.	Artemisia nova	Black Sagebrush	500971
	Artemisia spiciformis Osterhout	Artemisia tridentata ssp. spiciformis	Spiked Big Sagebrush	509174
	Artemisia spinescens D.C. Eat.	Picrothamnus desertorum	Bud Sagebrush	35496
	Artemisia tridentata Nutt. ssp. tridentata	Artemisia tridentata ssp. tridentata	Basin Big Sagebrush	35499
	Artemisia tridentata Nutt. ssp. vaseyana (Rydb.) Beetle	Artemisia tridentata ssp. vaseyana	Mountain Big Sagebrush	183740
	Artemisia tridentata Nutt. ssp. wyomingensis Beetle & Young	Artemisia tridentata ssp. wyomingensis	Wyoming Big Sagebrush	183741
	Aster ascendens Lindl.	Symphyotrichum ascendens	Western American-aster	193303
	Aster brachyactis Blake	Symphyotrichum ciliatum	Alkali American-aster	35536
	Aster glaucodes Blake	Eurybia glauca	Gray Wood-aster	35578
	Aster L.	Aster	Aster	35510
	Balsamorhiza hookeri Nutt.	Balsamorhiza hookeri	Hairy Balsamroot	36811
	Balsamorhiza sagittata (Pursh) Nutt.	Balsamorhiza sagittata	Arrowleaf Balsamroot	36818
	Bidens frondosa L.	Bidens frondosa	Devil's Pitchfork	35707
	Brickellia grandiflora (Hook.) Nutt.	Brickellia grandiflora	Tasselflower Brickelbush	36878
	Brickellia longifolia S. Wats.	Brickellia longifolia	Longleaf Brickelbush	36885
	Brickellia microphylla (Nutt.) Gray	Brickellia microphylla	Littleleaf Brickelbush	36886
	Brickellia oblongifolia Nutt.	Brickellia oblongifolia	Narrowleaf Brickelbush	36891
	Carduus nutans L.	Carduus nutans	Musk Thistle	35787
	Centaurea repens L.	Acroptilon repens	Hardheads	510530
	Chaenactis douglasii (Hook.) Hook. & Arn.	Chaenactis douglasii	Dusty Maiden	36987
	Chaenactis stevioides Hook. & Arn.	Chaenactis stevioides	Broad-flower Pincushion	36998
	Chaetopappa ericoides (Torr.) Nesom	Chaetopappa ericoides	Rose-heath	501376
	Chlorocrepis albiflora (Hook.) W.A. Weber	Hieracium albiflorum	White-flower Hawkweed	37693
	Chrysopsis villosa (Pursh) Nutt. ex DC.	Heterotheca villosa	Hairy Goldenaster	510984
	Chrysothamnus greenei (Gray) Greene	Chrysothamnus greenei	Greene's Rabbitbrush	37052
	Chrysothamnus linifolius Greene	Chrysothamnus linifolius	Spearleaf Rabbitbrush	37054
	Chrysothamnus nauseosus (Pallas ex Pursh) Britt.	Ericameria nauseosa	Rubber Rabbitbrush	37055
	Chrysothamnus nauseosus var. junceus (Greene) Hall	Ericameria nauseosa var. juncea	Rubber Rabbitbrush	533557
	Chrysothamnus parryi (Gray) Greene	Ericameria parryi	Parry's Rabbitbrush	37071
	Chrysothamnus parryi var. nevadensis (Gray) Kittell	Ericameria parryi var. nevadensis	Parry's Rabbitbrush	533576
	Chrysothamnus sp. Nutt.	Chrysothamnus	Rabbitbrush	37048
	Chrysothamnus viscidiflorus (Hook.) Nutt.	Chrysothamnus viscidiflorus	Green Rabbitbrush	37090

Family	Scientific Name (Welch et al. 1993)	Scientific Name (Kartez 1999)	Common Name	TSN
	Chrysothamnus viscidiflorus (Hook.) Nutt. ssp. lanceolatus (Nutt.) Hall & Clements	Chrysothamnus viscidiflorus ssp. lanceolatus	Green Rabbitbrush	37094
	Chrysothamnus viscidiflorus ssp. viscidiflorus var. stenophyllus (Gray) Hall	Chrysothamnus viscidiflorus var. stenophyllus	Green Rabbitbrush	531602
	Cirsium arvense (L.) Scop.	Cirsium arvense	Canada Thistle	36335
	Cirsium calcareum (M.E. Jones) Woot. & Standl.	Cirsium calcareum	Cainville Thistle	36346
	Cirsium ownbeyi Welsh	Cirsium ownbeyi	Ownbey's Thistle	501549
	Cirsium P. Mill.	Cirsium	Thistle	36334
	Cirsium undulatum (Nutt.) Spreng.	Cirsium undulatum	Wavyleaf Thistle	36423
	Cirsium vulgare (Savi) Ten.	Cirsium vulgare	Bull Thistle	36428
	Conyza canadensis (L.) Cronq.	Conyza canadensis	Canada Horseweed	37113
	Crepis acuminata Nutt.	Crepis acuminata	Longleaf Hawk's-beard	37169
	Crepis intermedia Gray	Crepis intermedia	Limestone Hawk's-beard	37185
	Crepis L.	Crepis	Hawk's-beard	37168
	Crepis modocensis Greene	Crepis modocensis	Siskiyou Hawk's-beard	37186
	Crepis runcinata (James) Torr. & Gray	Crepis runcinata	Fiddle-leaf Hawk's-beard	37203
	Crepis runcinata (James) Torr. & Gray ssp. glauca (Nutt.) Bab. & Steb.	Crepis runcinata ssp. glauca	Fiddle-leaf Hawk's-beard	37207
	Enceliopsis (Gray) A. Nels.	Enceliopsis	Sunray	37311
	Enceliopsis nudicaulis (Gray) A. Nels.	Enceliopsis nudicaulis	Naked-stem Sunray	37314
	Ericameria Nutt.	Ericameria	Rabbitbrush	37323
	Erigeron compositus Pursh	Erigeron compositus	Dwarf Mountain Fleabane	35843
	Erigeron engelmannii A. Nels.	Erigeron engelmannii	Engelmann's Fleabane	35859
	Erigeron nematophyllus Rydb.	Erigeron nematophyllus	Needle-leaf Fleabane	35910
	Erigeron pumilus Nutt.	Erigeron pumilus	Shaggy Fleabane	35934
	Erigeron sp. L.	Erigeron	Fleabane	35803
	Erigeron speciosus (Lindl.) DC.	Erigeron speciosus	Aspen Fleabane	35950
	Eupatorium maculatum L.	Eupatorium maculatum	Spotted Joe-pyeweed	502517
	Euthamia occidentalis Nutt.	Euthamia occidentalis	Western Goldentop	37356
	Gaillardia aristata Pursh	Gaillardia aristata	Great Blanket-flower	37398
	Grindelia squarrosa (Pursh) Dunal	Grindelia squarrosa	Curly-cup Gumweed	37472
	Gutierrezia sarothrae (Pursh) Britt. & Rusby	Gutierrezia sarothrae	Snakeweed	37483
	Haplopappus acaulis (Nutt.) Gray	Stenotus acaulis	Stemless Mock Goldenweed	37499
	Haplopappus armerioides (Nutt.) Gray	Stenotus armerioides	Skyline Goldenweed	37506
	Helianthella microcephala (Gray) Gray	Helianthella microcephala	Small-head Rockrose	37595
	Helianthella uniflora (Nutt.) Torr. & Gray	Helianthella uniflora	Dwarf Sunflower	37598
	Helianthus annuus L.	Helianthus annuus	Common Sunflower	36616

Family	Scientific Name (Welch et al. 1993)	Scientific Name (Kartez 1999)	Common Name	TSN
	Helianthus anomalus Blake	Helianthus anomalus	Western Sunflower	36617
	Helianthus L.	Helianthus	Sunflower	36611
	Helianthus petiolaris Nutt.	Helianthus petiolaris	Prairie Sunflower	36671
	Hymenopappus filifolius Hook.	Hymenopappus filifolius	Fineleaf Woollywhite	37766
	Hymenopappus filifolius Hook. var. luteus (Nutt.) B.L. Turner	Hymenopappus filifolius var. luteus	Fineleaf Woollywhite	528522
	Hymenoxys acaulis (Pursh) Parker	Tetraneuris acaulis	Arizona Bitterweed	514991
	Hymenoxys acaulis var. ivesiana (Greene) Parker	Tetraneuris ivesiana	Ives' Four-nerve-daisy	536278
	Hymenoxys Cass.	Hymenoxys	Rubberweed	37778
	Hymenoxys lapidicola Welsh & Neese	Hymenoxys lapidicola	Rock Rubberweed	503124
	Hymenoxys richardsonii (Hook.) Cockerell	Hymenoxys richardsonii	Colorado Rubberweed	37785
	Hymenoxys torreyana (Nutt.) Parker	Tetraneuris torreyana	Torrey's Four-Nerve-Daisy	515002
	Iva axillaris Pursh	Iva axillaris	Deer-root	36033
	Iva xanthifolia Nutt.	Iva xanthifolia	Coarse Sumpweed	36041
	Lactuca serriola L.	Lactuca serriola	Prickly Lettuce	36608
	Lygodesmia D. Don	Lygodesmia	Skeletonplant	500397
	Lygodesmia grandiflora (Nutt.) Torr. & Gray	Lygodesmia grandiflora	Rush-pink	503622
	Machaeranthera canescens (Pursh) Gray	Machaeranthera canescens	Hoary Tansy-aster	37984
	Machaeranthera grindelioides var. grindelioides (Nutt.) Shinners	Machaeranthera grindelioides var. grindelioides	Rayless Tansy-aster	37992
	Machaeranthera Nees	Machaeranthera	Tansy-aster	37970
	Onopordum L.	Onopordum	Cotton-thistle	38139
	Oxytenia acerosa Nutt.	Iva acerosa	Copperweed	518080
	Packera A. & D. Löve	Packera	Groundsel	564882
	Petradoria pumila (Nutt.) Greene	Petradoria pumila	Grassy Rock-goldenrod	38233
	Platyschkuhria integrifolia (Gray) Rydb.	Platyschkuhria integrifolia	Basin-daisy	38253
	Senecio canus Hook.	Packera cana	Silvery Ragwort	36109
	Senecio integerrimus Nutt.	Senecio integerrimus	Lamb-tongue Ragwort	36148
	Senecio L.	Senecio	Ragwort	36084
	Senecio multilobatus Torr. & Gray ex Gray	Packera multilobata	Lobeleaf Groundsel	36161
	Senecio streptanthifolius Greene	Packera streptanthifolia	Rocky Mountain Ragwort	36187
	Solidago canadensis L.	Solidago canadensis	Canada Goldenrod	36224
	Solidago gigantea Ait.	Solidago gigantea	Giant Goldenrod	36259
	Solidago L.	Solidago	Goldenrod	36223
	Solidago missouriensis Nutt.	Solidago missouriensis	Missouri Goldenrod	36277
	Solidago nana Nutt.	Solidago nana	Baby Goldenrod	36280
	Solidago spathulata DC.	Solidago simplex var. spathulata	Mt. Albert Goldenrod	36307
	Solidago velutina DC.	Solidago velutina	Three-nerve Goldenrod	505290
	Sonchus arvensis L. ssp. uliginosus (Bieb.) Nyman	Sonchus arvensis ssp. uliginosus	Field Sowthistle	38423

Family	Scientific Name (Welch et al. 1993)	Scientific Name (Kartez 1999)	Common Name	TSN
	Sonchus asper (L.) Hill	Sonchus asper	Spiny-leaf Sowthistle	38424
	Sonchus uliginosus Bieb.	Sonchus arvensis ssp. uliginosus	Field Sowthistle	521791
	Stephanomeria exigua Nutt.	Stephanomeria exigua	White-plume Wire-lettuce	38445
	Stephanomeria runcinata Nutt.	Stephanomeria runcinata	Flowering-straw	38452
	Taraxacum officinale G.H. Weber ex Wiggers	Taraxacum officinale	Common Dandelion	36213
	Tetradymia canescens DC.	Tetradymia canescens	Gray Horsebrush	38494
	Tetradymia nuttallii Torr. & Gray	Tetradymia nuttallii	Nuttall's Horsebrush	38498
	Tetradymia spinosa Hook. & Arn.	Tetradymia spinosa	Short-spine Horsebrush	38499
	Townsendia annua Beaman	Townsendia annua Annual	Townsend-daisy	38538
	Townsendia Hook.	Townsendia	Townsend-daisy	38536
	Townsendia incana Nutt.	Townsendia incana	Hoary Townsend-daisy	38549
	Townsendia leptotes (Gray) Osterhout	Townsendia leptotes	Common Townsend-daisy	38551
	Tragopogon dubius Scop.	Tragopogon dubius	Meadow Goat's-beard	38564
	Viguiera multiflora (Nutt.) Blake	Heliomeris multiflora	Showy False Goldeneye	523280
	Wyethia scabra Hook.	Wyethia scabra	Badland Mule's-ears	38687
	Xanthium strumarium L.	Xanthium strumarium	Rough Cocklebur	38692
	Xylorhiza venusta (M.E. Jones) Heller	Xylorhiza venusta	Charming Woody-aster	38701
Berberidaceae	Mahonia repens (Lindl.) G. Don	Mahonia repens	Creeping Oregon-grape	195045
Betulaceae	Betula occidentalis Hook.	Betula occidentalis	Water Birch	19488
Boraginaceae	Cryptantha crassisepala (Torr. & Gray) Greene	Cryptantha crassisepala	Thick-sepal Cat's-eye	31800
	Cryptantha flava (A. Nels.) Payson	Cryptantha flava	Plateau Yellow Cat's-eye	31770
	Cryptantha flavoculata (A. Nels.) Payson	Cryptantha flavoculata	Rough-seed Cat's-eye	31809
	Cryptantha Lehm. ex G. Don	Cryptantha	Cat's-eye	31765
	Lappula Moench	Lappula	Sheepburr	32043
	Lappula occidentalis (S. Wats.) Greene	Lappula occidentalis	Flat-spine Sheepburr	503329
	Lithospermum L.	Lithospermum	Gromwell	31937
	Lithospermum ruderale Dougl. ex Lehm.	Lithospermum ruderale	Columbian Puccoon	31953
	Mertensia oblongifolia (Nutt.) G. Don	Mertensia oblongifolia	Sagebrush Bluebells	31683
	Plagiobothrys Fisch. & C.A. Mey.	Plagiobothrys	Popcorn-flower	31979
Brassicaceae	Alyssum minus (L.) Rothm.	Alyssum minus	European Madwort	508080
	Alyssum alyssoides (L.) L.	Alyssum alyssoides	Pale Madwort	23030
	Alyssum desertorum Stapf	Alyssum desertorum	Desert Madwort	23032
	Alyssum L.	Alyssum	Madwort	23029
	Arabis divaricarpa A. Nels. (pro sp.)	Arabis X divaricarpa	Hybrid Rockcress	22688
	Arabis fernaldiana Rollins var. fernaldiana	Arabis vivariensis	Fernald's Rockcress	184335
	Arabis L.	Arabis	Rockcress	22671
	Camelina microcarpa DC.	Camelina microcarpa	Little-pod False Flax	22599

Family	Scientific Name (Welch et al. 1993)	Scientific Name (Kartez 1999)	Common Name	TSN
	Caulanthus crassicaulis (Torr.) S. Wats.	Caulanthus crassicaulis	Thick-stem Wild Cabbage	23080
	Chorispora tenella (Pallas) DC.	Chorispora tenella	Crossflower	23099
	Descurainia incana (Bernh. ex Fisch. & C.A. Mey.) Dorn	Descurainia incana	Mountain Tansy-mustard	502003
	Descurainia pinnata (Walt.) Britt.	Descurainia pinnata	Western Tansy-mustard	22826
	Descurainia sophia (L.) Webb ex Prantl	Descurainia sophia	Herb Sophia	22843
	Descurainia Webb & Berth.	Descurainia	Tansy-mustard	22819
	Draba cuneifolia Nutt. ex Torr. & Gray	Draba cuneifolia	Wedgeleaf Whitlow-grass	22874
	Draba L.	Draba	Whitlow-grass	22844
	Draba oligosperma Hook.	Draba oligosperma	Few-seed Whitlow-grass	22896
	Erysimum asperum (Nutt.) DC.	Erysimum capitatum var. capitatum	Western Wallflower	22931
	Erysimum L.	Erysimum	Wallflower	22926
	Lepidium L.	Lepidium	Pepperwort	22953
	Lepidium lasiocarpum Nutt.	Lepidium lasiocarpum	Hairy-pod Pepperwort	22967
	Lepidium latifolium L.	Lepidium latifolium	Broadleaf Pepperwort	503379
	Lepidium montanum Nutt.	Lepidium montanum	Mountain Pepperwort	503381
	Lepidium perfoliatum L.	Lepidium perfoliatum	Clasping Pepperwort	22974
	Lepidium virginicum L.	Lepidium virginicum	Poorman's Pepperwort	22955
	Lesquerella ludoviciana (Nutt.) S. Wats.	Lesquerella ludoviciana	Louisiana Bladderpod	23205
	Lesquerella S. Wats.	Lesquerella	Bladderpod	23162
	Malcolmia africana (L.) Ait. f.	Malcolmia africana	African Adder's-mouth	23243
	Nasturtium officinale Ait. f.	Rorippa nasturtium-aquaticum	Watercress	23255
	Physaria (Nutt. ex Torr. & Gray)	Gray	Physaria Twinpod	23269
	Physaria acutifolia Rydb.	Physaria acutifolia	Sharpleaf Twinpod	23270
	Physaria newberryi Gray	Physaria newberryi	Newberry's Twinpod	23281
	Physaria reediana O'Kane & Al-Shehbaz	Lesquerella alpina	Alpine Bladderpod	
	Lesquerella utahensis Rydb.	Lesquerella utahensis	Utah Bladderpod	23232
	Sisymbrium altissimum L.	Sisymbrium altissimum	Tall Hedge-mustard	23312
	Stanleya pinnata (Pursh) Britt.	Stanleya pinnata	Golden Prince's-plume	23329
	Streptanthella longirostris (S. Wats.) Rydb.	Streptanthella longirostris	Long-beak Fiddle-mustard	23333
	Thelypodium integrifolium (Nutt.) Endl. ex Walp.	Thelypodium integrifolium	Entireleaf Thelypody	23398
Cactaceae	Coryphantha vivipara (Nutt.) Britt. & Rose	Escobaria vivipara	Spinystar	19840
	Echinocereus triglochidiatus Engelm.	Echinocereus triglochidiatus	King-cup Cactus	19815
	Opuntia erinacea Engelm. & Bigelow ex Engelm.	Opuntia erinacea	Oldman Cactus	19705
	Opuntia fragilis (Nutt.) Haw.	Opuntia fragilis	Brittle Prickly-pear	19707
	Opuntia polyacantha Haw.	Opuntia polyacantha	Panhandle Prickly-pear	19726
	Pediocactus simpsonii (Engelm.) Britt. & Rose	Pediocactus simpsonii	Snowball Cactus	19776
	Sclerocactus whipplei (Engelm. & Bigelow) Britt. & Rose	Sclerocactus whipplei	Whipple's Fishhook Cactus	19765

Family	Scientific Name (Welch et al. 1993)	Scientific Name (Kartez 1999)	Common Name	TSN
Capparidaceae	Cleome lutea Hook.	Cleome lutea	Yellow Spiderflower	22620
	Cleome serrulata Pursh	Cleome serrulata	Rocky Mountain Beeplant	22626
Caprifoliaceae	Sambucus caerulea Raf.	Sambucus nigra ssp. caerulea	Blue Elder	35320
	Sambucus racemosa L.	Sambucus racemosa	European Red Elder	35326
	Symphoricarpos longiflorus Gray	Symphoricarpos longiflorus	Desert Snowberry	35334
	Symphoricarpos occidentalis Hook.	Symphoricarpos occidentalis	Western Snowberry	35336
	Symphoricarpos oreophilus Gray	Symphoricarpos oreophilus	Mountain Snowberry	35338
Caryophyllaceae	Arenaria congesta Nutt.	Arenaria congesta	Ball-head Sandwort	20243
	Arenaria fendleri Gray	Arenaria fendleri	Fendler's Sandwort	20245
	Arenaria L.	Arenaria	Sandwort	20235
	Silene antirrhina L.	Silene antirrhina	Sleepy Catchfly	20045
	Silene L.	Silene	Catchfly	20040
	Silene menziesii Hook.	Silene menziesii	White Catchfly	20083
	Stellaria jamesiana Torr.	Pseudostellaria jamesiana	Sticky False-starwort	521985
	Stellaria L.	Stellaria	Chickweed, Starwort	20163
Celastraceae	Paxistima myrsinites (Pursh) Raf.	Paxistima myrsinites	Oregon Boxleaf	504149
Chenopodiaceae	Atriplex argentea Nutt.	Atriplex argentea	Silverscale	20512
	Atriplex canescens (Pursh) Nutt.	Atriplex canescens	Fourwing Saltbush	20518
	Atriplex confertifolia (Torr. & Frém.) S. Wats.	Atriplex confertifolia	Shadscale	20519
	Atriplex corrugata S. Wats.	Atriplex corrugata	Mat Saltbush	20522
	Atriplex gardneri (Moq.) D. Dietr.	Atriplex gardneri	Gardner's Saltbush	20531
	Bassia scoparia (L.) A.J. Scott	Bassia scoparia	Mexican Fireweed	565741
	Chenopodium album L.	Chenopodium album	Lamb's-quarters	20592
	Chenopodium atrovirens Rydb.	Chenopodium atrovirens	Pinyon Goosefoot	20593
	Chenopodium desiccatum A. Nels.	Chenopodium desiccatum	Arid-land Goosefoot	20604
	Chenopodium fremontii S. Wats.	Chenopodium fremontii	Fremont's Goosefoot	20607
	Chenopodium L.	Chenopodium	Goosefoot	20589
	Chenopodium simplex (Torr.) Raf.	Chenopodium simplex	Giant-seed Goosefoot	501487
	Grayia spinosa (Hook.) Moq.	Grayia spinosa	Spiny Hopsage	20690
	Halogeton glomeratus (Bieb.) C.A. Mey.	Halogeton glomeratus	Salt-lover	20692
	Kochia americana S. Wats.	Kochia americana	Greenmolly	20694
	Krascheninnikovia lanata (Pursh) A.D.J. Meeuse & Smit	Krascheninnikovia lanata	Winter-fat	503290
	Salsola tragus L.	Salsola tragus	Prickly Russian-thistle	520950
	Sarcobatus vermiculatus (Hook.) Torr.	Sarcobatus vermiculatus	Black Greasewood	20707
	Suaeda torreyana S. Wats.	Suaeda moquinii	Shrubby Seepweed	20675
	Zuckia brandegeei (Gray) Welsh & Stutz ex Welsh	Zuckia brandegeei	Siltbush	505810
Cornaceae	Cornus sericea L.	Cornus sericea	Red-osier Dogwood	501637

Family	Scientific Name (Welch et al. 1993)	Scientific Name (Kartez 1999)	Common Name	TSN
	Cornus stolonifera Michx.	Cornus sericea ssp. sericea	Red-osier Dogwood	27818
Crassulaceae	Sedum debile S. Wats.	Sedum debile	Weak-stem Stonecrop	24111
	Sedum L.	Sedum	Stonecrop	24103
	Sedum lanceolatum Torr.	Sedum lanceolatum	Lanceleaf Stonecrop	24126
Crossosomataceae	Glossopetalon spinescens var. meionandrum (Koehne) Trel.	Glossopetalon spinescens var. meionandrum	Spiny Greasebush	528253
Cupressaceae	Juniperus communis L.	Juniperus communis	Common Juniper	194820
	Juniperus osteosperma (Torr.) Little	Juniperus osteosperma	Utah Juniper	194859
	Juniperus scopulorum Sarg.	Juniperus scopulorum	Rocky Mountain Juniper	194872
Cyperaceae	Carex	Carex	Sedge	39369
	Carex aquatilis Wahlenb.	Carex aquatilis	Aquatic Sedge	39374
	Carex aurea Nutt.	Carex aurea	Golden-fruit Sedge	39445
	Carex crawei Dewey	Carex crawei	Crawe's Sedge	39558
	Carex curatorum Stacey	Carex curatorum	Kaibab Sedge	39565
	Carex geyeri Boott	Carex geyeri	Geyer's Sedge	39613
	Carex hystericina Muhl. ex Willd.	Carex hystericina	Bottlebrush Sedge	39456
	Carex lanuginosa Michx.	Carex pellita	Woolly Sedge	39458
	Carex microptera Mackenzie	Carex microptera	Small-wing Sedge	39699
	Carex nebrascensis Dewey	Carex nebrascensis	Nebraska Sedge	39711
	Carex occidentalis Bailey	Carex occidentalis	Western Sedge	39726
	Carex parryana Dewey	Carex parryana	Parry's Sedge	39741
	Carex praegracilis W. Boott	Carex praegracilis	Clustered Field Sedge	39767
	Carex rossii Boott	Carex rossii	Ross' Sedge	39786
	Cyperus squarrosus L.	Cyperus squarrosus	Awned Flatsedge	501940
	Eleocharis palustris (L.) Roemer & J.A. Schultes	Eleocharis palustris	Marsh Spikerush	40019
	Eleocharis R. Br.	Eleocharis	Spikerush	40010
	Scirpus acutus Muhl. ex Bigelow	Schoenoplectus acutus	Hardstem Bulrush	40240
	Scirpus maritimus L.	Schoenoplectus maritimus	Saltmarsh Clubrush	40234
	Scirpus pungens Vahl	Schoenoplectus pungens	Common Threesquare	40275
	Scirpus validus Vahl	Schoenoplectus tabernaemontani	Softstem Bulrush	40239
Dryopteridaceae	Cystopteris fragilis (L.) Bernh.	Cystopteris fragilis	Fragile Fern	17482
Elaeagnaceae	Elaeagnus angustifolia L.	Elaeagnus angustifolia	Russian-olive	27770
	Shepherdia canadensis (L.) Nutt.	Shepherdia canadensis	Russet Buffaloberry	27779
	Shepherdia rotundifolia Parry	Shepherdia rotundifolia	Roundleaf Buffaloberry	27780
Ephedraceae	Ephedra torreyana S. Wats.	Ephedra torreyana	Torrey's Joint-fir	502318
	Ephedra viridis Coville	Ephedra viridis	Mormon-tea	502319
Equisetaceae	Equisetum arvense L.	Equisetum arvense	Field Horsetail	17152

Family	Scientific Name (Welch et al. 1993)	Scientific Name (Kartez 1999)	Common Name	TSN
	Equisetum hyemale L.	Equisetum hyemale	Common Scouring-rush	17154
	Equisetum L.	Equisetum	Horsetail	17148
	Equisetum laevigatum A. Braun	Equisetum laevigatum	Smooth Horsetail	17156
Ericaceae	Arctostaphylos patula Greene	Arctostaphylos patula	Greenleaf Manzanita	23512
Euphorbiaceae	Chamaesyce fendleri (Torr. & Gray) Small	Chamaesyce fendleri	Fendler's Sandmat	501419
	Chamaesyce glyptosperma (Engelm.) Small	Chamaesyce glyptosperma	Rib-Seed Sandmat	501422
	Chamaesyce parryi (Engelm.) Rydb.	Chamaesyce parryi	Parry's Sandmat	501448
	Euphorbia brachycera Engelm.	Euphorbia brachycera	Horned Spurge	28049
	Euphorbia sp. L.	Euphorbia	Spurge	28032
Fabaceae	Astragalus bisulcatus (Hook.) Gray	Astragalus bisulcatus	Two-grooved Milk-vetch	25438
	Astragalus cicer L.	Astragalus cicer Cicer	Milk-vetch	25464
	Astragalus convallarius Greene	Astragalus convallarius	Lesser Rushy Milk-vetch	25477
	Astragalus mollissimus Torr.	Astragalus mollissimus	Woolly Milk-vetch	25589
	Astragalus racemosus Pursh	Astragalus racemosus	Cream Milk-Vetch	25650
	Astragalus L.	Astragalus	Milk-vetch	25392
	Astragalus spatulatus Sheldon	Astragalus spatulatus	Tufted Milk-vetch	25687
	Astragalus tenellus Pursh	Astragalus tenellus	Loose-flower Milk-vetch	25696
	Glycyrrhiza lepidota Pursh	Glycyrrhiza lepidota	American Licorice	26719
	Hedysarum boreale Nutt.	Hedysarum boreale	Northern Sweet-vetch	26724
	Lupinus argenteus Pursh	Lupinus argenteus	Silver-stem Lupine	503575
	Lupinus caudatus Kellogg	Lupinus caudatus	Kellogg's Spurred Lupine	25981
	Lupinus sericeus Pursh	Lupinus sericeus	Pursh's Silky Lupine	26112
	Lupinus L.	Lupinus	Lupine	25916
	Melilotus albus Med.	Melilotus officinalis	Sweetclover	26149
	Melilotus officinalis (L.) Lam.	Melilotus officinalis	Sweetclover	26150
	Melilotus P. Mill.	Melilotus	Sweetclover	26148
	Psoralidium lanceolatum (Pursh) Rydb.	Psoralidium lanceolatum	Lemon Scurfpea	504645
	Trifolium gymnocarpon Nutt.	Trifolium gymnocarpon	Hollyleaf Clover	26255
	Trifolium L.	Trifolium	Clover	26204
	Trifolium pratense L.	Trifolium pratense	Red Clover	26313
	Trifolium repens L.	Trifolium repens	White Clover	26206
	Vicia L.	Vicia	Vetch	26329
Fumariaceae	Corydalis aurea Willd.	Corydalis aurea	Scrambledeggs	18999
Geraniaceae	Erodium cicutarium (L.) L'Her. ex Ait	Erodium cicutarium	Crane's-bill	29147
	Geranium viscosissimum Fisch. & C.A. Mey. ex C.A. Mey. var. incisum (Torr. & Gray) N. Holmgren	Geranium viscosissimum var. incisum	Sticky Geranium	566245
Grossulariaceae	Ribes aureum Pursh	Ribes aureum	Golden Currant	24452

Family	Scientific Name (Welch et al. 1993)	Scientific Name (Kartez 1999)	Common Name	TSN
	Ribes cereum var. pedicellare Brewer & S. Wats.	Ribes cereum	Wax Currant	24457
	Ribes inerme Rydb.	Ribes inerme	White-stem Gooseberry	24473
	Ribes L.	Ribes	Gooseberry	24448
	Ribes lacustre (Pers.) Poir.	Ribes lacustre Bristly	Black Currant	24476
	Ribes viscosissimum Pursh	Ribes viscosissimum	Sticky Currant	24510
Hydrangeaceae	Fendlerella utahensis (S. Wats.) Heller	Fendlerella utahensis	Utah Fendlerbush	24334
	Philadelphus microphyllus Gray	Philadelphus microphyllus	Littleleaf Mock Orange	24437
Hydrophyllaceae	Phacelia crenulata Torr. ex S. Wats.	Phacelia crenulata	Notchleaf Scorpionweed	31478
	Phacelia demissa Gray	Phacelia demissa	Basin Scorpion-weed	31483
	Phacelia sp. Juss.	Phacelia	Scorpionweed	31433
Iridaceae	Iris missouriensis Nutt.	Iris missouriensis	Stony Mountain Iris	43221
Juncaceae	Juncus balticus Willd.	Juncus arcticus	Arctic Rush	39222
	Juncus bufonius L.	Juncus bufonius	Toad Rush	39227
	Juncus ensifolius var. montanus (Engelm.) C.L. Hitchc.	Juncus saximontanus	Rocky Mountain Rush	536430
	Juncus ensifolius Wikstr.	Juncus ensifolius	Daggerleaf Rush	39269
	Juncus L.	Juncus	Rush	39220
	Juncus longistylis Torr.	Juncus longistylis	Long-styled Rush	503256
	Juncus orthophyllus Coville	Juncus orthophyllus	Straight-leaf Rush	39299
Lamiaceae	Mentha arvensis L.	Mentha arvensis	Wild Mint	565302
	Prunella vulgaris L.	Prunella vulgaris	Common Self-heal	32381
Liliaceae	Allium acuminatum Hook.	Allium acuminatum	Taper-tip Onion	42707
	Allium L.	Allium	Garlic, Onion, Wild Leek	42634
	Allium textile A. Nels. & J.F. Macbr.	Allium textile	White Wild Onion	42670
	Calochortus gunnisonii S. Wats.	Calochortus gunnisonii	Gunnison's Mariposa-lily	42849
	Calochortus nuttallii Torr. & Gray	Calochortus nuttallii	Sego-lily	42863
	Calochortus Pursh	Calochortus	Mariposa-lily	42823
	Erythronium grandiflorum Pursh	Erythronium grandiflorum	Yellow Avalanche Lily	196372
	Fritillaria atropurpurea Nutt.	Fritillaria atropurpurea	Spotted Missionbells	502669
	Smilacina stellata (L.) Desf.	Maianthemum stellatum	False Solomon's-seal	43038
	Zigadenus paniculatus (Nutt.) S. Wats.	Zigadenus paniculatus	Sand-corn	43167
	Zigadenus vaginatus (Rydb.) J.F. Macbr.	Zigadenus vaginatus	Sheathed Deathcamas	505802
Linaceae	Linum lewisii Pursh	Linum lewisii	Prairie Flax	29214
	Linum perenne L.	Linum perenne	Blue Flax	29217
Loasaceae	Mentzelia albicaulis (Dougl. ex Hook.) Dougl. ex Torr. & Gray	Mentzelia albicaulis	White-Stem Blazingstar	503757
	Mentzelia multicaulis (Osterhout) A. Nels. ex J. Darl.	Mentzelia multicaulis	Many-stem Blazingstar	503787
	Mentzelia thompsonii Glad.	Mentzelia humilis	Gyp Mentzelia	503810
Malvaceae	Sphaeralcea coccinea (Nutt.) Rydb.	Sphaeralcea coccinea	Scarlet Globemallow	21920

Family	Scientific Name (Welch et al. 1993)	Scientific Name (Kartez 1999)	Common Name	TSN
	Sphaeralcea parvifolia A. Nels.	Sphaeralcea parvifolia	Small-leaf Globemallow	21953
	Sphaeralcea sp. St.-Hil.	Sphaeralcea	Globemallow	21909
Nyctaginaceae	Abronia fragrans Nutt. ex Hook.	Abronia fragrans	Heart's-delight	19557
	Mirabilis linearis (Pursh) Heimerl	Mirabilis linearis	Narrowleaf Four-o'clock	19651
Oleaceae	Fraxinus anomala Torr. ex S. Wats.	Fraxinus anomala	Singleleaf Ash	32937
Onagraceae	Calylophus lavandulifolius (Torr. & Gray) Raven	Calylophus lavandulifolius	Lavender-leaf Sundrops	501160
	Camissonia Link	Camissonia	Suncup	27462
	Epilobium angustifolium L.	Chamerion angustifolium	Fireweed	27284
	Epilobium brachycarpum K. Presl.	Epilobium brachycarpum	Tall Annual Willowherb	27288
	Epilobium ciliatum Raf.	Epilobium ciliatum	Fringed Willowherb	27293
	Oenothera caespitosa Nutt.	Oenothera caespitosa	Tufted Evening-primrose	565328
	Oenothera pallida Lindl.	Oenothera pallida	White-pole Evening-primrose	27436
	Oenothera pallida Lindl. ssp. trichocalyx (Nutt.) Munz & W. Klein	Oenothera pallida ssp. trichocalyx	Pale Evening-primrose	27440
	Oenothera sp. L.	Oenothera	Evening-primrose	27367
Orchidaceae	Epipactis gigantea Dougl. ex Hook.	Epipactis gigantea	Giant Helleborine	43481
	Habenaria hyperborea (L.) R. Br. ex Ait. f.	Platanthera hyperborea	Northern Green Orchid	514368
	Habenaria zothecina Higgins & Welsh	Platanthera zothecina	Alcove Bog Orchid	514389
	Spiranthes romanzoffiana var. diluvialis (Sheviak) Welsh	Spiranthes diluvialis	Ute Ladie's-tresses	540892
Pinaceae	Pinus edulis Engelm.	Pinus edulis	Two-needle Pinyon	183336
	Pinus flexilis James	Pinus flexilis	Limber Pine	183343
	Pinus ponderosa P. & C. Lawson	Pinus ponderosa	Ponderosa Pine	183365
	Pseudotsuga menziesii (Mirbel) Franco	Pseudotsuga menziesii	Douglas-fir	183424
Plantaginaceae	Plantago major L.	Plantago major	Common Plantain	32887
	Plantago patagonica Jacq.	Plantago patagonica	Woolly Plantain	32907
Poaceae	Achnatherum Beauv.	Achnatherum	Ricegrass	500933
	Agropyron cristatum (L.) Gaertn.	Agropyron cristatum	Crested Wheatgrass	182478
	Agrostis L.	Agrostis	Bentgrass	40389
	Agrostis scabra Willd.	Agrostis scabra	Rough Bentgrass	40424
	Agrostis stolonifera L.	Agrostis stolonifera	Creeping Bentgrass	40400
	Agrostis variabilis Rydb.	Agrostis variabilis	Alpine Bentgrass	564993
	Alopecurus aequalis Sobol.	Alopecurus aequalis	Short-awn Foxtail	40436
	Aristida purpurea Nutt.	Aristida purpurea	Purple Three-awn	41429
	Bouteloua gracilis (Willd. ex Kunth) Lag. ex Griffiths	Bouteloua gracilis	Blue Grama	41493
	Bromus anomalus Rupr. ex Fourn.	Bromus anomalus	Nodding Brome	40491
	Bromus carinatus Hook. & Arn.	Bromus carinatus	California Brome	40481
	Bromus ciliatus L.	Bromus ciliatus	Fringed Brome	40496
	Bromus hordeaceus L.	Bromus hordeaceus	Soft Brome	501070

Family	Scientific Name (Welch et al. 1993)	Scientific Name (Kartez 1999)	Common Name	TSN
	Bromus inermis Leyss.	Bromus inermis	Smooth Brome	40502
	Bromus japonicus Thunb. ex Murr.	Bromus japonicus	Japanese Brome	40479
	Bromus sp. L.	Bromus	Brome	40478
	Bromus tectorum L.	Bromus tectorum	Cheatgrass	40524
	Calamagrostis scopulorum M.E. Jones	Calamagrostis scopulorum	Ditch Reedgrass	40566
	Cenchrus longispinus (Hack.) Fern.	Cenchrus longispinus	Innocent-weed	40570
	Dactylis glomerata L.	Dactylis glomerata	Orchard Grass	193446
	Danthonia unispicata (Thurb.) Munro ex Macoun	Danthonia unispicata	Few-flower Wild Oatgrass	41636
	Distichlis spicata (L.) Greene	Distichlis spicata	Saltgrass	40662
	Elymus canadensis L.	Elymus canadensis	Nodding Wild Rye	40683
	Elymus cinereus Scribn. & Merr.	Leymus cinereus	Great Basin Lyme Grass	40689
	Elymus elymoides (Raf.) Swezey	Elymus elymoides	Bottlebrush	502264
	Elymus glaucus Buckl.	Elymus glaucus	Blue Wild Rye	40684
	Elymus hispidus (Opiz) Melderis	Thinopyrum intermedium	Intermediate Wheatgrass	512825
	Elymus junceus Fisch.	Psathyrostachys juncea	Russian Wildrye	40702
	Elymus L.	Elymus	Wild Rye	40677
	Elymus lanceolatus (Scribn. & J.G. Sm.) Gould	Elymus lanceolatus	Streamside Wild Rye	502267
	Elymus repens (L.) Gould	Elymus repens	Creeping Wild Rye	512839
	Elymus salinus M.E. Jones	Leymus salinus	Salinas Lyme Grass	512841
	Elymus smithii (Rydb.) Gould	Pascopyrum smithii	Western Wheatgrass	512844
	Elymus spicatus (Pursh) Gould	Pseudoroegneria spicata	Bluebunch Wheatgrass	512845
	Elymus trachycaulus (Link) Gould ex Shinners	Elymus trachycaulus	Slender Wild Rye	502282
	Eremopyrum triticeum (Gaertn.) Nevski	Eremopyrum triticeum	Annual False Wheatgrass	41717
	Erioneuron pulchellum (Kunth) Tateoka	Dasyochloa pulchella	Low Woolly Grass	41732
	Festuca idahoensis Elmer	Festuca idahoensis	Idaho Fescue	40816
	Festuca L.	Festuca	Fescue	40792
	Festuca octoflora Walt.	Vulpia octoflora	Eight-flower Six-weeks Grass	513551
	Festuca ovina L.	Festuca ovina	Sheep Fescue	40804
	Festuca pratensis Huds.	Lolium pratense	Meadow Ryegrass	40822
	Glyceria striata (Lam.) A.S. Hitchc.	Glyceria striata	Fowl Mannagrass	40833
	Hilaria jamesii (Torr.) Benth.	Pleuraphis jamesii	James' Galleta	41768
	Hordeum brachyantherum Nevski	Hordeum brachyantherum	Meadow Barley	40875
	Hordeum jubatum L.	Hordeum jubatum	Foxtail Barley	40871
	Hordeum pusillum Nutt.	Hordeum pusillum	Little Barley	40866
	Koeleria macrantha (Ledeb.) J.A. Schultes	Koeleria macrantha	Prairie Junegrass	503284
	Melica bulbosa Geyer ex Porter & Coult.	Melica bulbosa	Onion Grass	41851
	Muhlenbergia asperifolia (Nees & Meyen ex Trin.) Parodi	Muhlenbergia asperifolia	Alkali Muhly	41899

Family	Scientific Name (Welch et al. 1993)	Scientific Name (Kartez 1999)	Common Name	TSN
	Muhlenbergia pungens Thurb.	Muhlenbergia pungens	Sandhill Muhly	41934
	Muhlenbergia thurberi Rydb.	Muhlenbergia thurberi	Thurber's Muhly	41944
	Oryzopsis micrantha (Trin. & Rupr.) Thurb.	Piptatherum micranthum	Little-seed Mountain Ricegrass	41989
	Panicum acuminatum Sw.	Dichanthelium acuminatum	Tapered Rosette Grass	518203
	Phalaris arundinacea L.	Phalaris arundinacea	Reed Canarygrass	41335
	Phleum pratense L.	Phleum pratense	Timothy	41062
	Phragmites australis (Cav.) Trin. ex Steud.	Phragmites australis	Common Reed	41072
	Poa bulbosa L.	Poa bulbosa	Bulbous Bluegrass	41116
	Poa fendleriana (Steud.) Vasey	Poa fendleriana	Muttongrass	504467
	Poa L.	Poa	Bluegrass	41074
	Poa leptocoma Trin.	Poa leptocoma	Marsh Bluegrass	41141
	Poa palustris L.	Poa palustris	Fowl Bluegrass	41151
	Poa pratensis L.	Poa pratensis	Kentucky Bluegrass	41088
	Poa secunda J. Presl.	Poa secunda	Curly Bluegrass	41103
	Schizachyrium scoparium (Michx.) Nash	Schizachyrium scoparium	Little Bluestem	42076
	Spartina pectinata Bosc ex Link	Spartina pectinata	Prairie Cordgrass	41272
	Sporobolus airoides (Torr.) Torr.	Sporobolus airoides	Alkali Sacaton	42128
	Sporobolus cryptandrus (Torr.) Gray	Sporobolus cryptandrus	Sand Dropseed	42132
	Stipa arida M.E. Jones	Achnatherum aridum	Mormon Needlegrass	42159
	Stipa comata Trin. & Rupr.	Hesperostipa comata	Needle-and-thread	42172
	Stipa hymenoides Roemer & J.A. Schultes	Achnatherum hymenoides	Indian Ricegrass	522063
	Stipa lettermanii Vasey	Achnatherum lettermanii	Letterman's Needlegrass	522065
	Stipa nelsonii Scribn.	Achnatherum nelsonii ssp. nelsonii	Nelson's Needlegrass	42182
	Stipa nelsonii ssp. dorei Barkworth & Maze	Achnatherum nelsonii ssp. dorei	Nelson's Needlegrass	42184
	Stipa viridula Trin.	Nassella viridula	Green Needlegrass	42167
Polemoniaceae	Gilia inconspicua (Sm.) Sweet	Gilia inconspicua	Shy Gilia	31127
	Gilia leptomeria Gray	Gilia leptomeria	Sand Gilia	31150
	Gilia pinnatifida Nutt. ex Gray	Gilia pinnatifida	Sticky Gilia	31168
	Gilia Ruiz & Pavón	Gilia	Gilia, Gily-flower	31075
	Gilia scopulorum M.E. Jones	Gilia scopulorum	Rock Gilia	31173
	Ipomopsis aggregata (Pursh) V. Grant	Ipomopsis aggregata	Scarlet Skyrocket	31192
	Ipomopsis congesta (Hook.) V. Grant	Ipomopsis congesta	Ball-head Skyrocket 31202	
	Ipomopsis Michx.	Ipomopsis	Skyrocket 31191	
	Ipomopsis pumila (Nutt.) V. Grant	Ipomopsis pumila	Low Skyrocket	31217
	Leptodactylon caespitosum Nutt.	Leptodactylon caespitosum	Matted Prickly-phlox	31239
	Leptodactylon pungens (Torr.) Torr. ex Nutt.	Leptodactylon pungens	Granite Prickly-phlox	31233
	Phlox austromontana Coville	Phlox austromontana	Desert Mountain Phlox	30913

Family	Scientific Name (Welch et al. 1993)	Scientific Name (Kartez 1999)	Common Name	TSN
	Phlox hoodii Richards.	Phlox hoodii	Hood's Phlox	30948
	Phlox L.	Phlox	Phlox	30897
	Phlox longifolia Nutt.	Phlox longifolia	Longleaf Phlox	30956
	Phlox multiflora A. Nels.	Phlox multiflora	Rocky Mountain Phlox	30964
	Phlox pulvinata (Wherry) Cronq.	Phlox pulvinata	Cushion Phlox	30980
	Polemonium L.	Polemonium	Jacob's-ladder	30998
Polygonaceae	Eriogonum alatum Torr.	Eriogonum alatum	Winged Wild Buckwheat	21057
	Eriogonum corymbosum Benth.	Eriogonum corymbosum	Crispleaf Wild Buckwheat	21103
	Eriogonum gordonii Benth.	Eriogonum gordonii	Gordon's Wild Buckwheat	21138
	Eriogonum heracleoides Nutt.	Eriogonum heracleoides	Parsnipflower Wild Buckwheat	21150
	Eriogonum inflatum Torr. & Frém.	Eriogonum inflatum	Indian-pipeweed	21163
	Eriogonum microthecum Nutt.	Eriogonum microthecum	Slender Wild Buckwheat	21192
	Eriogonum ovalifolium Nutt.	Eriogonum ovalifolium	Cushion Wild Buckwheat	21212
	Eriogonum salsuginosum (Nutt.) Hook.	Stenogonum salsuginosum	Smooth Two-whorl Buckwheat	513141
	Eriogonum sp. Michx.	Eriogonum	Wild Buckwheat	21054
	Eriogonum tumulosum (Barneby) Reveal	Eriogonum tumulosum	Woodside Buckwheat	21264
	Eriogonum umbellatum ssp. subaridum (S. Stokes) Munz	Eriogonum umbellatum var. subaridum	Sulphurflower Buckwheat	195621
	Eriogonum umbellatum Torr.	Eriogonum umbellatum	Sulphurflower Buckwheat	21266
	Polygonum aviculare L.	Polygonum aviculare	Yard Knotweed	20876
	Polygonum douglasii Greene	Polygonum douglasii	Douglas' Knotweed	20891
	Polygonum L.	Polygonum	Smartweed	20847
	Rumex crispus L.	Rumex crispus	Curly Dock	20937
	Rumex L.	Rumex	Dock, Sorrel	20933
Primulaceae	Dodecatheon pulchellum (Raf.) Merr.	Dodecatheon pulchellum	Dark-throat Shootingstar	23945
Pteridaceae	Cryptogramma R. Br.	Cryptogramma	Rockbrake	17460
	Pellaea glabella Mett. ex Kuhn	Pellaea glabella	Smooth Cliffbrake	17646
Ranunculaceae	Aquilegia micrantha Eastw.	Aquilegia micrantha	Mancos Columbine	18743
	Clematis columbiana (Nutt.) Torr. & Gray	Clematis columbiana	Columbian Virgin's-bower	18693
	Clematis ligusticifolia Nutt.	Clematis ligusticifolia	Deciduous Traveler's-joy	18702
	Delphinium nuttallianum Pritz. ex Walp.	Delphinium nuttallianum	Two-lobe Larkspur	18483
	Delphinium occidentale (S. Watson) S. Watson	Delphinium X occidentale	Duncecap Larkspur	
	Ranunculus cymbalaria Pursh	Ranunculus cymbalaria	Alkali Buttercup	18600
	Ranunculus testiculatus Crantz	Ceratocephala testiculata	Curveseed Butterwort	18649
Rhamnaceae	Ceanothus velutinus Dougl. ex Hook.	Ceanothus velutinus	Tobacco-brush	28517
Rosaceae	Amelanchier alnifolia (Nutt.) Nutt. ex M. Roemer	Amelanchier alnifolia	Saskatoon Serviceberry	25109
	Amelanchier Med.	Amelanchier	Serviceberry	25108
	Amelanchier utahensis Koehne	Amelanchier utahensis	Utah Serviceberry	25121

Family	Scientific Name (Welch et al. 1993)	Scientific Name (Kartez 1999)	Common Name	TSN
	Cercocarpus intricatus S. Wats.	Cercocarpus intricatus	Littleleaf Mountain-mahogany	25133
	Cercocarpus ledifolius Nutt.	Cercocarpus ledifolius	Curlleaf Mountain-mahogany	25134
	Cercocarpus montanus Raf.	Cercocarpus montanus	Mountain-mahogany	25136
	Holodiscus dumosus (Nutt. ex Hook.) Heller	Holodiscus dumosus	Glandular Oceanspray	25178
	Ivesia gordonii (Hook.) Torr. & Gray	Ivesia gordonii	Alpine Mousetail	503218
	Petrophyton caespitosum (Nutt.) Rydb.	Petrophyton caespitosum	Tufted Rockmat	25272
	Physocarpus alternans (M.E. Jones) J.T. Howell	Physocarpus alternans	Dwarf Ninebark	25278
	Physocarpus malvaceus (Greene) Kuntze	Physocarpus malvaceus	Mallow-leaf Ninebark	25280
	Potentilla gracilis Dougl. ex Hook.	Potentilla gracilis	Graceful Cinquefoil	24714
	Potentilla L.	Potentilla	Cinquefoil	24666
	Potentilla ovina Macoun ex J.M. Macoun	Potentilla ovina	Sheep Cinquefoil	24732
	Prunus virginiana L.	Prunus virginiana	Choke Cherry	24806
	Purshia mexicana (D. Don) Henrickson	Purshia mexicana	Mexican Cliffrose	195899
	Purshia tridentata (Pursh) DC.	Purshia tridentata	Bitterbrush	25290
	Rosa L.	Rosa	Rose	24807
	Rosa nutkana K. Presl	Rosa nutkana	Nootka Rose	24835
	Rosa woodsii Lindl.	Rosa woodsii	Woods' Rose	24847
	Rubus idaeus L.	Rubus idaeus	Red Raspberry	24947
Rubiaceae	Galium bifolium S. Wats.	Galium bifolium	Twinleaf Bedstraw	34826
	Galium multiflorum Kellogg	Galium multiflorum	Many-flower Bedstraw	34892
	Galium multiflorum var. coloradoense (W. Wight) Cronq.	Galium coloradoense	Colorado Bedstraw	535620
Salicaceae	Populus angustifolia James	Populus angustifolia	Narrowleaf Cottonwood	22452
	Populus deltoides var. wislizeni (S. Wats) Eckenwalder	Populus deltoides ssp. wislizeni	Rio Grande Cottonwood	524563
	Populus tremuloides Michx.	Populus tremuloides	Quaking Aspen	195773
	Populus x intercurrens S. Goodrich & S.L. Welsh	Populus x acuminata	Lanceleaf Cottonwood	
	Salix bebbiana Sarg.	Salix bebbiana	Long-beak Willow	22507
	Salix eriocephala Michaux	Salix eriocephala	Missouri Willow	22528
	Salix exigua Nutt.	Salix exigua	Coyote Willow	22529
	Salix L.	Salix	Willow	22476
	Salix lucida Muhl. ssp. caudata (Nutt.) E. Murr.	Salix lucida ssp. caudata	Shining Willow	524652
	Salix monticola Bebb	Salix monticola	Mountain Willow	22558
	Salix scouleriana Barratt ex Hook.	Salix scouleriana	Scouler's Willow	504980
Santalaceae	Comandra umbellata (L.) Nutt.	Comandra umbellata	Bastard Toadflax	501614
Saxifragaceae	Heuchera L.	Heuchera	Alumroot	24337
	Heuchera parvifolia Nutt. ex Torr. & Gray	Heuchera parvifolia	Littleleaf Alumroot	24366
Scrophulariaceae	Castilleja applegatei Fern. ssp. martinii (Abrams) Chuang & Heckard	Castilleja applegatei ssp. martinii	Wavyleaf Indian-paintbrush	525154
	Castilleja linariifolia Benth.	Castilleja linariifolia	Wyoming Indian-paintbrush	33138
	Castilleja Mutis ex L. f.	Castilleja	Indian-paintbrush	33049

Family	Scientific Name (Welch et al. 1993)	Scientific Name (Kartez 1999)	Common Name	TSN
	Collinsia parviflora Lindl.	Collinsia parviflora	Small-flower Blue-eyed Mary	33534
	Cordylanthus kingii S. Wats.	Cordylanthus kingii	King's Bird's-beak	33542
	Cordylanthus Nutt. ex Benth.	Cordylanthus	Bird's-beak	33537
	Orthocarpus Nutt.	Orthocarpus	Owl-clover	33430
	Orthocarpus tolmiei Hook. & Arn.	Orthocarpus tolmiei	Tolmie's Owl's-clover	33439
	Penstemon caespitosus Nutt. ex Gray	Penstemon caespitosus	Mat Penstemon	33839
	Penstemon humilis Nutt. ex Gray	Penstemon humilis	Low Beardtongue	33704
	Penstemon pachyphyllus Gray ex Rydb.	Penstemon pachyphyllus	Thickleaf Beardtongue	33963
	Penstemon paysoniorum Keck	Penstemon paysoniorum	Payson's Beardtongue	33975
	Penstemon Schmidel	Penstemon	Beardtongue	33665
	Penstemon strictus Benth.	Penstemon strictus	Rocky Mountain Beardtongue	33772
	Verbascum thapsus L.	Verbascum thapsus	Great Mullein	33394
	Veronica americana Schwein. ex Benth.	Veronica americana	American Brooklime	33399
Selaginellaceae	Selaginella mutica D.C. Eat. ex Underwood	Selaginella mutica	Bluntleaf Spike-moss	17086
Tamaricaceae	Tamarix chinensis Lour.	Tamarix chinensis	Chinese Tamarisk	22308
Typhaceae	Typha domingensis Pers.	Typha domingensis	Southern Cattail	42327
	Typha L.	Typha	Cattail	42324
	Typha latifolia L.	Typha latifolia	Broadleaf Cattail	42326
Ulmaceae	Celtis laevigata Willd. var. reticulata (Torr.) L. Benson	Celtis laevigata var. reticulata	Netleaf Hackberry	527226
Urticaceae	Urtica dioica L.	Urtica dioica	Stinging Nettle	19152
Violaceae	Viola sp. L.	Viola	Violet	22030

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. Eighteen associations in the table below were documented only during accuracy assessment (Plot codes in the rightmost column contain the letters “AA”). Three 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	Supporting Plot, Observation Point, and AA Point
Acer negundo - Celtis laevigata var. reticulata Woodland	CEGL002599	2	DINO.0320, DINO.0322
Acer negundo / Disturbed Understory Woodland	CEGL002693	11	DINO.0314, DINO.0315, DINO.0319, DINO.0621, DINO.0692, DINO.1413, DINO.1415
Acer negundo / Equisetum arvense Forest	CEGL000626	1	DINO.0010
Acer negundo / Prunus virginiana Forest	CEGL000628	2	DINO.0200, DINO.0236
Acer negundo / Rhus trilobata Woodland	CEGL002750	1	DINO.0688
Achnatherum hymenoides Colorado Plateau Herbaceous Vegetation	CEGL002343	2	DINO_AA.A1079, DINO_AA.A1081
Achnatherum lettermanii Herbaceous Alliance	A.2524	1	DINO.0532
Amelanchier (utahensis, alnifolia) - Cercocarpus montanus Shrubland	CEGL001070	14	DINO.0209, DINO.0212, DINO.0223, DINO.0267, DINO.0309, DINO.0328, DINO.0516, DINO.0559, DINO.0567, DINO.0591, DINO.0802, DINO.0804, DINO.0807, DINO.0911
Amelanchier alnifolia / Symphoricarpos oreophilus Shrubland	CEGL002569	3	DINO.0240, DINO.0329, DINO.0514
Amelanchier utahensis / Pseudoroegneria spicata Shrubland	CEGL001069	2	DINO.1011, DINO.1020
Amelanchier utahensis Shrubland	CEGL001067	2	DINO.0151, DINO.0696
Aquilegia micrantha - Calamagrostis scopulorum Herbaceous Vegetation	CEGL002592	7	DINO.0030, DINO.0031, DINO.0032, DINO.0693, DINO.1021, DINO.1411, DINO.1412
Arctostaphylos patula - Artemisia tridentata (ssp. vaseyana, ssp. wyomingensis) Shrubland	CEGL002694	2	DINO.0190, DINO.0310
Artemisia arbuscula ssp. longiloba / Elymus lanceolatus Shrubland	CEGL002585	2	DINO.0130, DINO.0595
Artemisia nova / Pseudoroegneria spicata Shrubland	CEGL001424	25	DINO.0186, DINO.0210, DINO.0219, DINO.0248, DINO.0259, DINO.0268, DINO.0346, DINO.0373, DINO.0403, DINO.0521, DINO.0557, DINO.0563, DINO.0570, DINO.0579, DINO.0581, DINO.0681, DINO.0685, DINO.0701, DINO.0702, DINO.0721, DINO.0803, DINO.0808, DINO.0809, DINO.0810, DINO.0903
Artemisia nova Shrubland	CEGL001417	3	DINO.0009, DINO.0156, DINO.0172
Artemisia tridentata - (Ericameria nauseosa) / Bromus tectorum Semi-natural Shrubland	CEGL002699	10	DINO.0022, DINO.0316, DINO.0429, DINO.0443, DINO.0459, DINO.0602, DINO.0609, DINO.0704, DINO.0712, DINO.1022
Artemisia tridentata (ssp. tridentata, ssp. xericensis) Shrubland Alliance	A.830	1	DINO.0500

Plant Association Scientific Name	Element Code	No. of Samples	Supporting Plot, Observation Point, and AA Point
Artemisia tridentata (ssp. vaseyana, ssp. wyomingensis) - Amelanchier utahensis Shrubland	CEGL002820	11	DINO.0147, DINO.0149, DINO.0628, DINO.0660, DINO.0661, DINO.0663, DINO.0664, DINO.0709, DINO.0904, DINO.0910, DINO.0914
Artemisia tridentata ssp. tridentata / Hesperostipa comata Shrubland	CEGL002966	2	DINO.0638, DINO.1408
Artemisia tridentata ssp. tridentata / Leymus cinereus Shrubland	CEGL001016	2	DINO.0611, DINO.1409
Artemisia tridentata ssp. tridentata / Sporobolus airoides Shrubland	CEGL002200	1	DINO.0132
Artemisia tridentata ssp. vaseyana / Achnatherum lettermanii Shrubland	CEGL002811	5	DINO.0271, DINO.0623, DINO.0662, DINO.0805, DINO.0812
Artemisia tridentata ssp. vaseyana / Balsamorhiza sagittata Shrubland	CEGL001020	2	DINO.0247, DINO.0630
Artemisia tridentata ssp. vaseyana / Hesperostipa comata Shrubland	CEGL002931	8	DINO.0256, DINO.0573, DINO.0582, DINO.0592, DINO.0622, DINO.0624, DINO.0625, DINO.0815
Artemisia tridentata ssp. vaseyana / Leymus cinereus Shrubland	CEGL001027	1	DINO.0553
Artemisia tridentata ssp. vaseyana / Pascopyrum smithii Shrubland	CEGL001028	1	DINO.0274
Artemisia tridentata ssp. vaseyana / Poa fendleriana Shrubland	CEGL002812	4	DINO.0330, DINO.0341, DINO.0561, DINO.0587
Artemisia tridentata ssp. vaseyana / Poa secunda Shrubland	CEGL001029	3	DINO.0525, DINO.0527, DINO.0548
Artemisia tridentata ssp. vaseyana / Pseudoroegneria spicata Shrubland	CEGL001030	7	DINO.0340, DINO.0345, DINO.0347, DINO.0550, DINO.0558, DINO.0566, DINO.0806
Artemisia tridentata ssp. wyomingensis - Atriplex confertifolia Shrubland	CEGL001040	4	DINO_AA.A0565, DINO_AA.A0569, DINO_AA.A0771, DINO_AA.A1290
Artemisia tridentata ssp. wyomingensis / Balsamorhiza sagittata Shrubland	CEGL000994	4	DINO.0102, DINO.0104, DINO.0408, DINO.0453
Artemisia tridentata ssp. wyomingensis / Disturbed Understory Semi-natural Shrubland	CEGL002083	13	DINO.0017, DINO.0145, DINO.0162, DINO.0265, DINO.0419, DINO.0422, DINO.0426, DINO.0483, DINO.0643, DINO.0644, DINO.0655, DINO.0659, DINO.1000
Artemisia tridentata ssp. wyomingensis / Elymus elymoides Shrubland	CEGL001043	1	DINO.0484

Plant Association Scientific Name	Element Code	No. of Samples	Supporting Plot, Observation Point, and AA Point
Artemisia tridentata ssp. wyomingensis / Hesperostipa comata Colorado Plateau Shrubland	CEGL002761	31	DINO.0005, DINO.0006, DINO.0008, DINO.0129, DINO.0152, DINO.0184, DINO.0288, DINO.0343, DINO.0360, DINO.0369, DINO.0461, DINO.0471, DINO.0473, DINO.0482, DINO.0489, DINO.0509, DINO.0597, DINO.0599, DINO.0618, DINO.0639, DINO.0648, DINO.0680, DINO.0697, DINO.0706, DINO.0719, DINO.0824, DINO.0842, DINO.1419, DINO.1421, DINO.1422, DINO.1423
Artemisia tridentata ssp. wyomingensis / Leymus salinus Shrubland	CEGL002813	3	DINO.0307, DINO.0371, DINO.0372
Artemisia tridentata ssp. wyomingensis / Pascopyrum smithii Shrub Herbaceous Vegetation	CEGL001047	2	DINO.0155, DINO.0252
Artemisia tridentata ssp. wyomingensis / Pleuraphis jamesii Shrubland	CEGL002084	7	DINO.0116, DINO.0182, DINO.0416, DINO.0434, DINO.0600, DINO.0835, DINO.0846
Artemisia tridentata ssp. wyomingensis / Poa fendleriana Shrubland	CEGL002775	19	DINO.0002, DINO.0107, DINO.0111, DINO.0118, DINO.0126, DINO.0150, DINO.0197, DINO.0218, DINO.0311, DINO.0370, DINO.0412, DINO.0414, DINO.0454, DINO.0465, DINO.0499, DINO.0501, DINO.0541, DINO.0723, DINO.0845
Artemisia tridentata ssp. wyomingensis / Poa secunda Shrubland	CEGL001049	3	DINO_AA.A0519, DINO_AA.A0794, DINO_AA.A1003
Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrubland	CEGL001009	16	DINO.0004, DINO.0112, DINO.0134, DINO.0220, DINO.0306, DINO.0411, DINO.0487, DINO.0498, DINO.0513, DINO.0905, DINO.0906, DINO.1002, DINO.1003, DINO.1004, DINO.1008, DINO.1404
Artemisia tridentata ssp. wyomingensis / Sparse Understory Shrubland	CEGL002768	6	DINO.0001, DINO.0153, DINO.0415, DINO.0420, DINO.0442, DINO.0683
Atriplex canescens / Achnatherum hymenoides Shrubland	CEGL001289	3	DINO_AA.A1091, DINO_AA.A1092, DINO_AA.A1093
Atriplex confertifolia - Krascheninnikovia lanata Shrubland	CEGL001301	2	DINO.0157, DINO.0196
Atriplex confertifolia / Achnatherum hymenoides Shrubland	CEGL001311	1	DINO.0141
Atriplex confertifolia / Hesperostipa comata Shrubland	CEGL001314	1	DINO.0305
Atriplex confertifolia / Pleuraphis jamesii Shrubland	CEGL001304	2	DINO.0175, DINO.0178
Atriplex confertifolia Great Basin Shrubland	CEGL001294	5	DINO.0180, DINO.0605, DINO.0634, DINO.0635, DINO.0698
Atriplex corrugata Dwarf-shrubland	CEGL001437	6	DINO.0012, DINO.0174, DINO.0418, DINO.0435, DINO.0436, DINO.0437

Plant Association Scientific Name	Element Code	No. of Samples	Supporting Plot, Observation Point, and AA Point
Atriplex gardneri Dwarf-shrubland	CEGL001438	1	DINO.0179
Carex pellita Herbaceous Vegetation	CEGL001809	1	DINO_AA.A1524
Betula occidentalis / Mesic Graminoids Shrubland	CEGL002654	2	DINO.0202, DINO.0237
Betula occidentalis Shrubland	CEGL001080	1	DINO.0324
Bromus tectorum Semi-natural Herbaceous Vegetation	CEGL003019	4	DINO.0367, DINO.0481, DINO.0823, DINO.1416
Calamagrostis scopulorum Hanging Garden Herbaceous Vegetation	CEGL002751	1	DINO.0690
Carex praegracilis Herbaceous Vegetation	CEGL002660	1	DINO.9001
Ceanothus velutinus Shrubland	CEGL002167	2	DINO.0530, DINO.0537
Cercocarpus intricatus Montane Shrubland	CEGL002587	2	DINO.0816, DINO.0909
Cercocarpus ledifolius / Artemisia tridentata ssp. vaseyana Woodland	CEGL001022	3	DINO_AA.A0444, DINO_AA.A0842, DINO_AA.B0454
Cercocarpus ledifolius / Prunus virginiana Shrubland	CEGL000966	3	DINO.0529, DINO.0533, DINO.0535
Cercocarpus ledifolius / Pseudoroegneria spicata Shrubland	CEGL000967	3	DINO.0109, DINO.0338, DINO.0522
Cercocarpus ledifolius Woodland Alliance	A.586	1	DINO.0213
Cercocarpus montanus / Pseudoroegneria spicata Shrubland	CEGL001090	22	DINO.0016, DINO.0148, DINO.0208, DINO.0239, DINO.0250, DINO.0269, DINO.0335, DINO.0336, DINO.0337, DINO.0363, DINO.0512, DINO.0517, DINO.0520, DINO.0524, DINO.0562, DINO.0571, DINO.0572, DINO.0574, DINO.0578, DINO.0707, DINO.0811, DINO.0902
Chrysothamnus viscidiflorus / Hesperostipa comata Shrubland	CEGL002799	2	DINO.0542, DINO.0727
Chrysothamnus viscidiflorus Talus Shrubland	CEGL002347	1	DINO.1001
Distichlis spicata Herbaceous Vegetation	CEGL001770	1	DINO.0695
Elaeagnus angustifolia Semi-natural Woodland	CEGL005269	1	DINO.0636
Eleocharis palustris Herbaceous Vegetation	CEGL001833	0	Field notes only
Elymus lanceolatus Herbaceous Vegetation	CEGL002588	4	DINO.0114, DINO.0115, DINO.0193, DINO.0718
Elymus repens Semi-natural Herbaceous Vegetation	CEGL005868	1	DINO.0603
Ephedra torreyana - (Atriplex spp.) / Nonvascular Gypsum Sparse Vegetation	CEGL002349	2	DINO.0726, DINO.1023
Ephedra viridis / Bromus tectorum Semi-natural Shrubland	CEGL002355	2	DINO.0023, DINO.0321
Equisetum hyemale Herbaceous Vegetation	CEGL002760	2	DINO_AA.A1402, DINO_AA.A1476
Equisetum laevigatum Herbaceous Vegetation	CEGL002241	1	DINO.0203
Ericameria nauseosa / Bromus tectorum Semi-natural Shrubland	CEGL002937	5	DINO.0227, DINO.0646, DINO.9046, DINO.9123, DINO.9683
Ericameria nauseosa / Pascopyrum smithii Shrubland [Park Special]	Park Special	1	DINO.0255

Plant Association Scientific Name	Element Code	No. of Samples	Supporting Plot, Observation Point, and AA Point
Ericameria nauseosa Desert Wash Shrubland	CEGL002261	1	DINO.1018
Ericameria nauseosa Sand Deposit Sparse Shrubland	CEGL002980	5	DINO.0177, DINO.0278, DINO.0291, DINO.0294, DINO.0428
Eriogonum (corymbosum, leptocladon) Dwarf-shrubland Alliance	A.1126	1	DINO.0376
Glycyrrhiza lepidota Herbaceous Vegetation [Park Special]	Park Special	7	DINO_AA.A1464, DINO_AA.A1479, DINO_AA.A1510, DINO_AA.B1481, DINO_AA.A1490, DINO_AA.A1515, DINO_AA.A1506
Grayia spinosa / Achnatherum hymenoides Shrubland	CEGL001350	3	DINO.0817, DINO.0818, DINO.0829
Hesperostipa comata - Achnatherum hymenoides Herbaceous Vegetation	CEGL001703	4	DINO.0136, DINO.0171, DINO.0279, DINO.0290
Hesperostipa comata Great Basin Herbaceous Vegetation	CEGL001705	22	DINO.0195, DINO.0282, DINO.0287, DINO.0326, DINO.0332, DINO.0353, DINO.0355, DINO.0359, DINO.0458, DINO.0466, DINO.0467, DINO.0479, DINO.0480, DINO.0716, DINO.0720, DINO.0832, DINO.1019, DINO.1406, DINO.1414, DINO.1417, DINO.1420, DINO.1424
Heterotheca villosa Herbaceous Vegetation [Park Special]	Park Special	11	DINO_AA.A1445, DINO_AA.A1475, DINO_AA.A1487, DINO_AA.A1443, DINO_AA.B1402, DINO_AA.A1186, DINO_AA.B1149, DINO_AA.B1150, DINO_AA.A1184, DINO_AA.A1182, DINO_AA.A1515
Juncus balticus Herbaceous Vegetation	CEGL001838	1	DINO.0610
Juniperus osteosperma / Artemisia nova Woodland	CEGL000728	5	DINO.0101, DINO.0160, DINO.0170, DINO.0645, DINO.0725
Juniperus osteosperma / Artemisia tridentata - Grayia spinosa Woodland [Park Special]	Park Special	4	DINO_AA.A0414, DINO_AA.A1534, DINO_AA.B0419, DINO_AA.C0091
Juniperus osteosperma / Artemisia tridentata ssp. tridentata Woodland	CEGL002360	2	DINO.0146, DINO.0840
Juniperus osteosperma / Artemisia tridentata ssp. wyomingensis Woodland	CEGL000730	19	DINO.0014, DINO.0117, DINO.0120, DINO.0123, DINO.0138, DINO.0139, DINO.0140, DINO.0344, DINO.0424, DINO.0427, DINO.0441, DINO.0446, DINO.0460, DINO.0474, DINO.0476, DINO.0497, DINO.0505, DINO.0632, DINO.0825
Juniperus osteosperma / Bromus tectorum Semi-natural Woodland	CEGL002817	2	DINO.0135, DINO.0137

Plant Association Scientific Name	Element Code	No. of Samples	Supporting Plot, Observation Point, and AA Point
Juniperus osteosperma / Cercocarpus montanus Woodland	CEGL000735	12	DINO.0011, DINO.0024, DINO.0121, DINO.0125, DINO.0154, DINO.0159, DINO.0161, DINO.0165, DINO.0181, DINO.0417, DINO.0642, DINO.0713
Juniperus osteosperma / Glossopetalon spinescens Woodland [Park Special]	Park Special	5	DINO_AA.A0183, DINO_AA.A0192, DINO_AA.A0201, DINO_AA.A0948, DINO_AA.B0197
Juniperus osteosperma / Hesperostipa comata Woodland	CEGL002815	4	DINO.0409, DINO.0457, DINO.0469, DINO.0475
Juniperus osteosperma / Leymus salinus Woodland	CEGL001488	1	DINO.0615
Juniperus osteosperma / Pleuraphis jamesii Woodland	CEGL002362	2	DINO.0826, DINO.0838
Juniperus osteosperma / Pseudoroegneria spicata Woodland	CEGL000738	7	DINO.0167, DINO.0472, DINO.0594, DINO.0724, DINO.0841, DINO.0843, DINO.1402
Juniperus osteosperma / Sparse Understory Woodland	CEGL000732	19	DINO.0007, DINO.0013, DINO.0127, DINO.0401, DINO.0430, DINO.0431, DINO.0433, DINO.0438, DINO.0440, DINO.0445, DINO.0447, DINO.0449, DINO.0468, DINO.0641, DINO.0649, DINO.0650, DINO.0839, DINO.1014, DINO.1017
Juniperus scopulorum / Artemisia tridentata Woodland	CEGL000743	9	DINO.0188, DINO.0241, DINO_AA.A0220, DINO_AA.A0557, DINO_AA.A0561, DINO_AA.A1019, DINO_AA.A1021, DINO_AA.A1034, DINO_AA.A1040
Juniperus scopulorum Temporarily Flooded Woodland Alliance	A.563	1	DINO.0317
Krascheninnikovia lanata / Hesperostipa comata Dwarf-shrubland	CEGL001327	1	DINO.0633
Krascheninnikovia lanata / Poa secunda Dwarf-shrubland	CEGL001326	1	DINO.1007
Leymus cinereus - Distichlis spicata Herbaceous Vegetation	CEGL001481	1	DINO.0694
Leymus cinereus - Pascopyrum smithii Herbaceous Vegetation	CEGL001483	1	DINO.0106
Leymus salinus Shale Sparse Vegetation	CEGL002745	1	DINO.0616
Muhlenbergia pungens Herbaceous Vegetation	CEGL002363	2	DINO.0819, DINO.0830
Pascopyrum smithii Herbaceous Vegetation	CEGL001577	5	DINO.0103, DINO.0105, DINO.0128, DINO.0251, DINO.0331
Philadelphus microphyllus - Ephedra viridis Shrubland [Park Special]	Park Special	1	DINO.1006
Phragmites australis Western North America Temperate Semi-natural Herbaceous Vegetation	CEGL001475	1	DINO.1410
Pinus edulis - Juniperus osteosperma / Amelanchier utahensis Woodland	CEGL002329	3	DINO.0003, DINO.0201, DINO.0234

Plant Association Scientific Name	Element Code	No. of Samples	Supporting Plot, Observation Point, and AA Point
Pinus edulis - Juniperus osteosperma / Artemisia nova Woodland	CEGL002331	9	DINO.0264, DINO.0273, DINO.0289, DINO.0352, DINO.0402, DINO.0456, DINO.0486, DINO.0545, DINO.0608
Pinus edulis - Juniperus osteosperma / Cercocarpus intricatus Woodland	CEGL000779	17	DINO.0142, DINO.0143, DINO.0166, DINO.0173, DINO.0204, DINO.0235, DINO.0280, DINO.0308, DINO.0375, DINO.0470, DINO.0510, DINO.0620, DINO.0627, DINO.0651, DINO.0801, DINO.0834, DINO.0836
Pinus edulis - Juniperus osteosperma / Cercocarpus ledifolius Woodland	CEGL002940	3	DINO.0244, DINO.0253, DINO.0266
Pinus edulis - Juniperus osteosperma / Ephedra viridis Woodland	CEGL002370	7	DINO_AA.A0112, DINO_AA.A0144, DINO_AA.A0171, DINO_AA.A0172, DINO_AA.A0233, DINO_AA.A0946, DINO_AA.C0923
Pinus edulis - Juniperus osteosperma / Petradoria pumila Woodland	CEGL002332	5	DINO.0298, DINO.0404, DINO.0406, DINO.0407, DINO.0543
Pinus edulis - Juniperus osteosperma / Pseudoroegneria spicata - Cushion Plant Woodland	CEGL002819	40	DINO.0108, DINO.0110, DINO.0225, DINO.0258, DINO.0276, DINO.0283, DINO.0284, DINO.0285, DINO.0292, DINO.0296, DINO.0303, DINO.0342, DINO.0356, DINO.0361, DINO.0405, DINO.0410, DINO.0444, DINO.0455, DINO.0504, DINO.0544, DINO.0546, DINO.0547, DINO.0551, DINO.0552, DINO.0554, DINO.0555, DINO.0556, DINO.0564, DINO.0565, DINO.0583, DINO.0585, DINO.0586, DINO.0612, DINO.0613, DINO.0614, DINO.0629, DINO.0653, DINO.0907, DINO.0913, DINO.1401
Pinus edulis - Juniperus osteosperma / Purshia tridentata Woodland	CEGL000789	2	DINO.0295, DINO.9041
Pinus edulis - Juniperus osteosperma / Sparse Understory Woodland	CEGL002148	28	DINO.0216, DINO.0358, DINO.0366, DINO.0413, DINO.0421, DINO.0439, DINO.0448, DINO.0450, DINO.0462, DINO.0463, DINO.0464, DINO.0478, DINO.0496, DINO.0580, DINO.0598, DINO.0606, DINO.0607, DINO.0617, DINO.0682, DINO.0687, DINO.0703, DINO.0722, DINO.0820, DINO.0821, DINO.0822, DINO.0833, DINO.0837, DINO.1016

Plant Association Scientific Name	Element Code	No. of Samples	Supporting Plot, Observation Point, and AA Point
Pinus edulis - Juniperus spp. / Artemisia tridentata (ssp. wyomingensis, ssp. vaseyana) Woodland	CEGL000776	16	DINO.0231, DINO.0297, DINO.0354, DINO.0357, DINO.0488, DINO.0490, DINO.0491, DINO.0493, DINO.0494, DINO.0495, DINO.0705, DINO.0813, DINO.0814, DINO.0827, DINO.0828, DINO.0844
Pinus edulis - Juniperus spp. / Cercocarpus montanus - Mixed Shrubs Woodlands	CEGL000780	18	DINO.0124, DINO.0192, DINO.0222, DINO.0327, DINO.0339, DINO.0350, DINO.0362, DINO.0423, DINO.0507, DINO.0508, DINO.0523, DINO.0576, DINO.0588, DINO.0626, DINO.0631, DINO.0901, DINO.1012, DINO.1418
Pinus edulis - Juniperus spp. / Leymus salinus Woodland	CEGL002340	1	DINO.0304
Pinus edulis - Juniperus spp. / Poa fendleriana Woodland	CEGL000787	9	DINO.0185, DINO.0194, DINO.0199, DINO.0249, DINO.0281, DINO.0351, DINO.0452, DINO.0492, DINO.1009
Pinus edulis – (Juniperus spp.) Woodland Alliance	A.516	1	DINO.0206
Pinus flexilis / Juniperus communis Woodland	CEGL000807	1	DINO.0189
Pinus ponderosa / Artemisia tridentata ssp. vaseyana Woodland	CEGL002794	2	DINO.0301, DINO.0589
Pinus ponderosa / Cercocarpus ledifolius Woodland	CEGL000850	2	DINO.0207, DINO.0539
Pinus ponderosa / Juniperus scopulorum Woodland	CEGL000861	4	DINO.0217, DINO.0232, DINO.0243, DINO.0506
Pinus ponderosa / Rockland Woodland	CEGL000877	14	DINO.0144, DINO.0215, DINO.0257, DINO.0300, DINO.0374, DINO.0485, DINO.0526, DINO.0528, DINO.0536, DINO.0560, DINO.0569, DINO.0590, DINO.0593, DINO.0604
Pleuraphis jamesii Herbaceous Vegetation	CEGL001777	2	DINO.0647, DINO.1013
Populus angustifolia - Juniperus scopulorum Woodland	CEGL002640	2	DINO.0230, DINO.0708
Populus angustifolia / Betula occidentalis Woodland	CEGL000648	1	DINO.0169
Populus angustifolia / Rhus trilobata Woodland	CEGL000652	5	DINO_AA.A1414, DINO_AA.A1463, DINO_AA.A1496, DINO_AA.A1530, DINO_AA.A1535
Populus angustifolia / Salix exigua Woodland	CEGL000654	1	DINO.0689
Populus deltoides (ssp. wislizeni, ssp. monilifera) / Distichlis spicata Woodland	CEGL000939	1	DINO.0133
Populus deltoides ssp. wislizeni / Disturbed Understory Woodland	CEGL003810	22	DINO_AA.A1157, DINO_AA.A1306, DINO_AA.A1308, DINO_AA.A1309, DINO_AA.A1310, DINO_AA.A1311, DINO_AA.A1312, DINO_AA.A1313, DINO_AA.A1314, DINO_AA.A1315, DINO_AA.A1316, DINO_AA.A1317,

Plant Association Scientific Name	Element Code	No. of Samples	Supporting Plot, Observation Point, and AA Point
			DINO_AA.A1319, DINO_AA.A1320, DINO_AA.A1321, DINO_AA.A1323, DINO_AA.A1324, DINO_AA.A1326, DINO_AA.A1328, DINO_AA.A1329, DINO_AA.A1331, DINO_AA.B1274
Populus deltoides ssp. wislizeni / Rhus trilobata Woodland	CEGL000940	1	DINO.0432
Populus deltoides ssp. wislizeni / Acer negundo Woodland	CEGL002336	3	DINO.0020, DINO.0325, DINO.0691
Populus tremuloides / Amelanchier alnifolia – Symphoricarpos oreophilus / Mixed Graminoid Forest	CEGL002336	5	DINO.0191, DINO.0299, DINO.0334, DINO.0364, DINO.0515
Populus tremuloides / Ceanothus velutinus Forest	CEGL000581	1	DINO.0519
Populus tremuloides / Juniperus communis Forest	CEGL000587	1	DINO.0211
Populus tremuloides / Prunus virginiana Forest	CEGL000596	2	DINO.0275, DINO.0534
Populus tremuloides / Symphoricarpos oreophilus / Carex rossii Forest	CEGL000613	1	DINO.0912
Populus tremuloides / Symphoricarpos oreophilus Forest	CEGL000610	2	DINO.0577, DINO.0652
Post-fire Herbaceous Vegetation [Park Special]	Park Special	3	DINO.0226, DINO.0242, DINO.0451
Prunus virginiana - (Prunus americana) Shrubland	CEGL001108	4	DINO.0224, DINO.0233, DINO.0245, DINO.1005
Pseudoroegneria spicata - Cushion Plants Herbaceous Vegetation	CEGL001666	26	DINO.0205, DINO.0221, DINO.0246, DINO.0260, DINO.0263, DINO.0272, DINO.0277, DINO.0286, DINO.0293, DINO.0302, DINO.0333, DINO.0348, DINO.0365, DINO.0425, DINO.0477, DINO.0549, DINO.0575, DINO.0584, DINO.0684, DINO.0699, DINO.0700, DINO.0710, DINO.0908, DINO.0915, DINO.1010, DINO.1400
Pseudoroegneria spicata - Leymus salinus Herbaceous Vegetation [Park Special]	Park Special	1	DINO.1403
Pseudoroegneria spicata Herbaceous Vegetation	CEGL001660	5	DINO.0113, DINO.0183, DINO.0214, DINO.0568, DINO.1405
Pseudotsuga menziesii Woodland Alliance	A.552	2	DINO.0168, DINO.0262
Pseudotsuga menziesii / Acer negundo Woodland	CEGL002754	1	DINO.0228
Pseudotsuga menziesii / Amelanchier alnifolia Forest	CEGL000420	2	DINO.0531, DINO.0540
Pseudotsuga menziesii / Cercocarpus ledifolius Woodland	CEGL000897	1	DINO.0538
Pseudotsuga menziesii / Cercocarpus montanus Woodland	CEGL000898	3	DINO_AA.A0012, DINO_AA.A0024, DINO_AA.A0030
Pseudotsuga menziesii / Juniperus communis Forest	CEGL000439	2	DINO.0261, DINO.0518
Pseudotsuga menziesii / Mahonia repens Forest	CEGL000442	1	DINO.0238
Pseudotsuga menziesii / Poa fendleriana Woodland	CEGL002809	1	DINO_AA.A0040

Plant Association Scientific Name	Element Code	No. of Samples	Supporting Plot, Observation Point, and AA Point
Pseudotsuga menziesii / Pseudoroegneria spicata Woodland	CEGL000908	2	DINO_AA.A0008, DINO_AA.A0023
Pseudotsuga menziesii / Symphoricarpos oreophilus Forest	CEGL000462	8	DINO.0187, DINO.0229, DINO.0254, DINO.0270, DINO.0349, DINO.0502, DINO.0503, DINO.0511
Rhus trilobata Intermittently Flooded Shrubland	CEGL001121	1	DINO.0637
Salix exigua / Barren Shrubland	CEGL001200	3	DINO.0686, DINO.0711, DINO.1407
Salix exigua / Mesic Forbs Shrubland	CEGL001202	2	DINO.0018, DINO.0318
Salix exigua / Mesic Graminoids Shrubland	CEGL001203	2	DINO.0025, DINO.0640
Sarcobatus vermiculatus / Artemisia tridentata Shrubland	CEGL001359	3	DINO.0158, DINO.0163, DINO.0619
Sarcobatus vermiculatus / Atriplex gardneri Shrubland	CEGL001360	1	DINO.0601
Sarcobatus vermiculatus / Sporobolus airoides Shrubland	CEGL001368	1	DINO.0656
Sarcobatus vermiculatus Disturbed Shrubland	CEGL001357	11	DINO.0026, DINO.0119, DINO.0122, DINO.0323, DINO.0368, DINO.0596, DINO.0657, DINO.0714, DINO.0715, DINO.0717, DINO.0831
Schoenoplectus acutus Herbaceous Vegetation	CEGL001840	1	DINO.0312
Schoenoplectus pungens Herbaceous Vegetation	CEGL001587	2	DINO.0019, DINO.0198
Shale Annual Herbaceous Vegetation [Park Special]	Park Special	1	DINO.0654
Spartina pectinata Western Herbaceous Vegetation	CEGL001476	1	DINO.0021
Spartina gracilis Herbaceous Vegetation	CEGL001588	0	Field notes only
Sporobolus cryptandrus Great Basin Herbaceous Vegetation	CEGL002691	1	DINO.0176
Tamarix spp. Temporarily Flooded Semi-natural Shrubland	CEGL003114	47	Accuracy assessment points only
Tetradymia canescens Shrubland [Park Special]	Park Special	1	DINO.0658
Xanthium strumarium Herbaceous Vegetation [Park Special]	Park Special	0	Field notes only

Appendix F

Plant Association Descriptions for Dinosaur National Monument

The Dinosaur National Monument (DINO) vegetation mapping project identified 163 National Vegetation Classification (NVC) plant associations and 11 park special vegetation types representing 74 vegetation alliances. 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 descriptions 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 DINO. 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.

In this appendix, NVC plant associations are arranged by physiognomic class (e.g., Forest, Woodland). 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 227

Conical-crowned temperate or subpolar needle-leaved evergreen forest 227

***Pseudotsuga menziesii* Forest Alliance 227**
Pseudotsuga menziesii / Amelanchier alnifolia Forest 227
Pseudotsuga menziesii / Juniperus communis Forest 229
Pseudotsuga menziesii / Mahonia repens Forest 231
Pseudotsuga menziesii / Symphoricarpos oreophilus Forest 233

Montane or boreal cold-deciduous forest 236

***Populus tremuloides* Forest Alliance 236**
Populus tremuloides / Amelanchier alnifolia - Symphoricarpos oreophilus / Mixed Graminoid Forest 236
Populus tremuloides / Ceanothus velutinus Forest 238
Populus tremuloides / Juniperus communis Forest 240
Populus tremuloides / Prunus virginiana Forest 242
Populus tremuloides / Symphoricarpos oreophilus / Carex rossii Forest 244
Populus tremuloides / Symphoricarpos oreophilus Forest 246

Temporarily flooded cold-deciduous forest 248

***Acer negundo* Temporarily Flooded Forest Alliance 248**
Acer negundo / Prunus virginiana Forest 248

Seasonally flooded cold-deciduous forest 251

***Acer negundo* Seasonally Flooded Forest Alliance 251**
Acer negundo / Equisetum arvense Forest 251

II. WOODLAND 252

Rounded-crowned temperate or subpolar needle-leaved evergreen woodland 252

***Juniperus osteosperma* Woodland Alliance 252**
Juniperus osteosperma / Artemisia nova Woodland 252
Juniperus osteosperma / Artemisia tridentata ssp. *tridentata* Woodland 254
Juniperus osteosperma / Artemisia tridentata ssp. *wyomingensis* Woodland 256
Juniperus osteosperma / Bromus tectorum Semi-natural Woodland 259
Juniperus osteosperma / Cercocarpus montanus Woodland 260
Juniperus osteosperma / Hesperostipa comata Woodland 262
Juniperus osteosperma / Leymus salinus Woodland 264
Juniperus osteosperma / Pleuraphis jamesii Woodland 267
Juniperus osteosperma / Pseudoroegneria spicata Woodland 268
Juniperus osteosperma / Sparse Understory Woodland 271

***Juniperus scopulorum* Woodland Alliance 273**
Juniperus scopulorum / Artemisia tridentata Woodland 273

***Pinus edulis - (Juniperus* spp.) Woodland Alliance 275**
Pinus edulis - Juniperus osteosperma / Amelanchier utahensis Woodland 275
Pinus edulis - Juniperus osteosperma / Artemisia nova Woodland 278
Pinus edulis -Juniperus osteosperma / Cercocarpus intricatus Woodland 280
Pinus edulis -Juniperus osteosperma / Cercocarpus ledifolius Woodland 282
Pinus edulis -Juniperus osteosperma / Ephedra viridis Woodland 284
Pinus edulis - Juniperus osteosperma / Petradoria pumila Woodland 287
Pinus edulis -Juniperus osteosperma / Pseudoroegneria spicata - Cushion Plant Woodland 289
Pinus edulis -Juniperus osteosperma / Purshia tridentata Woodland 291
Pinus edulis -Juniperus osteosperma / Sparse Understory Woodland 293
Pinus edulis -Juniperus spp. / *Artemisia tridentata* (ssp. *wyomingensis*, ssp. *vaseyana*) Woodland 295
Pinus edulis -Juniperus spp. / *Cercocarpus montanus* - Mixed Shrubs Woodland 297

Pinus edulis -Juniperus spp. / *Leymus salinus* Woodland 300
Pinus edulis -Juniperus spp. / *Poa fendleriana* Woodland 302

***Pinus flexilis* Woodland Alliance 304**
Pinus flexilis / Juniperus communis Woodland 304

***Pinus ponderosa* Woodland Alliance 307**
Pinus ponderosa / Artemisia tridentata ssp. vaseyana Woodland 307
Pinus ponderosa / Cercocarpus ledifolius Woodland 309
Pinus ponderosa / Juniperus scopulorum Woodland 311
Pinus ponderosa / Rockland Woodland 313

Conical-crowned temperate or subpolar needle-leaved evergreen woodland 315

***Pseudotsuga menziesii* Woodland Alliance 315**
Pseudotsuga menziesii / Acer negundo Woodland 315
Pseudotsuga menziesii / Cercocarpus ledifolius Woodland 317
Pseudotsuga menziesii / Cercocarpus montanus Woodland 319
Pseudotsuga menziesii / Poa fendleriana Woodland 321
Pseudotsuga menziesii / Pseudoroegneria spicata Woodland 323

Sclerophyllous extremely xeromorphic evergreen woodland 326

***Cercocarpus ledifolius* Woodland Alliance 326**
Cercocarpus ledifolius / Artemisia tridentata ssp. *vaseyana* Woodland 326

Cold-deciduous woodland 328

***Elaeagnus angustifolia* Semi-natural Woodland Alliance 328**
Elaeagnus angustifolia Semi-natural Woodland 328

Temporarily flooded cold-deciduous woodland 330

***Acer negundo* Temporarily Flooded Woodland Alliance 330**
Acer negundo - *Celtis laevigata* var. *reticulata* Woodland 330
Acer negundo / Disturbed Understory Woodland 332
Acer negundo / Rhus trilobata Woodland 334

***Populus angustifolia* Temporarily Flooded Woodland Alliance 336**
Populus angustifolia - *Juniperus scopulorum* Woodland 336
Populus angustifolia / Betula occidentalis Woodland 338
Populus angustifolia / Rhus trilobata Woodland 341
Populus angustifolia / Salix exigua Woodland 343

***Populus deltoides* Temporarily Flooded Woodland Alliance 346**
Populus deltoides (ssp. *wislizeni*, ssp. *monilifera*) / *Distichlis spicata* Woodland 346
Populus deltoides ssp. *wislizeni / Acer negundo* Woodland 349
Populus deltoides ssp. *wislizeni* / Disturbed Understory Woodland 351
Populus deltoides ssp. *wislizeni / Rhus trilobata* Woodland 353

III. SHRUBLAND 355

Sclerophyllous temperate broad-leaved evergreen shrubland 355

***Arctostaphylos patula* Shrubland Alliance 355**
Arctostaphylos patula - *Artemisia tridentata* (ssp. *vaseyana*, ssp. *wyomingensis*) Shrubland 355

***Ceanothus velutinus* Shrubland Alliance 357**
Ceanothus velutinus Shrubland 357

***Cercocarpus intricatus* Shrubland Alliance 359**
Cercocarpus intricatus Montane Shrubland 359

Lowland microphyllous evergreen shrubland 361

***Artemisia arbuscula* ssp. *longiloba* Shrubland Alliance 361**
Artemisia arbuscula ssp. *longiloba / Elymus lanceolatus* Shrubland 361

***Artemisia nova* Shrubland Alliance 363**

Artemisia nova / Pseudoroegneria spicata Shrubland....363
Artemisia nova Shrubland....365

***Artemisia tridentata* (ssp. *tridentata*, ssp. *xericensis*) Shrubland Alliance....367**
Artemisia tridentata ssp. *tridentata / Hesperostipa comata* Shrubland....367
Artemisia tridentata ssp. *tridentata / Leymus cinereus* Shrubland....369
Artemisia tridentata ssp. *tridentata / Sporobolus airoides* Shrubland....371

***Artemisia tridentata* Shrubland Alliance....373**
Artemisia tridentata (ssp. *vaseyana*, ssp. *wyomingensis*) -*Amelanchier utahensis* Shrubland....373
Artemisia tridentata - *(Ericameria nauseosa) / Bromus tectorum* Semi-natural Shrubland....375

***Artemisia tridentata* ssp. *vaseyana* Shrubland Alliance....377**
Artemisia tridentata ssp. *vaseyana / Achnatherum lettermanii* Shrubland....377
Artemisia tridentata ssp. *vaseyana / Balsamorhiza sagittata* Shrubland....379
Artemisia tridentata ssp. *vaseyana / Hesperostipa comata* Shrubland....381
Artemisia tridentata ssp. *vaseyana / Leymus cinereus* Shrubland....383
Artemisia tridentata ssp. *vaseyana / Pascopyrum smithii* Shrubland....385
Artemisia tridentata ssp. *vaseyana / Poa fendleriana* Shrubland....387
Artemisia tridentata ssp. *vaseyana / Poa secunda* Shrubland....389
Artemisia tridentata ssp. *vaseyana / Pseudoroegneria spicata* Shrubland....391

***Artemisia tridentata* ssp. *wyomingensis* Shrubland Alliance....393**
Artemisia tridentata ssp. *wyomingensis* - *Atriplex confertifolia* Shrubland....393
Artemisia tridentata ssp. *wyomingensis / Balsamorhiza sagittata* Shrubland....396
Artemisia tridentata ssp. *wyomingensis* / Disturbed Understory Semi-natural Shrubland....398
Artemisia tridentata ssp. *wyomingensis / Elymus elymoides* Shrubland....400
Artemisia tridentata ssp. *wyomingensis / Hesperostipa comata* Colorado Plateau Shrubland....402
Artemisia tridentata ssp. *wyomingensis / Leymus salinus* Shrubland....404
Artemisia tridentata ssp. *wyomingensis / Pleuraphis jamesii* Shrubland....406
Artemisia tridentata ssp. *wyomingensis / Poa fendleriana* Shrubland....407
Artemisia tridentata ssp. *wyomingensis / Poa secunda* Shrubland....409
Artemisia tridentata ssp. *wyomingensis / Pseudoroegneria spicata* Shrubland....411
Artemisia tridentata ssp. *wyomingensis* / Sparse Understory Shrubland....414

***Cercocarpus ledifolius* Shrubland Alliance....416**
Cercocarpus ledifolius / Prunus virginiana Shrubland....416
Cercocarpus ledifolius / Pseudoroegneria spicata Shrubland....418

***Chrysothamnus viscidiflorus* Shrubland Alliance....420**
Chrysothamnus viscidiflorus / Hesperostipa comata Shrubland....420
Chrysothamnus viscidiflorus Talus Shrubland....421

***Ericameria nauseosa* Shrubland Alliance....423**
Ericameria nauseosa / Bromus tectorum Semi-natural Shrubland....423
Ericameria nauseosa Desert Wash Shrubland....425
Ericameria nauseosa Sand Deposit Sparse Shrubland....427

Temporarily flooded microphyllous shrubland....429

***Tamarix* spp. Semi-natural Temporarily Flooded Shrubland Alliance....429**
Tamarix spp. Temporarily Flooded Semi-natural Shrubland....429

Broad-leaved and microphyllous evergreen extremely xeromorphic subdesert shrubland....431

***Ephedra viridis* Shrubland Alliance....431**
Ephedra viridis / Bromus tectorum Semi-natural Shrubland....431

Facultatively deciduous extremely xeromorphic subdesert shrubland....433

***Atriplex canescens* Shrubland Alliance....433**
Atriplex canescens / Achnatherum hymenoides Shrubland....433

***Atriplex confertifolia* Shrubland Alliance....435**
Atriplex confertifolia - *Krascheninnikovia lanata* Shrubland....435

Atriplex confertifolia / Achnatherum hymenoides Shrubland 437
Atriplex confertifolia / Hesperostipa comata Shrubland....439
Atriplex confertifolia / Pleuraphis jamesii Shrubland....441
Atriplex confertifolia Great Basin Shrubland....444

Temperate cold-deciduous shrubland....445

***Amelanchier alnifolia* Shrubland Alliance....445**
Amelanchier alnifolia / Symphoricarpos oreophilus Shrubland....445

***Amelanchier utahensis* Shrubland Alliance....447**
Amelanchier (utahensis, alnifolia) - Cercocarpus montanus Shrubland....447
Amelanchier utahensis / Pseudoroegneria spicata Shrubland....450
Amelanchier utahensis Shrubland....452

***Cercocarpus montanus* Shrubland Alliance....454**
Cercocarpus montanus / Pseudoroegneria spicata Shrubland....454

***Prunus virginiana* Shrubland Alliance....456**
Prunus virginiana - (Prunus americana) Shrubland....456

Intermittently flooded cold-deciduous shrubland....458

***Rhus trilobata* Intermittently Flooded Shrubland Alliance....458**
Rhus trilobata Intermittently Flooded Shrubland....458

Temporarily flooded cold-deciduous shrubland....461

***Salix (exigua, interior)* Temporarily Flooded Shrubland Alliance....461**
Salix exigua / Barren Shrubland....461
Salix exigua / Mesic Forbs Shrubland....463
Salix exigua / Mesic Graminoids Shrubland....466

Seasonally flooded cold-deciduous shrubland....468

***Betula occidentalis* Seasonally Flooded Shrubland Alliance....468**
Betula occidentalis / Mesic Graminoids Shrubland....468
Betula occidentalis Shrubland....470

Extremely xeromorphic deciduous subdesert shrubland without succulents....473

***Grayia spinosa* Shrubland Alliance....473**
Grayia spinosa / Achnatherum hymenoides Shrubland....473

Intermittently flooded extremely xeromorphic deciduous subdesert shrubland....475

***Sarcobatus vermiculatus* Intermittently Flooded Shrubland Alliance....475**
Sarcobatus vermiculatus / Artemisia tridentata Shrubland....475
Sarcobatus vermiculatus / Atriplex gardneri Shrubland....477
Sarcobatus vermiculatus / Sporobolus airoides Shrubland....479
Sarcobatus vermiculatus Disturbed Shrubland....481

IV. DWARF-SHRUBLAND....483

Extremely xeromorphic evergreen subdesert dwarf-shrubland....483

***Krascheninnikovia lanata* Dwarf-shrubland Alliance....483**
Krascheninnikovia lanata / Hesperostipa comata Dwarf-shrubland....483
Krascheninnikovia lanata / Poa secunda Dwarf-shrubland....485

Facultatively deciduous subdesert dwarf-shrubland....487

***Atriplex corrugata* Dwarf-shrubland Alliance....487**
Atriplex corrugata Dwarf-shrubland....487

***Atriplex gardneri* Dwarf-shrubland Alliance....489**
Atriplex gardneri Dwarf-shrubland....489

V. HERBACEOUS VEGETATION....491

Tall bunch temperate grassland 491
***Leymus cinereus* Herbaceous Alliance 491**
Leymus cinereus - Pascopyrum smithii Herbaceous Vegetation 491
Medium-tall sod temperate or subpolar grassland 493
***Elymus lanceolatus* Herbaceous Alliance 493**
Elymus lanceolatus Herbaceous Vegetation 493
***Elymus repens* Herbaceous Alliance 495**
Elymus repens Semi-natural Herbaceous Vegetation 495
***Pascopyrum smithii* Herbaceous Alliance 497**
Pascopyrum smithii Herbaceous Vegetation 497
Medium-tall bunch temperate or subpolar grassland 499
***Achnatherum hymenoides* Herbaceous Alliance 499**
Achnatherum hymenoides Colorado Plateau Herbaceous Vegetation 499
***Hesperostipa comata* Bunch Herbaceous Alliance 501**
Hesperostipa comata - Achnatherum hymenoides Herbaceous Vegetation 501
Hesperostipa comata Great Basin Herbaceous Vegetation 503
***Pseudoroegneria spicata* Herbaceous Alliance 505**
Pseudoroegneria spicata - Cushion Plants Herbaceous Vegetation 505
Pseudoroegneria spicata Herbaceous Vegetation 508
***Sporobolus cryptandrus* Herbaceous Alliance 510**
Sporobolus cryptandrus Great Basin Herbaceous Vegetation 510
Short sod temperate or subpolar grassland 512
***Pleuraphis jamesii* Herbaceous Alliance 512**
Pleuraphis jamesii Herbaceous Vegetation 512
Intermittently flooded temperate or subpolar grassland 514
***Distichlis spicata* Intermittently Flooded Herbaceous Alliance 514**
Distichlis spicata Herbaceous Vegetation 514
***Leymus cinereus* Intermittently Flooded Herbaceous Alliance 516**
Leymus cinereus - Distichlis spicata Herbaceous Vegetation 516
Temporarily flooded temperate or subpolar grassland 518
***Spartina pectinata* Temporarily Flooded Herbaceous Alliance 518**
Spartina pectinata Western Herbaceous Vegetation 518
Seasonally flooded temperate or subpolar grassland 521
***Carex pellita* Seasonally Flooded Herbaceous Alliance 521**
Carex pellita Herbaceous Vegetation 521
***Carex praegracilis* Seasonally Flooded Herbaceous Alliance 523**
Carex praegracilis Herbaceous Vegetation 523
***Eleocharis (palustris, macrostachya)* Seasonally Flooded Herbaceous Alliance 525**
Eleocharis palustris Herbaceous Vegetation 525
***Juncus balticus* Seasonally Flooded Herbaceous Alliance 528**
Juncus balticus Herbaceous Vegetation 528
***Spartina gracilis* Seasonally Flooded Herbaceous Alliance 530**
Spartina gracilis Herbaceous Vegetation 530
Semipermanently flooded temperate or subpolar grassland 532
***Phragmites australis* Semipermanently Flooded Herbaceous Alliance 532**
Phragmites australis Western North America Temperate Semi-natural Herbaceous Vegetation 532
***Schoenoplectus acutus - (Schoenoplectus tabernaemontani)* Semipermanently Flooded Herbaceous**

Alliance **534**
Schoenoplectus acutus Herbaceous Vegetation 534

***Schoenoplectus pungens* Semipermanently Flooded Herbaceous Alliance** **536**
Schoenoplectus pungens Herbaceous Vegetation 536

Saturated temperate or subpolar grassland **538**

***Calamagrostis scopulorum* Saturated Hanging Garden Herbaceous Alliance** **538**
Calamagrostis scopulorum Hanging Garden Herbaceous Vegetation 538

Medium-tall temperate or subpolar grassland with a sparse needle-leaved or microphyllous evergreen shrub layer **540**

***Artemisia tridentata* ssp. *wyomingensis* Shrub Herbaceous Alliance** **540**
Artemisia tridentata ssp. *wyomingensis / Pascopyrum smithii* Shrub Herbaceous Vegetation 540

Short temperate or subpolar grassland with a sparse microphyllous evergreen shrub layer **542**

***Muhlenbergia pungens* Herbaceous Alliance** **542**
Muhlenbergia pungens Herbaceous Vegetation 542

Semipermanently flooded temperate perennial forb vegetation **544**

***Equisetum (arvense, variegatum, hyemale)* Semipermanently Flooded Herbaceous Alliance** **544**
Equisetum hyemale Herbaceous Vegetation 544

***Equisetum laevigatum* Semipermanently Flooded Herbaceous Alliance** **546**
Equisetum laevigatum Herbaceous Vegetation 546

Saturated temperate perennial forb vegetation **548**

***Aquilegia micrantha* Saturated Hanging Garden Herbaceous Alliance** **548**
Aquilegia micrantha - Calamagrostis scopulorum Herbaceous Vegetation 548

Short temperate annual grassland **550**

***Bromus tectorum* Semi-natural Herbaceous Alliance** **550**
Bromus tectorum Semi-natural Herbaceous Vegetation 550

VII. SPARSE VEGETATION **552**

Dry slopes **552**

***Ephedra torreyana* Sparsely Vegetated Alliance** **552**
Ephedra torreyana - (*Atriplex* spp.) / Nonvascular Gypsum Sparse Vegetation 552

***Leymus salinus* Sparsely Vegetated Alliance** **554**
Leymus salinus Shale Sparse Vegetation 554

VIII. PLANT COMMUNITIES IDENTIFIED TO ALLIANCE-LEVEL **556**

Alliances **556**
Achnatherum lettermanii Herbaceous Alliance 556
Artemisia tridentata (ssp. tridentata, ssp. xericensis) Shrubland Alliance 557
Cercocarpus ledifolius Woodland Alliance 560
Eriogonum (corymbosum, leptocladon) Dwarf-shrubland Alliance 562
Juniperus scopulorum Temporarily Flooded Woodland Alliance 564
Pinus edulis - (Juniperus spp.) Woodland Alliance 566
Pseudotsuga menziesii Woodland Alliance 569

IX. HIERARCHY PLACEMENT UNDETERMINED **572**

Park Specials **572**
Ericameria nauseosa / Pascopyrum smithii Shrubland [Park Special] 572
Glycyrrhiza lepidota Herbaceous Vegetation [Park Special] 573
Heterotheca villosa Herbaceous Vegetation [Park Special] 575
Juniperus osteosperma / Artemisia tridentata - Grayia spinosa Woodland [Park Special] 576

Juniperus osteosperma / Glossopetalon spinescens Woodland [Park Special] 578
Philadelphus microphyllus - Ephedra viridis Shrubland [Park Special] 580
Post-fire Herbaceous Vegetation [Park Special] 581
Pseudoroegneria spicata - Leymus salinus Herbaceous Vegetation [Park Special] 583
Shale Annual Herbaceous Vegetation [Park Special] 584
Tetradymia canescens Shrubland [Park Special] 585
Xanthium strumarium Herbaceous Vegetation [Park Special] 587

BIBLIOGRAPHY 589

Pseudotsuga menziesii / Amelanchier alnifolia Forest
Douglas-fir / Saskatoon Serviceberry Forest

CODE	CEGL000420
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest (I.A.8.N.)
FORMATION	Conical-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.c.)
ALLIANCE	*PSEUDOTSUGA MENZIESII* FOREST ALLIANCE (A.157) Douglas-fir Forest Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association has been reported from colluvial slopes, ridges, mountains and canyon walls in northwestern Colorado, northwestern Wyoming and central Montana. In the northern part of its range, stands occur on warm, southerly slopes, whereas in Colorado the type is restricted to cold north-facing slopes. Slopes range from moderate to very steep (over 100%); elevations range from 1220 m in Montana to more than 2250 m in Colorado (4000-8350 feet). Soils are gravelly loams and sandy loams derived from granite or sandstone and often are very rocky. Litter and duff cover much of the unvegetated ground surface. *Pseudotsuga menziesii* dominates the tree canopy of this association with at least 20% cover, except in Montana, where cover may be as low as 5%. Other trees, such as *Pinus albicaulis, Pinus flexilis, Pinus ponderosa, Populus tremuloides*, or *Juniperus scopulorum*, may be present to codominant. In younger stands, these species may have higher cover than *Pseudotsuga menziesii*. *Abies concolor* is typically absent. The shrub layer is often dense. Dominant shrubs in the understory include *Amelanchier alnifolia, Prunus virginiana, Spiraea betulifolia*, and *Symphoricarpos* spp., as well as lesser amounts of *Rosa* spp., *Ribes* spp, *Juniperus communis, Mahonia repens*, and *Paxistima myrsinites*. Graminoids are rare to abundant; *Pseudoroegneria spicata, Bromus carinatus, Achnatherum lettermanii, Elymus trachycaulus, Carex geyeri*, and *Agrostis scabra* are common species. Common forbs include *Eurybia conspicua, Eucephalus engelmannii, Helianthella uniflora, Fragaria virginiana, Symphyotrichum ascendens*, and *Maianthemum racemosum*.

DISTRIBUTION

Dinosaur National Monument

This association is known from the Douglas Mountain region of the monument.

Globally

This association is known from just north of Grand Teton National Park in Wyoming, from Dinosaur National Monument in northwestern Colorado and from the Bear's Paw Mountains of the Montana Isolated Mountain Ranges Subsection of the Northwestern Glaciated Plains Section (Roberts 1980).

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This forest association occurs in small stands on moderate to steep slopes and ravines, and also on gentle gradient benches at elevations above 2300 m. Soil texture is typically loamy, and the surface is covered with organic litter and downed wood.

Globally

This association has been reported from colluvial slopes, ridges, mountains and canyon walls in northwestern Colorado, northwestern Wyoming and central Montana. In the northern part of its range, stands occur on warm, southerly slopes, whereas in Colorado it is restricted to cold north-facing slopes. Slopes range from moderate to very steep (over 100%); elevations range from 1220 m in Montana to more than 2250 m in Colorado (4000-8350 feet). Mean annual precipitation is about 40-50 cm in Montana (Soil Conservation Service 1981b). Soils are gravelly loams and sandy loams with a slightly acidic reaction and often are very rocky. Litter and duff cover much of the unvegetated ground surface. Parent materials include granite and sandstone.

VEGETATION DESCRIPTION

Dinosaur National Monument

Pseudotsuga menziesii, 15 to 20 m tall, dominates the tree canopy of this association with at least 20% cover. A subcanopy of younger *Pseudotsuga menziesii* and/or *Juniperus scopulorum* may also be present. The next stratum is typically comprised of tall shrubs *Amelanchier utahensis* and *Prunus virginiana* with 5 to 15% cover and the presence of *Populus tremuloides* saplings and seedlings. Short shrubs and dwarf-shrubs that may occur with minimal to moderate cover include *Symphoricarpos oreophilus, Ribes cereum, Rosa woodsii, Juniperus communis, Mahonia repens*, and *Paxistima myrsinites*. Forb species composition and abundance vary among sites. Grasses are more consistent and abundant and likely to include *Bromus carinatus, Poa* spp., *Achnatherum lettermanii*, and *Elymus trachycaulus*.

Globally

Pseudotsuga menziesii dominates the tree canopy of this association with at least 20% cover, except in Montana, where cover may be as low as 5%. Other trees, such as *Pinus albicaulis, Pinus flexilis, Pinus ponderosa, Populus tremuloides,* or *Juniperus scopulorum*, may be present to codominant. In younger stands, these species may have higher cover than *Pseudotsuga menziesii*. *Abies concolor* is typically absent. The shrub layer is often dense. Dominant shrubs in the understory include *Amelanchier alnifolia* (5-30% cover), *Prunus virginiana* (5-15%), *Spiraea betulifolia* (0-15%), and *Symphoricarpos* spp. (3-10%), as well as lesser amounts of *Rosa* spp., *Ribes* spp, *Juniperus communis, Mahonia repens,* and *Paxistima myrsinites*. Graminoids are rare to abundant; *Pseudoroegneria spicata, Bromus carinatus, Achnatherum lettermanii, Elymus trachycaulus, Carex geyeri*, and *Agrostis scabra* are common species. Common forbs include *Eurybia conspicua, Eucephalus engelmannii, Helianthella uniflora, Fragaria virginiana, Symphyotrichum ascendens*, and *Maianthemum racemosum*.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Tree canopy	*Pseudotsuga menziesii*
Tall shrub/sapling	*Amelanchier alnifolia*
Herb (field)	*Bromus carinatus*

Globally

Stratum	Species
Tree canopy	*Pseudotsuga menziesii*
Short shrub/sapling	*Amelanchier alnifolia*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G2Q (6-Jul-2005). The rank for this type needs to be reviewed. This association has been described from the Bear's Paw Mountains of central Montana, as well as Grand Teton National Park and Dinosaur National Monument. It appears to be restricted to steep, rocky slopes with northerly aspects and elevations ranging from 1220 m to more than 2250 m (4000-8350 feet). Stands tend to be relatively small and somewhat isolated. It is possible that seral stages of other climax associations may pass through a stage that compositionally overlaps with Pseudotsuga menziesii / Amelanchier alnifolia Forest (CEGL000420), but their site parameters would differ. Potential threats to this type include logging, firewood cutting, wildfire, and ungulate browsing (*Amelanchier alnifolia* is a preferred browse species). Fire on these slopes is followed by bunchgrass- and then shrub-dominated structural/seral stages, with more than 80 years post-fire required to attain the current forest structure.

CLASSIFICATION COMMENTS

Dinosaur National Monument

Data are not available.

Globally

Roberts' (1980) 5 stands are in a relatively early-seral stage, dominated by *Pinus ponderosa* (average cover 38%), with a constant presence of *Pseudotsuga menziesii* with average cover of only 5%. The Grand Teton and Dinosaur plots have no ponderosa pine, but do have other pines and early-seral species. To better fit with the NatureServe concept of plant associations as existing vegetation, it is suggested that we place the Roberts type in *Pinus ponderosa / Amelanchier alnifolia* Woodland (CEGL000840).

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is limited to a few small sites in the monument. *Dinosaur National Monument Data Sources*: The description is based on 2002 field data (2 plots: DINO.0531, DINO.0540). *Local Description Authors:* J. Thompson, mod. J. Coles
Global Description Authors: P. Lesica and S.V. Cooper, mod. G. Kittel and J. Coles

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Fischer and Clayton 1983, MTNHP 2002b, Pfister et al. 1977, Roberts 1980, Soil Conservation Service 1981b.

Pseudotsuga menziesii / Juniperus communis Forest
Douglas-fir / Common Juniper Forest

CODE	CEGL000439
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest (I.A.8.N.)
FORMATION	Conical-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.c.)
ALLIANCE	*PSEUDOTSUGA MENZIESII* FOREST ALLIANCE (A.157) Douglas-fir Forest Alliance
ECOLOGICAL SYSTEM(S):	Middle Rocky Mountain Montane Douglas-fir Forest and Woodland (CES306.959) Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)
USFWS WETLAND SYSTEM:	Not applicable

CONCEPT SUMMARY
Globally
This Rocky Mountain forest association occurs from northwestern Montana south into central and eastern Idaho, western Wyoming and north-central Colorado. These forests occupy gentle to steep slopes (11-100%), on dry, exposed rocky slopes and ridgetops, at lower to mid elevations of the forested zone, from 1430 to 2930 m (4690-9620 feet) in elevation. Sites are relatively dry and occur on all aspects. Substrates are typically coarse-textured soils derived from a variety of parent materials. This association includes stands dominated by the evergreen needle-leaved tree *Pseudotsuga menziesii* or a mixed montane conifer tree canopy. *Pseudotsuga menziesii* is the dominant tree species in the overstory and often in the understory as well. *Pinus ponderosa, Pinus flexilis, Pinus contorta,* or *Pinus albicaulis* are occasionally present to codominant on drier sites, *Populus tremuloides* on moister sites. The low-shrub layer is dominated by near-continuous to large patches of *Juniperus communis*. Other shrubs include *Arctostaphylos uva-ursi, Jamesia americana, Juniperus horizontalis, Mahonia repens, Purshia tridentata, Ribes cereum, Symphoricarpos oreophilus,* or *Shepherdia canadensis*. The herbaceous cover is generally depauperate in the southern and central Rockies, with less than 10% cover of grasses or forbs. Forb species typically provide less than 5% cover and include *Achillea millefolium, Arnica cordifolia, Astragalus miser*, and *Packera streptanthifolia*. Grass species also contribute less than 5% herbaceous canopy cover and include *Muhlenbergia montana, Danthonia parryi, Bouteloua gracilis,* or *Festuca arizonica*. However, occurrences in the northern Rockies may have relatively high herbaceous cover (30-60%), and individual stands can be diverse. Common grasses include *Pseudoroegneria spicata* and *Festuca campestris*. A number of forbs contribute to the overall diversity, although the cover for any one species is not high. *Antennaria rosea, Penstemon confertus*, and *Allium cernuum* have high constancy, and *Selaginella densa var. scopulorum* may be abundant on some sites, particularly those where rock outcrops are present.

DISTRIBUTION

Dinosaur National Monument
This association is known from Zenobia Basin. It is likely to occur in any open, rocky stand of *Pseudotsuga menziesii*.

Globally
This forested association occurs from northwestern Montana south into central and eastern Idaho, western Wyoming and northern Colorado.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association occurs at elevations above 2400 m on gently sloping benches or steep mountain ridges. Aspect varies among sites. The southwest-facing site is at a higher elevation, and the north-facing site is at a lower elevation. Soils are thin, rocky, coarse-textured or loamy, depending on the geologic substrate that the soil is derived from and the solar radiation that the site receives.

Globally
These Douglas-fir forests occupy dry, exposed rocky slopes, benches and ridgetops throughout the Rocky Mountains of Montana, Wyoming and Colorado. Slopes are gentle to steep (11-100%), at the lower to mid elevations of the forested zone, from 1430 to 2930 m (4690-9620 feet) in elevation. Sites are relatively dry and occur on all aspects. Soils are typically coarse-textured, rocky, and extremely well-drained. They may be derived from a variety of parent materials, including granite, sandstone, siltstone and glacial till. The ground surface is often rocky and mostly covered by litter and duff. Bare rock can be as much as 40% of the cover, often encrusted with lichens; litter depth is usually less than 6 cm.

VEGETATION DESCRIPTION
Dinosaur National Monument
This association has a complex structure and varies in density. North-facing slopes may have a dense tree canopy of *Pseudotsuga menziesii* with a sparse understory. Alternately, the canopy of a stand on a west-facing slope may have less than 50% cover. Tree canopies range from 15 to 20 m tall. A subcanopy of *Pseudotsuga menziesii* may be present, as well as *Populus tremuloides* and *Prunus virginiana*. The dominant low shrub is *Juniperus communis* with 1 to 20% cover. Herbaceous species vary among sites and usually are low in cover.
Globally This association includes stands dominated by the evergreen needle-leaved tree *Pseudotsuga menziesii* or a mixed montane conifer tree canopy. Although total canopy cover may vary from sparse to dense, *Pseudotsuga menziesii* is the dominant tree species in the overstory and often in the subcanopy as well. *Populus tremuloides, Picea pungens, Pinus ponderosa, Pinus flexilis, Pinus contorta,* or *Pinus albicaulis* are occasionally present to codominant on drier sites, *Populus tremuloides* on moister sites. Total cover of the shrub and herbaceous layers tends to be negatively correlated with canopy closure. Scattered tall shrubs such as *Prunus virginiana* may be present, but they do not form a layer. The low-shrub layer is dominated by patches of *Juniperus communis*, which may vary in cover from 1% to more than 75%. Other shrubs may include *Arctostaphylos uva-ursi, Dasiphora fruticosa* ssp. *floribunda, Jamesia americana, Juniperus horizontalis, Mahonia repens, Purshia tridentata, Ribes cereum, Symphoricarpos oreophilus,* and *Shepherdia canadensis*. The herbaceous cover is generally depauperate in the southern and central Rockies, with less than 10% cover of grasses or forbs. Forb species typically provide less than 5% cover and include *Achillea millefolium var. occidentalis, Antennaria* spp., *Arnica cordifolia, Artemisia ludoviciana, Astragalus miser, Geranium caespitosum, Packera streptanthifolia,* and *Penstemon* spp. Grass species also contribute less than 5% herbaceous canopy cover and include *Muhlenbergia montana, Danthonia parryi, Bouteloua gracilis,* or *Festuca arizonica*. However, occurrences in the northern Rockies may have relatively high herbaceous cover (30-60%), and individual stands can be diverse. Common grasses include *Pseudoroegneria spicata* and *Festuca campestris*. A number of forbs contribute to the overall diversity, although the cover for any one species is not high. *Antennaria rosea, Penstemon confertus*, and *Allium cernuum* have high constancy, and *Selaginella densa var. scopulorum* may be abundant on some sites, particularly those where rock outcrops are present.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Pseudotsuga menziesii*
Short shrub/sapling	*Juniperus communis*

Globally

Stratum	**Species**
Tree canopy	*Pseudotsuga menziesii*
Short shrub/sapling	*Juniperus communis*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association occurs on warm exposures in the higher elevation areas of the monument.
Dinosaur National Monument Data Sources: This description was derived from 2002 field data (2 plots: DINO.0261, DINO.0518).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: G. Kittel, mod. K.A. Schulz and J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Giese 1975, Johnston 1987, Jones and Ogle 2000, MTNHP 2002b, Murphy 1982, Pfister et al. 1977, Steele et al. 1981, Steele et al. 1983, Vories 1974, .

***Pseudotsuga menziesii / Mahonia repens* Forest**
Douglas-fir / Creeping Oregon-grape Forest

CODE	CEGL000442
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest (I.A.8.N.)
FORMATION	Conical-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.c.)
ALLIANCE	*PSEUDOTSUGA MENZIESII* FOREST ALLIANCE (A.157) Douglas-fir Forest Alliance
ECOLOGICAL SYSTEM(S):	Middle Rocky Mountain Montane Douglas-fir Forest and Woodland (CES306.959) 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 dry, often nutrient-poor sites in northern Arizona and New Mexico north through Colorado and Utah into Idaho and Wyoming. Stands occur on lower mountain slopes and upper canyon slopes. Elevations range from 2135 to 2595 m (7000-8500 feet) in northern Arizona and New Mexico, 1740 to 2930 m

(5700-9600 feet) in Colorado, and 1375 to 2595 m (4500-8500 feet) in Utah and southern Idaho. Soils are variable in texture and parent material, but are usually deep and often rocky. The vegetation is representative of closed-canopy stands of *Pseudotsuga menziesii* where most species other than *Mahonia repens* have been shaded out. In some stands, a few individual *Pinus ponderosa, Pinus contorta, Pinus flexilis, Populus tremuloides,* or *Juniperus scopulorum* may persist in the canopy or subcanopy. The understory may be sparse, with 10% or less total cover, but sometimes will have up to 30% total herbaceous and shrub cover. *Mahonia repens* is the dominant species with at least 1% cover, but other species are usually present with at least trace cover, including *Juniperus communis, Symphoricarpos oreophilus, Paxistima myrsinites,* and *Prunus virginiana*. The herbaceous layer is generally sparse but may include small amounts of *Poa fendleriana, Festuca arizonica, Carex geyeri, Carex rossii, Arnica cordifolia, Maianthemum racemosum, Galium boreale, Bromus ciliatus, Clematis columbiana,* and *Thalictrum fendleri.* The mature, older canopy trees in some stands are fire-scarred, indicating that ground-fire activity may be important in stands of this type. Some stands appear to be ponderosa pine woodlands that have filled in within the last 150 years with a closed canopy of Douglas-fir.

DISTRIBUTION

Dinosaur National Monument

This association is known from the labyrinth canyons of the Ely Creek drainage west of Jones Hole Creek.

Globally

This association occurs in dry mountain and canyon sites in northern Arizona and New Mexico, north through central Utah into Oregon and southern Idaho, and east into Wyoming and Colorado.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occupies cool, wet, north-facing slopes in narrow tributary canyons. The elevation at the sample plot is 1500 m. The soil is a loamy sand, and the ground surface is covered by organic litter and downed wood.

Globally

This forest association occurs on dry, often nutrient-poor sites in northern Arizona and New Mexico north through Colorado and Utah into Idaho and Wyoming. Stands occur on lower mountain slopes and upper canyon slopes. Elevations range from 2135 to 2595 m (7000-8500 feet) in northern Arizona and New Mexico, 1740 to 2930 m (5700-9600 feet) in Colorado, and 1375 to 2595 m (4500-8500 feet) in Utah and southern Idaho. Soils are variable in texture and parent material, but are usually deep and often rocky. Litter and downed wood cover nearly all the unvegetated surface.

VEGETATION DESCRIPTION

Dinosaur National Monument This is one of the most mesic coniferous forest associations within the monument. It has a canopy of *Pseudotsuga menziesii* more than 20 m tall and with more than 75% canopy closure. Scattered individuals of *Acer negundo* and *Juniperus scopulorum* form a sparse subcanopy with approximately 5% cover. The tall shrubs *Prunus virginiana* and *Betula occidentalis* occur with 20% total cover, and the dwarf-shrub *Mahonia repens* has 20% cover. Herbaceous species are sparse, possibly due to the dense shade and heavy litter cover. Grass species present include *Poa fendleriana, Piptatherum micranthum,* and *Pseudoroegneria spicata*.
Globally This association represents closed-canopy stands of *Pseudotsuga menziesii* where most species other than *Mahonia repens* have been shaded out. In some stands, a few individual *Pinus ponderosa, Pinus contorta, Pinus flexilis, Populus tremuloides,* or *Juniperus scopulorum* may persist in the canopy or subcanopy. The understory may be sparse, with 10% or less total cover, but sometimes will have up to 30% total herbaceous and shrub cover. *Mahonia repens* is the dominant species with at least 1% cover, but other species are usually present with at least trace cover, including *Juniperus communis, Symphoricarpos oreophilus, Paxistima myrsinites,* and *Prunus virginiana*. The herbaceous layer is generally sparse but may include small amounts of *Poa fendleriana, Festuca arizonica, Carex geyeri, Carex rossii, Arnica cordifolia, Maianthemum racemosum, Galium boreale, Bromus ciliatus, Clematis columbiana,* and *Thalictrum fendleri.*

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**

Tree canopy	*Pseudotsuga menziesii*
Tall shrub/sapling	*Prunus virginiana*
Herb (field)	*Mahonia repens*

Globally

Stratum	**Species**
Tree canopy	*Pseudotsuga menziesii*
Herb (field)	*Mahonia repens*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.
Globally This association describes a dry, mature to old-growth, closed-canopy *Pseudotsuga menziesii* forest type of the interior western U.S.; earlier seral stages have a more open, mixed canopy and more diversity and cover by shrubs and herbaceous species. *Mahonia repens* is a common understory species in all seral stages of these forests, but usually is mixed with varying amounts of species that are also indicators in other associations. It is not necessarily clear what degree of dominance by *Mahonia repens* versus other diagnostic species (such as *Carex geyeri*, *Paxistima myrsinites*, *Symphoricarpos oreophilus*, or *Juniperus communis*) places a stand into this association.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association was sampled only once but may occur in other narrow tributary canyons within the monument.
Dinosaur National Monument Data Sources: This description is based on 2002 field data (1 plot: DINO.0238).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Alexander et al. 1984b, Atzet and Wheeler 1984, Bourgeron and Engelking 1994, CONHP 2003, Cole 1977b, Cole 1982, Driscoll et al. 1984, Hoffman and Alexander 1976, Johnston 1984, Johnston 1987, Jones and Ogle 2000, Kagan et al. 2000, Larson and Moir 1987, MTNHP 2002b, Mauk and Henderson 1984, Roberts 1980, Roberts et al. 1992, Steele et al. 1981, Steele et al. 1983, Youngblood and Mauk 1985

Pseudotsuga menziesii / Symphoricarpos oreophilus
Forest Douglas-fir / Mountain Snowberry Forest

CODE	CEGL000462
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Evergreen forest (I.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest (I.A.8.N.)
FORMATION	Conical-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.c.)
ALLIANCE	*PSEUDOTSUGA MENZIESII* FOREST ALLIANCE (A.157) Douglas-fir Forest Alliance
ECOLOGICAL SYSTEM(S):	Middle Rocky Mountain Montane Douglas-fir Forest and Woodland (CES306.959) Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest (CES306.805)

Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

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

DISTRIBUTION

Dinosaur National Monument

This association is known from Rippling Brook in Lodore Canyon, Zenobia Basin, Round Top Mountain, and Iron Springs Bench.

Globally

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

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs on steep to very steep slopes of mountain ridges. Sites are commonly associated with north- or east-facing aspects, and elevation ranges from 1900 to 2600 m. Soils are shallow, sandy, rocky and rarely exposed. Leaf litter, downed trees and limbs, and large rocks cover the ground.

Globally

This widespread forest association occurs in foothills, mountains and plateaus from southwestern Montana through Wyoming and Colorado to Trans-Pecos Texas, west to Arizona, Utah, and into eastern Oregon and Washington. Elevation ranges from 700-2900 m (2310-9500 feet). This broadly defined forest association occurs as both a non-obligate riparian community and as an upland community. In more arid regions stands occur along drainages along narrow riparian areas in ravines, canyons, and up steep draws. It continues upland on steep north-facing slopes in narrow canyons where dense shade and steepness preclude any significant shrub or herbaceous understory. Elsewhere at more northern latitudes, it occurs near lower treeline on warm, dry southern aspects 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

Dinosaur National Monument

A dense canopy of *Pseudotsuga menziesii* characterizes this forest association with heights reaching 20 m. The subcanopy/tall-shrub stratum, 2-5 m high, consists of *Juniperus scopulorum, Pinus edulis, Juniperus osteosperma, Amelanchier alnifolia, Ribes cereum, Acer glabrum*, and *Rhus trilobata.* Their total cover is 5 to 10%. *Symphoricarpos oreophilus* is the dominant shrub, with 5 to 20% cover, and the dwarf-shrub *Paxistima myrsinites* is

often present with 1 to 10% cover. Forb species are inconsistent among sites and contribute minimal cover, although *Petradoria pumila* is often present. Graminoids, with cover of 1 to 40%, vary among sites. Most common species include *Poa fendleriana, Pseudoroegneria spicata,* and *Achnatherum lettermanii*.

Globally
This forest 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 generally 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
Dinosaur National Monument

Stratum	Species
Tree canopy	*Pseudotsuga menziesii*
Tall shrub/sapling	*Amelanchier alnifolia*
Short shrub/sapling	*Ribes cereum, Symphoricarpos oreophilus*
Herb (field)	*Paxistima myrsinites*
Herb (field)	*Penstemon strictus*
Herb (field)	*Pascopyrum smithii, Pseudoroegneria spicata*

Globally

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

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Poa pratensis

Globally
Data are not available.

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

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

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This is the most common Douglas-fir forest type within the monument. It may be distinguished from other *Pseudotsuga menziesii* associations by the presence, and usually dominance of, *Symphoricarpos oreophilus* and *Paxistima myrsinites* in the understory. Most examples are located where high mountain ridges have been cut by erosion to form steep, north-facing escarpments.
Dinosaur National Monument Data Sources: This description is based on 2002 field data (8 plots: DINO.0187,

DINO.0229, DINO.0254, DINO.0270, DINO.0349, DINO.0502, DINO.0503, DINO.0511).
Local Description Authors: J. Thompson, mod. J. Coles
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, Mauk and Henderson 1984, Muldavin et al. 1996, Pfister et al. 1977, Reed 1976, Steele et al. 1981, Steele et al. 1983, Ecology Working Group n.d., Williams and Lillybridge 1983, Williams and Lillybridge 1985, Williams et al. 1990b, Wright et al. 1979, Youngblood and Mauk 1985

Populus tremuloides / Amelanchier alnifolia - Symphoricarpos oreophilus / Mixed Graminoid Forest

Quaking Aspen / Saskatoon Serviceberry - Mountain Snowberry / Mixed Graminoid Forest

CODE	CEGL002816
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Deciduous forest (I.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous forest (I.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
FORMATION	Montane or boreal cold-deciduous forest (I.B.2.N.b.)
ALLIANCE	*POPULUS TREMULOIDES* FOREST ALLIANCE (A.274) Quaking Aspen Forest Alliance

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

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association has only been described from Dinosaur National Monument. Stands within the monument occur on moderate to steep slopes of mountains and plateaus between 2300 and 2600 m elevation (7545-8530 feet). Soil textures vary, but soils are rocky and covered by litter and boulders. At Dinosaur, this appears to be a persistent aspen type; coniferous trees are absent from the canopy. *Populus tremuloides* forms a canopy with between 20 and 80% cover. The understory may be sparse to moderately dense and is always diverse. Tall shrubs are dominated by *Amelanchier alnifolia* or *Amelanchier utahensis*, generally accompanied by other species such as *Salix scouleriana* and *Prunus virginiana*. The short-shrub layer includes high cover of *Symphoricarpos oreophilus*, although *Rosa woodsii, Artemisia tridentata*, and *Juniperus communis* are commonly associated. The dwarf-shrubs *Mahonia repens* and *Paxistima myrsinites* also occur with variable cover. The herbaceous layer is characterized by graminoids such as *Achnatherum lettermanii*; *Carex rossii* and *Carex geyeri* are absent. Forbs are present but have much less cover than the grasses.

DISTRIBUTION

Dinosaur National Monument

This association is known from north-facing slopes descending from the Yampa Plateau, including Martha's Peak, Round Top Mountain, Peterson Valley, and Miner's Draw Road.

Globally

This association has only been described from Dinosaur National Monument in northwestern Colorado and adjacent Utah.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occupies moderate to moderately steep slopes of mountains and plateaus between 2300 and 2600 m elevation. It occurs in small stands on benches or slopes with north aspects or other areas that collect snow and have a higher soil moisture throughout the growing season. The soil texture is silty to sandy loam. Leaf litter and downed limbs and trees contribute the majority of the ground cover, although in some stands the cover by large rocks may be as high as 40%.

Globally
This association has only been described from Dinosaur National Monument. Until further inventory is completed, there is no global information.

VEGETATION DESCRIPTION
Dinosaur National Monument
This lush woodland/forest association has diverse species composition and complex structure. Young to mature stands of *Populus tremuloides* dominate the tree canopy. Heights range from 2 to 10 m, and canopy cover ranges from 20 to 80%. The tall shrub *Amelanchier alnifolia* (sometimes *Amelanchier utahensis*) occurs in the understory with 5 to 80% cover. Other tall shrubs present may include *Salix scouleriana* and *Prunus virginiana*. The short-shrub stratum (10-30% cover) is dominated by *Symphoricarpos oreophilus*, although *Rosa woodsii, Artemisia tridentata*, and *Juniperus communis* are commonly associated. The dwarf-shrubs *Mahonia repens* and *Paxistima myrsinites* also occur with variable cover. Herbaceous species are highly diverse and inconsistent in composition among sites, but grasses are more abundant than forbs, although lacking an indicator species. Species most likely to be present include *Achnatherum lettermanii* and *Lupinus argenteus*.

Globally
This association has only been described from Dinosaur National Monument. Until further inventory is completed, there is no global information.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	Species
Tree canopy	*Populus tremuloides*
Tree subcanopy	*Populus tremuloides*
Tall shrub/sapling	*Amelanchier alnifolia, Prunus virginiana, Salix scouleriana*
Short shrub/sapling	*Rosa woodsii, Symphoricarpos oreophilus*
Herb (field)	*Mahonia repens, Paxistima myrsinites*
Herb (field)	*Lupinus argenteus*
Herb (field)	*Achnatherum lettermanii, Hesperostipa comata*

Globally
Data are not available.

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Poa pratensis

Globally
Data are not available.

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association occurs in small but conspicuous stands in the higher elevations and more mesic locations of the monument. It is distinguished from other aspen associations by the dominance of a mixed grass herbaceous layer lacking a diagnostic species such as *Carex rossii*.
Dinosaur National Monument Data Sources: The description is based on field data (5 plots: DINO.0191, DINO.0299, DINO.0334, DINO.0364, DINO.0515).

Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

Populus tremuloides / Ceanothus velutinus Forest
Quaking Aspen / Tobacco-brush Forest

CODE	CEGL000581
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Deciduous forest (I.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous forest (I.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
FORMATION	Montane or boreal cold-deciduous forest (I.B.2.N.b.)
ALLIANCE	*POPULUS TREMULOIDES* FOREST ALLIANCE (A.274) Quaking Aspen Forest Alliance

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

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association occurs on the slopes of ridges and mountains in northwestern Wyoming and western Colorado. Elevations range from 2225-2680 m (7300-8800 feet). These forests occur on north to northeast slopes in Colorado and southern slopes in Wyoming. Soils vary from very well-drained, non-skeletal sandy loam and loam to very coarse rocky colluvium, and may be shallow to deep. Stands are often located at the middle to upper portions of the slope; slopes range from level to more than 100%. *Populus tremuloides* makes up a pure, but often open, tree canopy, while the shrub layer consists of a variable mix in which *Ceanothus velutinus* is usually dominant. Other common shrub species include *Mahonia repens, Paxistima myrsinites, Rosa woodsii, Rubus parviflorus, Symphoricarpos oreophilus, Amelanchier alnifolia, Spiraea betulifolia,* and *Sorbus scopulina*. The herbaceous layer is diverse and may include *Eucephalus engelmannii, Eurybia glauca, Lathyrus lanszwertii, Lupinus* spp., *Thalictrum fendleri, Machaeranthera canescens, Arnica cordifolia, Iliamna rivularis, Calamagrostis rubescens, Bromus porteri, Bromus carinatus, Achnatherum lettermanii,* and *Carex geyeri*. This association appears to be maintained by stand-replacing fire, as both *Populus tremuloides* and *Ceanothus velutinus* will resprout after a cool fire. The seeds of *Ceanothus velutinus* and the rootstocks of *Populus tremuloides* can persist in the soil for more than 100 years, and re-establish themselves from seeds and sprouts following a hot fire.

DISTRIBUTION

Dinosaur National Monument

This association is known from the vicinity of Zenobia Peak and is unlikely to be found elsewhere in the monument.

Globally

This association is known from scattered, isolated stands in Montrose, Gunnison, Moffat and Routt counties of western Colorado, and north of Grand Teton National Park, Wyoming.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs at elevations above 2300 m on north-facing slopes where blowing snow collects. Organic litter and downed wood cover the dark loamy soil.

Globally

This association occurs on the slopes of ridges and mountains in northwestern Wyoming and western Colorado. Elevations range from 2225-2680 m (7300-8800 feet). These forests occur on north to northeast slopes in the southern part of the range, and southern slopes in the northern part of the range. Soils vary from very well-drained, non-skeletal sandy loam and loam to very coarse rocky colluvium, and may be shallow to deep. Stands are often located at the middle to upper portions of the slope; slopes range from level to more than 100%. The unvegetated ground surface is well-covered by litter and downed wood.

VEGETATION DESCRIPTION

Dinosaur National Monument This association is represented at Dinosaur National Monument by a young post-fire stand of *Populus tremuloides*, 2-5 m tall, with about 30% cover. The open understory is dense and diverse. *Ceanothus velutinus* dominates the shrub layer with 30% cover and is associated with *Symphoricarpos oreophilus, Mahonia repens*, and *Paxistima myrsinites*. Common grass species include *Poa fendleriana, Achnatherum lettermanii, Bromus carinatus,* and *Elymus elymoides*. Typical forbs include *Solidago nana* and *Machaeranthera canescens*. *Populus tremuloides* seedlings (sprouts) are also present.
Globally Populus tremuloides makes up a pure, but often open, tree canopy, while the shrub layer consists of a variable mix in which *Ceanothus velutinus* is usually dominant. Other common shrub species include *Mahonia repens, Paxistima myrsinites, Rosa woodsii, Rubus parviflorus, Symphoricarpos oreophilus, Amelanchier alnifolia, Spiraea betulifolia*, and *Sorbus scopulina*. The herbaceous layer is diverse and may include *Eucephalus engelmannii, Eurybia glauca, Lathyrus lanszwertii, Lupinus* spp., *Thalictrum fendleri, Machaeranthera canescens, Arnica cordifolia, Iliamna rivularis, Calamagrostis rubescens, Bromus porteri, Bromus carinatus, Achnatherum lettermanii*, and *Carex geyeri.*

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Tree canopy	*Populus tremuloides*
Short shrub/sapling	*Symphoricarpos oreophilus*
Short shrub/sapling	*Ceanothus velutinus*
Herb (field)	*Mahonia repens*
Herb (field)	*Achnatherum lettermanii, Elymus elymoides, Poa fendleriana*

Globally

Stratum	Species
Tree canopy	*Populus tremuloides*
Short shrub/sapling	*Ceanothus velutinus*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G2 (16-Dec-1999). This association is known from fewer than 30 stands in Colorado. The literature indicates that stands occur on very well-drained soils at the middle to upper position of slopes.

CLASSIFICATION COMMENTS

Dinosaur National Monument
Data are not available.

Globally
This association is only known from Colorado and Wyoming. No other studies reviewed mentioned *Populus tremuloides*-dominated communities with any *Ceanothus* spp. in the understory. Bunin (1975) indicated the existence of a variant of this association in which *Rubus parviflorus* was the dominant shrub; however, there are no other references to *Ceanothus* spp. as a component of *Populus tremuloides / Rubus parviflorus* Forest (CEGL000602). Other studies did mention *Populus tremuloides* associations with some of the same understory species (such as *Symphoricarpos oreophilus* and *Amelanchier alnifolia*); however, these did not include reference to any *Ceanothus* spp. Johnston (1987) suggested that this association would fit better as a phase of his *Populus tremuloides / Amelanchier alnifolia - Prunus virginiana* Plant Association; however, no *Ceanothus* is mentioned. This is probably a fire-maintained type that succeeds to another association with enough time post fire.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Stands of quaking aspen are rare and scattered about the high country in small stands. Elk and deer use them heavily. Stands dominated by the shrub *Ceanothus velutinus* occur nearby where Douglas-fir stands burned.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (1 plot: DINO.0519). *Local Description Authors:* J. Thompson, mod. J. Coles
Global Description Authors: J. Thompson and J. Stevens, mod. G. Kittel and J. Coles

REFERENCES: Bourgeron and Engelking 1994, Bunin 1975a, Bunin 1975c, CONHP unpubl. data, CONHP unpubl. data 2003, Driscoll et al. 1984, Johnston 1987, Western Ecology Working Group n.d.

Populus tremuloides / Juniperus communis Forest
Quaking Aspen / Common Juniper Forest

CODE	CEGL000587
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Deciduous forest (I.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous forest (I.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
FORMATION	Montane or boreal cold-deciduous forest (I.B.2.N.b.)
ALLIANCE	*POPULUS TREMULOIDES* FOREST ALLIANCE (A.274) Quaking Aspen Forest Alliance

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

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This *Populus tremuloides* forest association is known from the mountains of Utah, Colorado, Wyoming and Montana. It occurs on gentle to steep slopes (10-100%), on nearly all exposures from 2285 to 3000 m (7500-9800 feet) in elevation. It is also documented from swales, broad benches or dry flats acting as frost pockets, or where subject to cold-air drainage. Soils are derived primarily from sandstone or granite. The tree canopy is dominated by *Populus tremuloides*. Scattered conifer trees occur, such as *Pseudotsuga menziesii, Abies lasiocarpa, Pinus contorta, Pinus ponderosa, Pinus flexilis, Picea engelmannii*, and *Picea pungens*. The shrub layer is dominated by *Juniperus communis*, although it also contains *Acer glabrum, Paxistima myrsinites, Rosa woodsii*, *Symphoricarpos oreophilus*, and sometimes *Artemisia tridentata*, and dwarf-shrubs *Arctostaphylos uva-ursi, Mahonia repens*, and *Vaccinium myrtillus*. The herbaceous layer is variable in expression, with graminoids dominant in some stands and forbs dominant in others. Graminoids commonly occurring include *Carex geyeri, Carex rossii, Elymus trachycaulus, Calamagrostis rubescens, Bromus ciliatus, Achnatherum occidentale, Oryzopsis asperifolia, Danthonia parryi, Poa nemoralis*, or *Poa secunda*. Forbs include *Achillea millefolium, Astragalus miser, Geranium viscosissimum, Lupinus argenteus*, and *Thalictrum fendleri*. Diagnostic characteristics of this association are canopy dominance by *Populus tremuloides* and a short-shrub layer with abundant *Juniperus communis*.

DISTRIBUTION
Dinosaur National Monument
This rare association is known from Wild Mountain in the northwestern part of the project area. It is likely to be found elsewhere in the monument, on well-drained soils.

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

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association occurs as inclusions within larger stands of aspen with a generally more mesic understory. The sampled stand is located at 2535 m elevation on the upper slopes of a mountain. The plot has a north aspect. The soil texture is a well-drained silty loam. The ground surface is covered with leaf litter and downed limbs and trunks.

Globally
This *Populus tremuloides* forest association is known from the mountains of Utah, Colorado, Wyoming and Montana. It occurs on gentle to steep slopes (10-100%), on nearly all exposures from 2285 to 3000 m (7500-9800 feet) in elevation. Distribution of these forests is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand (Mueggler 1988). Secondarily, its range is limited by the length of the growing season or low temperatures (Mueggler 1988). This forest type occurs in two differing environments: (1) warm, dry sites near the margin of bunchgrass meadows and (2) swales, broad benches or dry flats acting as frost pockets, or where subject to cold-air drainage. Soils are derived primarily from sandstone, limestone or granite parent material, and the ground surface may have a high percentage of boulders and gravel.

VEGETATION DESCRIPTION
Dinosaur National Monument
This woodland/forest association has a nearly closed canopy consisting solely of *Populus tremuloides* under 10 m tall. The stand is an even-aged clone, with stems averaging only 7.5 cm (range 3-12 cm). *Juniperus communis* dominates the understory with 10% cover. Other shrub and dwarf-shrubs present include *Amelanchier alnifolia, Symphoricarpos oreophilus, Rosa woodsii, Paxistima myrsinites*, and *Mahonia repens*. Herbaceous species are variable but include *Lupinus argenteus, Machaeranthera canescens, Pascopyrum smithii*, and *Poa fendleriana*.

Globally
Stands a have a somewhat closed to closed canopy of trees 5-20 m tall that is dominated or codominated by the cold-deciduous broad-leaved tree *Populus tremuloides*. Scattered conifer trees sometimes occur, such as *Pseudotsuga menziesii, Abies lasiocarpa, Pinus contorta, Pinus ponderosa, Pinus flexilis, Picea engelmannii*, and *Picea pungens*, but at least some stands appear to be persistent aspen clones. The shrub layer is dominated by *Juniperus communis*, although it also contains *Acer glabrum, Amelanchier alnifolia, Paxistima myrsinites, Rosa woodsii, Symphoricarpos oreophilus*, and sometimes *Artemisia tridentata*, and dwarf-shrubs *Arctostaphylos uva-ursi, Mahonia repens*, and *Vaccinium myrtillus*. The herbaceous layer is variable in expression, with graminoids dominant in some stands and forbs dominant in others. Common graminoids may include *Bromus porteri, Danthonia parryi, Elymus trachycaulus, Elymus glaucus, Bromus carinatus, Calamagrostis rubescens, Carex siccata, Carex geyeri, Carex rossii, Festuca thurberi, Poa fendleriana*, and *Hesperostipa comata*. The most common forbs present include *Thalictrum fendleri, Vicia americana, Achillea millefolium, Astragalus flexuosus, Astragalus miser, Fragaria virginiana, Pseudocymopterus montanus, Thermopsis divaricarpa, Lupinus argenteus, Campanula rotundifolia*, and *Arnica cordifolia*. Exotic species, such as *Taraxacum officinale, Poa pratensis, Bromus inermis* and *Bromus tectorum*, are often common in stands disturbed by grazing.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	Species
Tree canopy	*Populus tremuloides*
Short shrub/sapling	*Juniperus communis*
Herb (field)	*Paxistima myrsinites*

Globally

Stratum	Species
Tree canopy	*Populus tremuloides*
Short shrub/sapling	*Juniperus communis*
Herb (field)	*Achillea millefolium, Thalictrum fendleri*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Bromus inermis, Poa pratensis, Taraxacum officinale

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

CLASSIFICATION COMMENTS

Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: *Populus tremuloides* stands are uncommon in the monument, especially those with an understory of *Juniperus communis*.
Dinosaur National Monument Data Sources: The description is based on field data (1 plot: DINO.0211).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: G. Kittel, mod. S.L. Neid, K.A. Schulz, J. Coles

REFERENCES: Baker 1984a, Bourgeron and Engelking 1994, CONHP 2003, Curry 1962, Driscoll et al. 1984, Johnston 1987, Jones and Ogle 2000, MTNHP 2002b, Marr et al. 1973b, Mueggler 1988, Mueggler and Campbell 1986, Murphy 1982, Peet 1975, Peet 1981, Powell 1988a, Shepherd 1975, Youngblood and Mueggler 1981

Populus tremuloides / Prunus virginiana Forest
Quaking Aspen / Choke Cherry Forest

CODE	CEGL000596
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Deciduous forest (I.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous forest (I.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
FORMATION	Montane or boreal cold-deciduous forest (I.B.2.N.b.)
ALLIANCE	*POPULUS TREMULOIDES* FOREST ALLIANCE (A.274) Quaking Aspen Forest Alliance

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

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This aspen forest type is found in the Rocky Mountains and Black Hills of the western United States. It occurs on slope crests and midslopes with sandy loam, loam, or clay loam soils from approximately 1545 to 2720 m (5100-8980 feet) in elevation. Aspects are highly variable, and slopes are primarily gentle (0-20%) but may also be steep (50-100%). This association is dominated by *Populus tremuloides*. Conifers are sparse when present and can include *Pseudotsuga menziesii, Pinus contorta, Pinus ponderosa*, and *Picea glauca* in the Black Hills. The shrub layer can be a rich multilayered mixture of medium- and low-height shrubs. *Prunus virginiana* is often dominant or codominant with *Amelanchier alnifolia*. Additional shrub associates can include *Acer grandidentatum, Ribes inerme, Ribes oxyacanthoides* ssp. *setosum, Rosa woodsii, Cornus sericea, Paxistima myrsinites, Rubus parviflorus, Symphoricarpos occidentalis,* and *Symphoricarpos oreophilus*. Herbaceous species can have low cover due to the well-developed shrub layer but commonly include *Agastache urticifolia, Aralia nudicaulis, Bromus carinatus, Carex sprengelii, Calamagrostis rubescens, Carex geyeri, Elymus glaucus, Fragaria virginiana, Galium boreale, Geranium viscosissimum, Maianthemum stellatum, Osmorhiza depauperata, Osmorhiza berteroi, Rudbeckia occidentalis, Senecio serra,* and *Thalictrum fendleri*. Diagnostic features of this association are *Populus tremuloides* dominant in the canopy and *Prunus virginiana* well-represented in the shrub layer.

DISTRIBUTION
Dinosaur National Monument
This association is known from the higher elevations of Zenobia Peak and Douglas Mountain.

Globally
This aspen forest type is found in the Rocky Mountains and Black Hills of the western United States, ranging from South Dakota west to Wyoming and Oregon, and south to Colorado and Utah.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs on steep slopes with northerly aspects on mountains or high ridges at elevations around 2500 m. Soils are loamy, and the ground cover is primarily litter with patches of bare soil. At some sites, large boulders contribute much of the ground cover.

Globally

This aspen forest type occurs on slope crests and midslopes with sandy loam, loam, or clay loam soils from approximately 1545 to 2720 m (5100-8980 feet) in elevation. Aspects are highly variable, and slopes are primarily gentle (0-20%) but may be steep (50-100%). In the Black Hills, stands occur along mesic valley bottoms. The slopes can vary from steep (at the bottom of the hillslope) to gentle (along the valley bottom) (H. Marriott pers. comm. 1999). In the southern Rocky Mountains, a stand occurs on a steep, southeasterly midslope on granitic substrates, and on the Colorado Plateau a stand occurs at the end of a box canyon on a steep northwesterly slope on sandstone colluvium.

VEGETATION DESCRIPTION

Dinosaur National Monument

In this association, *Populus tremuloides* dominates the tree canopy and exhibits variable cover, height and age classes. Stands range from young saplings, 2 m high with 10% cover, to mature trees, 10 m high with 50% cover. Single trees of *Pseudotsuga menziesii* may occur. *Prunus virginiana* and *Amelanchier alnifolia* are major components of the tall-shrub layer. Other shrubs present in the shrub layer are *Ribes cereum* and *Cercocarpus ledifolius*. Low shrubs include *Ceanothus velutinus, Juniperus communis, Rosa woodsii, Symphoricarpos oreophilus,* and *Paxistima myrsinites*. Herbaceous species are variable in composition and cover. Species that are known to occur with significant cover are *Elymus glaucus, Poa pratensis,* and *Bromus inermis*.

Globally

This association is dominated by *Populus tremuloides*. Conifers are sparse (<25% of the tree canopy) when present and can include *Pseudotsuga menziesii, Pinus contorta, Pinus ponderosa,* and *Picea glauca* in the Black Hills. The shrub layer can be a rich multilayered mixture of medium- and low-height shrubs. *Prunus virginiana* is often dominant or codominant with *Amelanchier alnifolia*. Additional shrub associates can include *Acer grandidentatum, Amelanchier utahensis, Cornus sericea, Mahonia repens, Ribes inerme, Ribes oxyacanthoides* ssp. *setosum, Rosa woodsii, Paxistima myrsinites, Rubus parviflorus, Symphoricarpos occidentalis,* and *Symphoricarpos oreophilus.* Herbaceous species have low cover due to the well-developed shrub layer but commonly include *Agastache urticifolia, Aralia nudicaulis, Artemisia ludoviciana, Bromus carinatus, Carex sprengelii, Calamagrostis rubescens, Carex geyeri, Elymus glaucus, Fragaria virginiana, Galium boreale, Geranium viscosissimum, Maianthemum stellatum, Osmorhiza depauperata, Osmorhiza berteroi, Piptatherum micranthum, Rudbeckia occidentalis, Senecio serra, Thermopsis divaricarpa*, and *Thalictrum fendleri*. Exotic graminoids, such as *Agropyron cristatum, Bromus tectorum, Phleum pratense*, and *Poa pratensis*, may dominate disturbed herbaceous layers. Diagnostic features of this association are *Populus tremuloides* dominant in the canopy and *Prunus virginiana* dominant in the shrub layer.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Tree canopy	*Populus tremuloides*
Tall shrub/sapling	*Amelanchier alnifolia, Prunus virginiana*
Herb (field)	*Paxistima myrsinites*
Herb (field)	*Bromus inermis, Elymus glaucus, Poa pratensis*

Globally

Stratum	Species
Tree canopy	*Populus tremuloides*
Short shrub/sapling	*Amelanchier alnifolia, Prunus virginiana*
Tall shrub/sapling	*Amelanchier utahensis*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Bromus inermis, Poa pratensis

Globally
Agropyron cristatum, Bonasa umbellus, Bromus tectorum, Phleum pratense, Poa pratensis

CONSERVATION STATUS RANK
Global Rank & Reasons: G3G4 (24-Oct-2002). This community has a relatively restricted range (which would not change even if combined with Populus tremuloides / Prunus virginiana Woodland (CEGL002130)). Stands are somewhat patchy on the landscape, with relatively small occurrences. They require a moderately specific set of abiotic factors, being found in drainage bottoms, with or without flowing streams. Few Element Occurrences have been documented. The restriction of this type to primarily riparian areas or moist drainages makes it susceptible to impacts caused by cattle grazing, especially at lower elevations.

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
This type appears to be most common in riparian areas (Marriott and Faber-Langendoen 2000). This type seems equivalent to *Populus tremuloides / Prunus virginiana* Woodland (CEGL002130).

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Though one plot used to describe this association is in an early-successional stage following fire, identification is straightforward when the two characteristic elements of aspen and choke cherry are present.
Dinosaur National Monument Data Sources: This association is described from 2002 field data (2 plots: DINO.0275, DINO.0534).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Drake, mod. S.L. Neid and K.A. Schulz

REFERENCES: Coenenberg and Depuit 1979, Crowe et al. 2004, Driscoll et al. 1984, Johnston 1987, Kagan et al. 2004, Komarkova et al. 1988b, MTNHP 2002b, Marriott and Faber-Langendoen 2000, Marriott pers. comm., Midwestern Ecology Working Group n.d., Mueggler 1988, Mueggler and Campbell 1986, Titus et al. 1998, Youngblood and Mueggler 1981

Populus tremuloides / Symphoricarpos oreophilus / Carex rossii Forest
Quaking Aspen / Mountain Snowberry / Ross' Sedge Forest

CODE	CEGL000613
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Deciduous forest (I.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous forest (I.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
FORMATION	Montane or boreal cold-deciduous forest (I.B.2.N.b.)
ALLIANCE	*POPULUS TREMULOIDES* FOREST ALLIANCE (A.274) Quaking Aspen Forest Alliance

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

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This association is documented from high plateaus in Utah and Colorado and is reported to occur in the mountains of northwestern Wyoming and central Nevada. Elevations range from 1860 m to more than 2600 m (6100-8530 feet). Slopes are gentle to moderate and sites occur on all aspects. Soils vary in texture but are often rocky and may be derived from granite, sandstone, limestone or volcanics. The canopy consists of moderately closed to closed stands of *Populus tremuloides*, although stands will occasionally contain *Pseudotsuga menziesii*, *Abies concolor*, or *Abies lasiocarpa*, indicating that some stands may eventually convert to coniferous forests. The shrub layer consists

primarily of *Symphoricarpos oreophilus*, although minor amounts of *Amelanchier utahensis, Prunus virginiana, Artemisia tridentata, Rosa woodsii, Juniperus communis, Mahonia repens*, and *Paxistima myrsinites* may be present. In addition to the generally dominant *Carex rossii*, the herbaceous understory may contain *Achnatherum occidentale, Bromus anomalus, Elymus trachycaulus, Poa pratensis, Thalictrum fendleri, Geranium viscosissimum, Arnica cordifolia*, and *Lupinus argenteus*. This association is generally a climax type, not usually subject to replacement by coniferous species. Overgrazing converts the understory to dominance by *Poa pratensis, Elymus elymoides, Astragalus miser, Taraxacum officinale*, and *Achillea millefolium*.

DISTRIBUTION

Dinosaur National Monument

This association is known from the vicinity of Tanks Peak.

Globally

This association occurs on high plateaus in Utah and Colorado. It is also reported to occur in the Bridger-Teton National Forest in Wyoming and the Monitor Range in Nevada (Mueggler 1988).

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occupies sheltered areas of snow deposition on undulating benches and plateaus at elevations above 2300 m. The gently sloping substrate is typically strewn with boulders and is north-facing. Soils are clay loams and covered by organic litter and fallen trees.

Globally

This association is documented from high plateaus in Utah and Colorado and is reported to occur in the mountains of northwestern Wyoming and central Nevada. Elevations range from 1860 m to more than 2600 m (6100-8530 feet). Slopes are gentle to moderate, may be rocky, and sites occur on all aspects. Soils vary in texture and may be derived from granite, sandstone, limestone or volcanics.

VEGETATION DESCRIPTION

Dinosaur National Monument The sampled plot is of a mature, dense stand of *Populus tremuloides*, 5-10 m tall, with 70% cover. The multi-layered understory is dense and diverse. Taller shrubs are scattered but include *Amelanchier utahensis, Prunus virginiana*, and *Artemisia tridentata*. *Symphoricarpos oreophilus* dominates the shrub layer with 10% cover. Other short and dwarf-shrubs include *Rosa woodsii, Juniperus communis, Mahonia repens*, and *Paxistima myrsinites*. *Carex rossii* dominates the herbaceous layer with 10% cover and is associated with *Bromus ciliatus, Nassella viridula, Lupinus* sp., *Solidago* sp., *Achillea millefolium*, and *Geranium viscosissimum*.

Globally

This infrequent aspen forest type occurs throughout the southern Rocky Mountains and into the Great Basin. The canopy consists of moderately closed to closed stands of *Populus tremuloides*, although stands will occasionally contain *Pseudotsuga menziesii, Abies concolor*, or *Abies lasiocarpa*, indicating that some stands may eventually convert to coniferous forests. The shrub layer consists primarily of *Symphoricarpos oreophilus*, although minor amounts of *Amelanchier utahensis, Prunus virginiana, Artemisia tridentata, Rosa woodsii, Juniperus communis, Mahonia repens*, and *Paxistima* myrsinites may be present. In addition to the generally dominant *Carex rossii*, the herbaceous understory may contain *Achnatherum occidentale, Bromus anomalus, Elymus trachycaulus, Poa pratensis, Thalictrum fendleri, Geranium viscosissimum, Arnica cordifolia*, and *Lupinus argenteus*.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Populus tremuloides*
Short shrub/sapling	*Symphoricarpos oreophilus*
Herb (field)	*Mahonia repens, Paxistima myrsinites*
Herb (field)	*Carex rossii, Nassella viridula*

Globally

Stratum	**Species**

Tree canopy	*Populus tremuloides*
Short shrub/sapling	*Symphoricarpos oreophilus*
Tall shrub/sapling	*Carex rossii*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G3G4 (1-Feb-1996).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: *Populus tremuloides* stands are uncommon in the monument, and when they do occur, they are typically small in area. Trees tend to be small-diameter clones heavily scarred by elk. Elk and deer browsing has also artificially suppressed the cover of serviceberry and choke cherry. Aspen stands tend to occur as islands in a matrix of sagebrush and mixed mountain shrublands.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (1 plot: DINO.0912).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Mueggler 1988, Mueggler and Campbell 1986, NVNHP 2003.

Populus tremuloides / Symphoricarpos oreophilus Forest
Quaking Aspen / Mountain Snowberry Forest

CODE	CEGL000610
PHYSIOGNOMIC CLASS	Forest (I)
PHYSIOGNOMIC SUBCLASS	Deciduous forest (I.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous forest (I.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
FORMATION	Montane or boreal cold-deciduous forest (I.B.2.N.b.)
ALLIANCE	*POPULUS TREMULOIDES* FOREST ALLIANCE (A.274) Quaking Aspen Forest Alliance

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

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This deciduous forest association is widespread in the Rocky Mountains and found in mountains of the interior western U.S. Stands occur at montane and subalpine elevations of 2010 to 2960 m (6600-9700 feet) on a variety of intermediately mesic sites, including lower slopes and benches, draws, sheltered slopes, and high benches that range from flat to steep slopes of any aspect. Northern to eastern aspects are common in the drier and warmer environments such as the southern portions of its range. Soils are generally well-developed, well-drained loams or sandy loams. Vegetation is characterized by a moderately dense to dense tree canopy of *Populus tremuloides* with a short-shrub layer that is dominated by *Symphoricarpos oreophilus*. Occasional conifer trees are possible in the stand

but do not make up more than 25% of the tree canopy.

DISTRIBUTION

Dinosaur National Monument

This association is known from the upper, north-facing slopes of Douglas Mountain and the escarpment separating the Yampa Plateau from Iron Springs Bench and the Yampa Bench.

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

Dinosaur National Monument

This association occupies gentle north-facing slopes on benches and plateaus at elevations above 2300 m. Soils are clay loams and covered with organic litter and fallen trees.

Globally

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

VEGETATION DESCRIPTION

Dinosaur National Monument This association is characterized by mixed-aged stands of *Populus tremuloides,* young trees 2-5 m tall and mature trees 10-15 m tall, totaling 10 to 70% cover. *Pinus ponderosa* and *Juniperus scopulorum* may be present in some stands but are scattered and not reproducing. The multi-layered understory is dense and diverse. Tall shrubs present with low cover include *Amelanchier utahensis, Prunus virginiana,* and *Artemisia tridentata*. In the short-shrub layer *Symphoricarpos oreophilus* dominates with 10 to 20% cover. Other shrubs and dwarf-shrubs present are *Rosa woodsii, Mahonia repens,* and *Paxistima myrsinites*. Tall grasses with 10 to 50% total cover dominate the herbaceous layer. Species occurring often include *Bromus ciliatus, Poa pratensis, Nassella viridula, Pseudoroegneria spicata, Achnatherum lettermanii,* and *Elymus trachycaulus*.
Globally This association is characterized by a moderately dense to dense tree canopy of *Populus tremuloides* with a short-shrub layer that is dominated by *Symphoricarpos oreophilus* (usually >10% cover). Associated shrubs with lesser cover include *Rosa woodsii, Mahonia repens, Amelanchier utahensis, Prunus virginiana, Paxistima myrsinites,* and *Amelanchier alnifolia*. The generally sparse herbaceous layer is composed primarily of graminoid species such as *Carex geyeri, Achnatherum lettermanii, Poa fendleriana, Elymus glaucus,* and *Festuca thurberi.* Associated herbaceous species include *Achillea millefolium, Thalictrum fendleri, Geranium richardsonii, Geranium caespitosum, Lupinus argenteus, Osmorhiza* spp., and *Fragaria virginiana*. Occasional conifer trees are possible in the stand, including *Juniperus scopulorum, Picea pungens,* and *Pseudotsuga menziesii,* but do not make up more than 25% of the tree canopy. Total vegetation cover is often in excess of 100%, although the tree canopy may only have 20% closure.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Populus tremuloides*
Short shrub/sapling	*Symphoricarpos oreophilus*
Herb (field)	*Achnatherum lettermanii, Nassella viridula, Poa pratensis, Pseudoroegneria spicata*

Globally

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

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Poa pratensis

Globally
Poa pratensis

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

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

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: *Populus tremuloides* stands are uncommon in the monument and, when they do occur, are typically small and heavily used by elk and deer. This association may be distinguished from *Populus tremuloides / Symphoricarpos oreophilus / Carex rossii* Forest (CEGL000613) by a lack of *Carex rossii* in the herbaceous layer.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (2 plots: DINO.0577, DINO.0652, 1 observation point: DINO 9905).
Local Description Authors: J. Thompson, mod. J. Coles
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

Acer negundo / Prunus virginiana Forest
Box-elder / Choke Cherry Forest

CODE	CEGL000628
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	*ACER NEGUNDO* TEMPORARILY FLOODED FOREST ALLIANCE (A.278) Box-elder Temporarily Flooded Forest Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This box-elder riparian forest is found on floodplains at warm elevations in the western Great Plains of the United States, as well as in the Black Hills region and the Colorado Plateau. This is an early-successional community dominated by *Acer negundo*. Stands occur on level to gently sloping sites between 1067 and 1800 m (3500-5900 feet) elevation. Aspect is not important, but in northwestern Colorado, stands are limited to narrow drainages that are oriented north-south. Soils are poorly developed and derived from alluvium or colluvium. Tree cover may be somewhat sparse to high; stands typically have 10-25% cover but may have cover as high as 60% in narrow canyons. Other tree species may be present to codominant, including *Ulmus americana, Quercus macrocarpa, Fraxinus pennsylvanica*, and *Populus deltoides*. The shrub understory is well-developed and may be more than 2 m high; exact composition will vary by region. *Prunus virginiana, Rhus trilobata, Cornus sericea, Symphoricarpos occidentalis, Ribes aureum, Artemisia tridentata* ssp. *tridentata, Mahonia repens*, and *Toxicodendron pubescens* are common, although at Wind Cave National Park *Prunus virginiana* may be absent. Total shrub cover (tall and short shrubs) is often greater than 50%. Herbaceous cover is variable but usually less than 50% and often is diverse. Species composition also varies, although graminoids tend to be dominant; common species include *Poa pratensis, Piptatherum micranthum, Poa fendleriana, Elymus lanceolatus, Bromus tectorum, Heterotheca villosa*, *Clematis ligusticifolia, Achillea millefolium, Monarda fistulosa*, and *Apocynum cannabinum*.

DISTRIBUTION

Dinosaur National Monument

This association is correlated with side drainages of the Yampa and Green rivers. The sample sites are located near Ely Creek and on a tributary to the Yampa River near Mantle Cave.

Globally

This riparian forest grows on broad alluvial floodplains at warm elevations in the western and northern Great Plains of the United States and Canada, ranging from eastern Colorado to Wyoming, eastern Montana and Alberta. It is also documented from the Black Hills region of South Dakota and the Colorado Plateau of western Colorado and adjacent eastern Utah.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This forest association occupies stream or wash terraces on narrow, north/south-oriented canyon floors at elevations below 1800 m. The substrate is flat or gently sloped, positioned between the floodplain and steeper-sloped canyon walls. Soils are sandy alluvium. Leaf litter, trunks and limbs from the deciduous trees and shrubs contribute significantly to ground cover.

Globally

This uncommon riparian forest association has been documented on the banks, terraces and lower canyon slopes of small intermittent or perennial streams in western South Dakota and northwestern Colorado. It has been reported from throughout the western and northern Great Plains, including eastern Montana and Colorado, and is likely to occur in isolated stands in sheltered canyons throughout the Colorado Plateau. Stands occur on level to gently sloping sites between 1067 and 1800 m (3500-5900 feet) elevation. Aspect is not important, but in northwestern Colorado, stands are limited to narrow drainages that are oriented north-south. Soils are poorly developed and derived from alluvium or colluvium.

VEGETATION DESCRIPTION

Dinosaur National Monument

Acer negundo dominates the tree canopy, ranging from 20 to 60% cover and averaging 10 m in height. *Juniperus scopulorum* is also likely to occur in the canopy. The shrub layer has up to 40% cover and is dominated by *Prunus virginiana*. *Rhus trilobata* and *Artemisia tridentata* ssp. *tridentata* are present with lesser cover. *Mahonia repens* may occur in the dwarf-shrub layer with significant cover. Herbaceous cover ranges between 30 and 60% and is dominated by graminoids, including *Piptatherum micranthum, Poa fendleriana, Poa pratensis, Elymus lanceolatus*, and *Bromus tectorum*. Forb species may include *Heterotheca villosa*, *Clematis ligusticifolia*, and *Achillea millefolium*.

Globally

This is an early-successional community dominated by *Acer negundo*. Tree cover may be somewhat sparse to high; stands typically have 10-25% cover but may have cover as high as 60% in narrow canyons. Other tree species may

be present to codominant, including *Ulmus americana, Quercus macrocarpa, Fraxinus pennsylvanica,* and *Populus deltoides*. The shrub understory is well-developed and may be more than 2 m high; exact composition will vary by region. *Prunus virginiana, Rhus trilobata, Cornus sericea, Symphoricarpos occidentalis, Ribes aureum, Artemisia tridentata* ssp. *tridentata, Mahonia repens*, and *Toxicodendron pubescens* are common, although at Wind Cave National Park *Prunus virginiana* may be absent. Total shrub cover (tall and short shrubs) is often greater than 50%. Herbaceous cover is variable but usually less than 50% and often is diverse. Species composition also varies, although graminoids tend to be dominant; common species include *Poa pratensis, Piptatherum micranthum, Poa fendleriana, Elymus lanceolatus, Bromus tectorum, Heterotheca villosa, Clematis ligusticifolia, Achillea millefolium, Monarda fistulosa,* and *Apocynum cannabinum*.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Acer negundo*
Short shrub/sapling	*Prunus virginiana*

Globally

Stratum	**Species**
Tree canopy	*Acer negundo*
Tall shrub/sapling	*Prunus virginiana*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum, Poa pratensis

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G3 (1-Feb-1996).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
In the Black Hills, see description by Marriott and Faber-Langendoen (2000). There box-elder / choke cherry forest is equivalent to the box-elder / water birch (*Betula occidentalis* - Kentucky bluegrass (*Poa pratensis*) association, in part, in the Black Hills Riparian Vegetation Classification (RMS 1998). That association includes stands at higher elevations where water birch, rather than choke cherry, dominates the shrub layer. These stands typically have sparse or patchy tree cover and have been treated as water birch shrubland in the current classification, developed during the Black Hills Community Inventory (BHCI, Marriott et al. 1999). Lower elevation riparian forests and woodlands in the Black Hills include several similar types that have not been well-characterized due to lack of survey (much of the land at lower elevations is in private ownership). An ash - elm - box-elder forest type was included in the preliminary Black Hills vegetation classification for the BHCI but was dropped in favor of the ash - elm / western snowberry type. With additional survey, it may be found to be a valid type in the area.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Only two plots were assigned to this association. It is likely to occur elsewhere in the monument but is restricted to small stands in narrow, cool canyons. The box-elder canopy cover as measured within the monument is likely to fall into the woodland physiognomic class but is included in the existing forest association.
Dinosaur National Monument Data Sources: This association is described from 2002 field data (2 plots: DINO.0200, DINO.0236).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Drake, mod. H. Marriott and J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP pers. comm., CONHP unpubl. data 2003, Carsey et al. 2003a, Driscoll et al. 1984, Hansen et al. 1991, Hansen et al. 1995, Jones 1992b, Kittel et al. 1994, Kittel et al. 1999a, Kudray et al. 2004, MTNHP 2002b, Marriott pers. comm., RMS 1998, Western Ecology Working Group n.d.

Acer negundo / Equisetum arvense Forest
Box-elder / Field Horsetail Forest

CODE	CEGL000626
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	Seasonally flooded cold-deciduous forest (I.B.2.N.e.)
ALLIANCE	*ACER NEGUNDO* SEASONALLY FLOODED FOREST ALLIANCE (A.341) Box-elder Seasonally Flooded Forest Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This plant association occurs in the Overthrust Mountains of northeastern Utah, in northwestern Colorado and possibly in Idaho and Wyoming. Stands generally occur on the banks of low-gradient streams that experience periodic flooding and scouring that remove non-rhizomatous species. The association occurs in narrow valleys below 2000 m in elevation. Stream gradients are low, terraces slope gently, the water table is high through at least part of the growing season, and soils are generally sandy and derived from alluvium. *Acer negundo* dominates the open overstory with a dense understory of *Equisetum arvense*. Canopy cover is at least 20%. Shrubs occur in patches and may include *Salix exigua, Salix monticola, Tamarix ramosissima, Rhus trilobata,* and *Sambucus caerulea*. Herbaceous species are mostly crowded out by the *Equisetum*; there may be occasional stems of *Maianthemum stellatum, Mentha arvensis, Clematis ligusticifolia, Elymus glaucus,* and the introduced grasses *Agrostis stolonifera* and *Poa pratensis*.

DISTRIBUTION

Dinosaur National Monument

This association is known from Cub Creek in the southwestern part of the monument. It is likely to occur along other small, permanent streams in the area having sandy banks and a flashy flood regime, such as the confluence of Ely and Jones Hole creeks.

Globally

The association is known to occur in the Overthrust Mountains of northeastern Utah, northwestern Colorado and possibly Wyoming and Idaho.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs on the banks of permanent streams within the active floodplain at elevations below 1800 m. Streambanks are flat and soils are a sandy loam. Litter covers most of the nonvegetated surface.

Globally

This plant association occurs in the Overthrust Mountains of northeastern Utah, in northwestern Colorado and possibly in Idaho and Wyoming. The association occurs on low-gradient stream terraces in narrow valleys below 2000 m in elevation. Stream gradients are low, terraces slope gently, the water table is high through at least part of the growing season, and soils are generally sandy and derived from alluvium.

VEGETATION DESCRIPTION

Dinosaur National Monument

Acer negundo comprises the tree canopy in this association. Canopy cover is about 20% and 15 m tall. Shrub cover is 30% and 1-2 m tall. Significant shrub species are *Salix exigua, Salix monticola*, and *Tamarix ramosissima. Rhus*

trilobata and Sambucus nigra also occur at less than 1% cover. Herbaceous cover is 30% and dominated by *Equisetum arvense* with 20% cover. Herbaceous species with 10% cover include *Agrostis gigantea* and *Clematis ligusticifolia*.

Globally
Acer negundo dominates the open overstory with a dense understory of *Equisetum arvense*. Canopy cover is at least 20%. Shrubs occur in patches and may include *Salix exigua, Salix monticola, Tamarix ramosissima, Rhus trilobata,* and *Sambucus caerulea*. Herbaceous species are mostly crowded out by the *Equisetum*; there may be occasional stems of *Maianthemum stellatum, Mentha arvensis, Clematis ligusticifolia, Elymus glaucus,* and the introduced grasses *Agrostis stolonifera* and *Poa pratensis*.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	Species
Tree canopy	*Acer negundo*
Short shrub/sapling	*Salix exigua, Salix monticola, Sambucus nigra, Tamarix ramosissima*
Herb (field)	*Clematis ligusticifolia*
Herb (field)	*Agrostis gigantea*
Herb (field)	*Equisetum arvense*

Globally

Stratum	Species
Tree canopy	*Acer negundo*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum, Cirsium arvense, Poa pratensis, Tamarix ramosissima

Globally
Agrostis stolonifera, Bromus tectorum, Cirsium arvense, Poa pratensis, Tamarix ramosissima

CONSERVATION STATUS RANK
Global Rank & Reasons: G2? (30-Nov-1998). This is a minor type that is known from the Overthrust Mountains of northeastern Utah, northwestern Colorado and possibly Idaho and Wyoming. Stands of Acer negundo are typically small in size due to confinement in narrow valley bottoms. Grazing and/or lowered water tables or reduced flood regimes will shift understory species composition. The association was originally described by Padgett et al. (1989).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.
Globally
Classification is based on field data collected in 1989 from the Wasatch Mountains of Utah and in 2002 in Dinosaur National Park in Utah and Colorado.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This vegetation association is based on one plot. Significant cover by Equisetum arvense under a canopy of *Acer negundo* and the presence of flowing water will distinguish it from other Acer negundo associations.
Dinosaur National Monument Data Sources: This association is described from 2002 field data (1 plot: DINO.0010).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: M. Jankovsky-Jones, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, IDCDC 2005, Padgett et al. 1989.

Juniperus osteosperma / Artemisia nova Woodland

Utah Juniper / Black Sagebrush Woodland

CODE	CEGL000728
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
ALLIANCE	*JUNIPERUS OSTEOSPERMA* 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 association occurs on the slopes of ridges, saddles and benches below 2200 m elevation in the Colorado Plateau and Great Basin. Substrates and soils are variable but tend to be coarse and contain a calcareous element. *Juniperus osteosperma* forms an open canopy, with a sparse to moderate understory of *Artemisia nova*. The herbaceous layer tends to be sparse and dominated by graminoids, including *Poa secunda*.

DISTRIBUTION

Dinosaur National Monument

This somewhat rare association is known from the low- to mid-elevation regions of the monument, including the outer hogbacks on the quarry side of Split Mountain and Red Wash near Island Park.

Globally

This association is known to occur in Idaho, western Colorado, northeastern Utah, and northern and central Nevada. It is suspected to occur in eastern California but has not yet been documented from there.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occupies broad gentle slopes, benches and ridges at elevations ranging from 1500 to 1900 m. Soils are mostly coarse-textured, rapidly drained sandy loams, and ground cover is variable, including bedrock, boulders, cryptogamic crusts, and organic litter under the canopies of live vegetation. The underlying substrate is variable and includes Glen Canyon sandstone, Chinle shale and Weber sandstone, although this does not seem to affect the species present.

Globally

This association occurs in small to moderate patches (<1 to approximately 10 ha) on saddles, benches and ridges within the Colorado Plateau and Great Basin. Stands occur on gentle to moderate slopes oriented to any aspect between 1500 and 2200 m (4920-7220 feet) elevation. The substrate is often a calcareous shale, sandstone, or volcanic tuff. Soils are generally shallow sandy loams with a high percentage of bare ground or desert pavement accounting for most of the non-vegetated surface.

VEGETATION DESCRIPTION

Dinosaur National Monument *Juniperus osteosperma* dominates this association with 10 to 40% cover. *Pinus edulis* may occur in the stand as an occasional mature tree or seedling. Dwarf-shrub *Artemisia nova* dominates the shrub layer with 5 to 20% cover. Common associated shrubs with lesser cover include *Ephedra viridis, Artemisia tridentata* ssp. *wyomingensis,* and dwarf-shrub *Gutierrezia sarothrae*. Herbaceous vegetation varies in composition and typically contributes less than 10% cover, except where exotic *Bromus tectorum* has successfully invaded the site. Common graminoid species include *Poa fendleriana, Achnatherum hymenoides, Pseudoroegneria spicata, Pleuraphis jamesii*, and *Bromus tectorum*. Forbs are usually present but are highly variable in composition and have minimal cover.

Globally

This woodland association is characterized by an open canopy (10-40% cover) of *Juniperus osteosperma*. *Pinus*

edulis is occasionally present with less than 1% cover. *Artemisia nova* dominates the sparse to moderate shrub layer (2-25% cover); other shrubs that may contribute to the shrub layer include *Ephedra viridis, Gutierrezia sarothrae, Amelanchier utahensis*, and *Purshia tridentata*. The herbaceous layer is variable and generally sparse, with few species exceeding 1% cover. The most common herbaceous species include *Poa secunda, Leymus salinus, Pleuraphis jamesii*, and *Phlox* spp.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Tree canopy	*Juniperus osteosperma*
Herb (field)	*Artemisia nova*
Herb (field)	*Bromus tectorum*

Globally

Stratum	Species
Tree canopy	*Juniperus osteosperma*
Short shrub/sapling	*Bromus tectorum*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Bromus tectorum

Globally
Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: G5? (1-Feb-1996).

CLASSIFICATION COMMENTS

Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Dinosaur National Monument Inventory Notes: Data are not available.
Dinosaur National Monument Data Sources: The description is based on 2002 and 2003 field data (5 plots: DINO.0101, DINO.0160, DINO.0170, DINO.0645, DINO.0725).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Blackburn et al. 1968c, Blackburn et al. 1971, Bourgeron and Engelking 1994, Caicco and Wellner 1983c, Driscoll et al. 1984, NVNHP 2003.

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	*JUNIPERUS OSTEOSPERMA* 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

Dinosaur National Monument

This association is known to occur in Hell's Canyon, Bear Wallow Canyon, Island Park, and the east end of the monument. It is generally restricted to the floors of narrow drainages, where the juniper that occupy canyon walls have invaded an established sagebrush community.

Globally

This association has been sampled in eastern Utah and northwestern Colorado. It is likely to be widespread throughout the Colorado Plateau.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This woodland association occurs in narrow stands on upper stream terraces, on the floor of narrow tributary drainages or at the break between valley floor and slope. Slope angles are gentle to moderate (under 25% slope), and elevation at known sites is below 1700 m. Soils are sandy loams derived from alluvium, often with significant moss cover.

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

Dinosaur National Monument

This association is characterized by sparse to moderately dense cover of *Juniperus osteosperma*. The shrub *Artemisia tridentata* ssp. *tridentata* contributes up to 40% cover. Other associated shrubs with minimal cover include *Amelanchier utahensis, Ericameria nauseosa, Atriplex canescens, Opuntia* spp., and *Gutierrezia sarothrae*. Sparse to moderately dense grass cover is dominated by *Distichlis spicata, Hesperostipa comata,* or *Bromus tectorum*. Other herbaceous species vary among sites depending on disturbance and shrub canopy cover.

Globally

This woodland association is best developed 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*.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	Species
Tree canopy	*Juniperus osteosperma*
Short shrub/sapling	*Artemisia tridentata* ssp. *tridentata*
Herb (field)	*Bromus tectorum, Distichlis spicata*

Globally

Stratum	Species
Tree canopy	*Juniperus osteosperma*
Short shrub/sapling	*Artemisia tridentata* ssp. *tridentata*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum
Globally
Bromus tectorum

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (22-Mar-2005).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Data are not available.
Dinosaur National Monument Data Sources: The description is based on 2002 and 2003 field data (2 plots: DINO.0146, DINO.0840).
Local Description Authors: J. Thompson, mod. J. Coles
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	*JUNIPERUS OSTEOSPERMA* 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 feet). 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 not uncommon. 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
Dinosaur National Monument
This association is known from throughout the monument, including Stone Bridge, Rainbow Park, and Island Park, Dinosaur Quarry, Red Wash, Chew Ranch, Yampa Bench, and Viva's Cake Hill.

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
Dinosaur National Monument
This association typically occurs in extensive stands occupying basins, benches, slopes and plateaus at elevations ranging from 1500 to 2000 m. The topography is level to moderately sloping. The soil surface is mostly free of gravel or rocks, and often abundantly covered with cryptobiotic crust and mosses. Soil texture varies from sandy loam to clay loam. Stands tend to occur on deeper soils, often eolian in origin and not necessarily derived from the underlying substrate.

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 feet). 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 not uncommon. There are generally significant amounts of bare ground, litter, and desert pavement at the soil surface. Rock cover is variable.

VEGETATION DESCRIPTION
Dinosaur National Monument
This woodland association is characterized by broad, open, evenly spaced trees of *Juniperus osteosperma*. The tree canopy cover ranges from 10 to 40%. The shrub understory is strongly dominated by *Artemisia tridentata* ssp. *wyomingensis* with 10 to 40% cover. *Gutierrezia sarothrae, Opuntia* spp., and *Eriogonum microthecum* are typically present with low cover. Herbaceous species contribute 5 to 20% cover and commonly include *Bromus tectorum, Achnatherum hymenoides, Hesperostipa comata, Poa fendleriana, Elymus elymoides*, and *Pleuraphis jamesii*. Forbs often include *Leptodactylon pungens, Eriogonum umbellatum*, and *Phlox hoodii. Juniperus osteosperma* seedlings are often present. *Cryptobiotic crusts* and mosses are prevalent in this association.

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

Dinosaur National Monument

Stratum	Species
Tree canopy	*Juniperus osteosperma*
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Gutierrezia sarothrae, Opuntia polyacantha*
Herb (field)	*Achnatherum hymenoides, Bromus tectorum, Hesperostipa comata, Poa fendleriana*

Globally

Stratum	Species
Tree canopy	*Juniperus osteosperma*
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument Bromus tectorum

Globally
Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5? (1-Feb-1996).

CLASSIFICATION COMMENTS

Dinosaur National Monument
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

Dinosaur National Monument Inventory Notes: This association is widely distributed in the monument. There are many instances where *Juniperus osteosperma* is invading sagebrush shrubland, where the cover is borderline between shrubland and woodland. This woodland type is reserved for cases where the tree cover is greater than 10% and the shrub layer has clearly begun to break down in the face of competition from the junipers. Stands with less than 10% tree cover should be considered *Artemisia tridentata* shrublands.
Dinosaur National Monument Data Sources: This description is based on 2002 and 2003 field data (19 plots: DINO.0014, DINO.0117, DINO.0120, DINO.0123, DINO.0138, DINO.0139, DINO.0140, DINO.0344, DINO.0424, DINO.0427, DINO.0441, DINO.0446, DINO.0460, DINO.0474, DINO.0476, DINO.0497, DINO.0505, DINO.0632, DINO.0825).
Local Description Authors: J. Thompson, mod. J. Coles
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 / Bromus tectorum Semi-natural Woodland
Utah Juniper / Cheatgrass Semi-natural Woodland

CODE	CEGL002817
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
ALLIANCE	*JUNIPERUS OSTEOSPERMA* 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 semi-natural woodland association is usually a degraded form of other *Juniperus osteosperma* associations with native grass understories. It occurs on ridges and benches in western Colorado and eastern Utah. In these stands, significant ground disturbance, such as ground fire or sheep grazing, allows *Bromus tectorum* to establish and out-compete native grasses. Elevations range from below 1600 to 1745 m (5250-5725 feet), and slopes vary from gentle to moderately steep. Soils are sandy and well-drained. The substrate is often rocky, and rocks, downed wood and cryptobiotic crusts may cover most of the unvegetated surface. The canopy of *Juniperus osteosperma* is usually open, with between 20 and 55% cover. Shrubs are sparse and low in diversity but may include scattered individuals of *Artemisia tridentata, Gutierrezia sarothrae*, and *Opuntia polyacantha*. The exotic annual grass *Bromus tectorum* dominates the understory, although cover will vary from year to year depending on soil moisture levels in the early spring. Sometimes traces of the original native grasses will persist, including *Achnatherum hymenoides, Poa fendleriana, Pleuraphis jamesii,* and *Hesperostipa comata*. If forbs are present, they tend to indicate disturbance.

DISTRIBUTION

Dinosaur National Monument

This association is known from Rainbow Park and Snow Ranch.

Globally

This association has been described from western Colorado and eastern Utah. It is likely to occur throughout the Intermountain West.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association typically occurs on low-elevation sites, below 1600 m, and on level to gently sloping topography. Soils are coarse-textured and rapidly drained. Moss and cryptobiotic crusts cover much of the soil surface. One plot occurred at 2200 m elevation on a steep, rocky, southeast-facing slope.

Globally

This woodland association occurs on ridges and benches in western Colorado and eastern Utah. Elevations range from below 1600 to 1745 m (5250-5725 feet), and slopes vary from gentle to moderately steep. Soils are sandy and well-drained. The substrate is often rocky, and rocks, downed wood and cryptobiotic crusts may cover most of the unvegetated surface.

VEGETATION DESCRIPTION

Dinosaur National Monument

This woodland association is dominated by *Juniperus osteosperma*, with canopy cover ranging between 20 and

60%. Shrubs such as *Artemisia tridentata* ssp. *wyomingensis*, *Gutierrezia sarothrae*, and *Opuntia polyacantha* occasionally occur with low cover. The herbaceous understory is dominated by annual grass *Bromus tectorum* with over 10% cover. Native herbaceous species occurring with sparse cover include *Poa fendleriana, Achnatherum hymenoides, Cryptantha flava*, and *Erigeron* spp. Nonvascular species such as cryptobiotic crusts and mosses may have significant cover.

Globally
This semi-natural woodland association is usually a degraded form of other *Juniperus osteosperma* associations with native grass understories. The canopy of *Juniperus osteosperma* is usually open, with between 20 and 55% cover. Shrubs are sparse and low in diversity but may include scattered individuals of *Artemisia tridentata*, *Gutierrezia sarothrae*, and *Opuntia polyacantha*. The exotic annual grass *Bromus tectorum* dominates the understory, although cover will vary from year to year depending on soil moisture levels in the early spring. Sometimes traces of the original native grasses will persist, including *Achnatherum hymenoides*, *Poa fendleriana, Pleuraphis jamesii*, and *Hesperostipa comata*. If forbs are present, they also tend to indicate disturbance.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Juniperus osteosperma*
Herb (field)	*Bromus tectorum*

Globally

Stratum	**Species**
Tree canopy	*Juniperus osteosperma*
Herb (field)	*Bromus tectorum*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: GNA (ruderal) (12-Jul-2005).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association may increase its cover within the monument as *Bromus tectorum* continues to spread by means of wildfire and grazing.
Dinosaur National Monument Data Sources: This description is based on 2002 field data (2 plots: DINO.0135, DINO.0137).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

Juniperus osteosperma / Cercocarpus montanus Woodland
Utah Juniper / Mountain-mahogany Woodland

CODE CEGL000735

PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
ALLIANCE	*JUNIPERUS OSTEOSPERMA* 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 is a low, shrubby woodland type growing on shallow, rocky soils on hogbacks, ridges and colluvial slopes in south-central Wyoming, western Colorado and adjacent Utah. Sites are sometimes classified as the shallow breaks range site (Warren n.d.). *Juniperus osteosperma* and *Cercocarpus montanus* occur together in either a wooded shrubland or woodland form, depending on the relative cover of the two dominant species. Occasionally the junipers are stunted and grow no taller than the mountain-mahogany. Sparse grasses dominate the understory, including *Pseudoroegneria spicata, Poa secunda, Pleuraphis jamesii*, and *Hesperostipa comata*.

DISTRIBUTION

Dinosaur National Monument

This association was sampled in the western and southern regions of the monument in Daniel Canyon, Buckwater Draw, Cub Creek, Stone Bridge Draw, Horse Trail Draw and along the Sounds of Silence Trail.

Globally

This type occurs in south-central Wyoming, western Colorado and adjacent Utah.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occupies alluvial plains and clay hills at lower elevations within the monument, as well as rocky sandstone ridges, hogbacks, and plateau outcrops at elevations ranging between 1500 and 1900 m. This open woodland association occurs on gentle to moderately steep slopes and on all aspects except south and southeast. Soil texture ranges from sandy loam to sandy clay. Ground cover includes a mixture of bedrock, large and small rocks, and organic litter. Cryptogamic crusts may also provide high ground cover.

Globally

This association generally occurs on the rocky slopes of canyons, hills, hogbacks and ridges below 1900 m (6234 feet) elevation in south-central Wyoming, western Colorado and adjacent Utah. It also occurs on barren ridges of the Carmel Formation in Colorado. Slopes range from gentle to moderately steep, and stands are often oriented to east or north aspects. Substrates include sandstone, talus and shale, and soils generally correspond to the substrate: sandy loams on sandstones, clay soils on shales. The unvegetated ground surface often has a high percentage of rock, bedrock or bare ground, but in undisturbed examples on sandy substrates, the cover of soil crusts may be high.

VEGETATION DESCRIPTION

Dinosaur National Monument

This woodland association is dominated by *Juniperus osteosperma* in the canopy with 10 to 30% cover. *Pinus edulis* may occur in the stand as an occasional mature tree or seedling. *Cercocarpus montanus* dominates the shrub layer with an average of 10% cover. Other common shrubs include *Ephedra viridis, Artemisia tridentata* ssp. *wyomingensis, Gutierrezia sarothrae*, and *Artemisia nova*, all with low cover. Herbaceous vegetation species composition is diverse with typically less than 10% cover. Common herbaceous species include graminoids *Poa fendleriana* and *Achnatherum hymenoides*. Forb species composition is sparse and no species occur consistently.

Globally

This woodland association is characterized by an open to moderately closed canopy of *Juniperus osteosperma* with a mixed shrub understory dominated by *Cercocarpus montanus*. Other species generally present in the shrub layer include *Fraxinus anomala, Ephedra viridis, Artemisia tridentata* ssp. *wyomingensis*, and *Gutierrezia sarothrae*. The

herbaceous layer typically has less than 10% total cover of grasses and forbs. *Poa fendleriana, Pleuraphis jamesii, Achnatherum hymenoides*, and *Heterotheca villosa* are common herbaceous species. Nonvascular plants and cryptobiotic soil crusts are often present but usually with very low cover.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Juniperus osteosperma*
Short shrub/sapling	*Cercocarpus montanus*

Globally

Stratum	**Species**
Tree canopy	*Juniperus osteosperma*
Short shrub/sapling	*Cercocarpus montanus*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G2G3 (15-Feb-2006). The range in rank reflects the limited area in which this vegetation type may occur and uncertainty about its status. It appears to be uncommon and restricted in environmental setting. Its classification confidence is still moderate.

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Evidence for this plant association in south-central Wyoming is contained in a brief description of range sites in the BLM's Great Divide Resource Area. Quantitative data on the composition and structure of the vegetation in Wyoming are lacking. *Juniperus osteosperma* and *Cercocarpus montanus* both occur in southwestern Wyoming; this vegetation type might be found there, no supporting data is available. The association has been documented by vegetation plots in both Black Canyon of the Gunnison National Park and Dinosaur National Monument.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is common and easily identified in the field because of the open canopy, the presence of *Cercocarpus montanus* and the relative lack of *Pinus edulis*. Stands are usually relatively small.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (12 plots: DINO.0011, DINO.0024, DINO.0121, DINO.0125, DINO.0154, DINO.0159, DINO.0161, DINO.0165, DINO.0181, DINO.0417, DINO.0642, DINO.0713).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: G.P. Jones

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Warren 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	*JUNIPERUS OSTEOSPERMA* 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 feet) but may occur as high as 2200 m (7215 feet) on warm southerly exposures that discourage establishment of *Pinus edulis*. Most sites have sandy soils derived from sandstone or alluvium, but at Capitol Reef National Park, some stands occur on barren slopes and clay soils of the Carmel Formation. Gravel, bare ground or soil 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* with 5 to 25% cover. Shrubs are generally present but too sparse to form a layer. Common species include *Coleogyne ramosissima, Ephedra* spp., *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* spp., *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

Dinosaur National Monument

This association is known from the Yampa Plateau, Echo Park, and the Yampa Bench.

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

Dinosaur National Monument

This association occurs mostly below 1800 m elevation on gentle to moderate slopes of hills, benches and terraces. The substrate often has a high percentage of surface gravel, and soil crusts can also contribute significant cover. This association was noted at 2200 m on a steep, southeasterly slope. In this case, the high solar radiation may inhibit the growth of *Pinus edulis*, a common associate of Juniperus osteosperma at higher elevations.

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 feet) but may occur as high as 2200 m (7215 feet) 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

Dinosaur National Monument

An open to moderately closed canopy *of Juniperus osteosperma* and an understory dominated by *Hesperostipa comata* characterize this woodland association. *Gutierrezia sarothrae* and *Opuntia polyacantha* are commonly associated and contribute less than 5% cover. Other common but minor graminoids include *Bromus tectorum* and *Elymus elymoides*. Forbs are sparse to absent.

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* with 5 to 25% cover. 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, Tetraneuris 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
Dinosaur National Monument

Stratum	Species
Tree canopy	*Juniperus osteosperma*
Herb (field)	*Hesperostipa comata*

Globally

Stratum	Species
Tree canopy	*Juniperus osteosperma*
Herb (field)	*Hesperostipa comata*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Bromus tectorum

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (6-Jul-2005).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association should be widely distributed throughout the lower and middle elevations of the monument.
Dinosaur National Monument Data Sources: This association is described from 2002 field data (4 plots: DINO.0409, DINO.0457, DINO.0469, DINO.0475).
Local Description Authors: J. Thompson, mod. J. Coles
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	*JUNIPERUS OSTEOSPERMA* 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 feet), 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 and may be 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 up to 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

Dinosaur National Monument

This association is known from two sites on the eastern edge of the monument.

Globally

The plant association occurs on low-elevation marine shales in western Colorado and eastern Utah.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs at 1800 m elevation on gentle to moderate slopes of the monument's arid shale hogbacks. Aspect is variable. The soil texture is clay loam, and the soil surface may be overlain by small rock or gravel and organic litter under tree canopies. Numerous shallow erosion channels run through the stands, which occur on Mancos or Morrison shales.

Globally

This sparse woodland association occurs on canyon rims, ledges, low- to mid-elevation hogbacks, colluvial slopes, toeslopes and badlands in the Colorado Plateau of western Colorado and eastern Utah. Elevations range from 1488 to 1997 m (4880-6550 feet), 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 is common on the ground surface. Soils are rapidly drained and may be sandy loams or silty clays.

VEGETATION DESCRIPTION

Dinosaur National Monument

This association has an open canopy of Juniperus osteosperma with between 15 and 25% cover. *Juniperus osteosperma* and *Pinus edulis* seedlings may be present. Shrubs are scattered and diverse but do not form a stratum.

The herbaceous layer is dominated by *Leymus salinus* with between 5 and 15% cover; other grasses may be present with lesser cover. Forb species present include *Petradoria pumila, Phlox hoodii,* and *Stenotus acaulis*.

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 up to 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
Dinosaur National Monument

Stratum	Species
Tree canopy	*Juniperus osteosperma*
Herb (field)	*Leymus salinus*

Globally

Stratum	Species
Tree canopy	*Juniperus osteosperma*
Herb (field)	*Leymus salinus*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
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 hectares.

CLASSIFICATION COMMENTS
Dinosaur National Monument
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
Dinosaur National Monument Inventory Notes: Occurs only occasionally in small stands.
Dinosaur National Monument Data Sources: This description was derived from 2002 and 2004 field data (1 plot: DINO.0615, 1 observation point: DINO.9040).
Local Description Authors: J. Thompson, mod. J. Coles
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	*JUNIPERUS OSTEOSPERMA* 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

Dinosaur National Monument

This association is known from Conway Draw near the Gates of Lodore and the Yampa Bench.

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

Dinosaur National Monument

This association occupies the gentle slopes of ridges and benches with a northeast aspect at elevations ranging from 1600 to 1800 m. Soil texture ranges from sandy to clayey loam. The soil surface under the tree canopy is mostly covered with leaf litter, and cryptogamic crust occurs in canopy interspaces.

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

Dinosaur National Monument

This association has total vegetative cover of between 50 and 65%. The tree canopy consists solely *of Juniperus osteosperma* with 20 to 40% cover. Typical dwarf-shrub species present include *Artemisia tridentata* ssp. *wyomingensis, Opuntia polyacantha*, and *Gutierrezia sarothrae*; cover is not high enough to constitute a stratum.

Pleuraphis jamesii dominates the herbaceous layer with 20% cover. Other herbaceous species present with lesser cover include *Hesperostipa comata* and *Achnatherum hymenoides*.

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
Dinosaur National Monument

Stratum	Species
Tree canopy	*Juniperus osteosperma*
Herb (field)	*Hesperostipa comata, Pleuraphis jamesii*

Globally

Stratum	Species
Tree canopy	*Juniperus osteosperma*
Herb (field)	*Pleuraphis jamesii*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (22-Mar-2005).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association occurs in small stands that may be reflecting a minor change in topography or soil to warmer or drier conditions. Adjacent communities can be dominated in the herbaceous layer by *Hesperostipa comata* or *Pseudoroegneria spicata*.
Dinosaur National Monument Data Sources: This description was derived from 2002 field data (2 plots: DINO.0826, DINO.0838).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

Juniperus osteosperma / Pseudoroegneria spicata Woodland
Utah Juniper / Bluebunch Wheatgrass Woodland

CODE CEGL000738

PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
ALLIANCE	*JUNIPERUS OSTEOSPERMA* WOODLAND ALLIANCE (A.536) Utah Juniper Woodland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Juniper Savanna (CES304.782)
Great Basin Pinyon-Juniper Woodland (CES304.773)
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 juniper woodland association occurs on moderate to steep talus slopes, foothills, benches, plateaus, and canyons in Idaho, Montana, north-central and western Wyoming, Colorado, Utah and Nevada. Elevation ranges from 1520 to 2140 m (4985-7020 feet), and sites are typically oriented to the south or west. Soils are generally clay loam, sandy loam or sandy clay and are generally shallow and often gravelly or rocky. They are derived from limestone, sandstone or shale. The open tree canopy is dominated by *Juniperus osteosperma*; in Wyoming, *Cercocarpus ledifolius* or *Juniperus scopulorum* are sometimes also present. If *Pinus edulis* is present, it is as seedlings or scattered individuals with minimal cover. Tree canopy cover ranges between 10 and 40%. There is no developed shrub layer, but scattered individuals of *Artemisia nova, Artemisia tridentata* ssp. *wyomingensis*, *Chrysothamnus viscidiflorus, Ephedra viridis, Gutierrezia sarothrae*, and *Opuntia polyacantha* may be present, as may *Juniperus osteosperma* seedlings. *Pseudoroegneria spicata* dominates the herbaceous understory with 2 to 30% cover. Other herbaceous species commonly present with lesser cover include graminoids *Achnatherum hymenoides*, *Bouteloua gracilis, Hesperostipa comata, Pleuraphis jamesii, Poa fendleriana, Poa secunda,* and *Bromus tectorum*. Forbs are generally sparse; species likely to be present include *Arenaria hookeri, Leptodactylon pungens, Phlox hoodii, Sphaeralcea coccinea*, and *Stenotus acaulis*.

DISTRIBUTION

Dinosaur National Monument

This association is known from Split Mountain and Yampa Bench in the monument.

Globally

This association has been documented from throughout much of the Intermountain western U.S., including Idaho, Montana, north-central and western Wyoming, Colorado, Utah and Nevada.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs on moderate to steep talus slopes of hills, benches, mesas, and canyons. Elevation ranges from 1650 to 1950 m. Sites are typically oriented to the south or west. Gravel and rocks, often derived from limestone, cover 50% of the soil surface, and pedestals form at the base of the bunch grasses, indicating sheet erosion. The soil texture is generally clay loam or sandy clay.

Globally

This association occurs on moderate to steep talus slopes, foothills, benches, plateaus, and canyons in throughout much of the Intermountain western U.S. Elevation ranges from 1520 to 2140 m (4985-7020 feet), and sites are typically oriented to the south or west. Gravel and rocks cover 50% of the soil surface in most stands, but in some stands, cryptobiotic crusts may cover much of the soil surface. Soils are generally clay loam or sandy clay, are generally shallow and often gravelly or rocky, and are derived from limestone, sandstone or shale.

VEGETATION DESCRIPTION

Dinosaur National Monument

This woodland association is dominated by Juniperus osteosperma. Tree canopy cover ranges between 10 and 40%. *Pinus edulis* may be present but with minimal cover. There is no developed shrub layer, but scattered individuals of *Artemisia tridentata* ssp. *wyomingensis, Ephedra viridis, Gutierrezia sarothrae*, and *Opuntia polyacantha* may be

present. *Juniperus osteosperma* seedlings are typically present in the shrub stratum. *Pseudoroegneria spicata* dominates the herbaceous understory with 3 to 10% cover. Other herbaceous species commonly present with lesser cover include graminoids *Achnatherum hymenoides, Pleuraphis jamesii,* and *Bromus tectorum*. Forb species likely to be present include *Chaetopappa ericoides, Leptodactylon pungens, Penstemon* spp., and *Sphaeralcea coccinea*. Globally This woodland association is dominated by *Juniperus osteosperma*; in Wyoming, *Cercocarpus ledifolius* or *Juniperus scopulorum* are sometimes also present in the canopy. If *Pinus edulis* is present, it is as seedlings or scattered individuals with minimal cover. Tree canopy cover ranges between 10 and 40%. There is no developed shrub layer, but scattered individuals of *Artemisia nova, Artemisia tridentata* ssp. *wyomingensis, Chrysothamnus viscidiflorus, Ephedra viridis, Gutierrezia sarothrae,* and *Opuntia polyacantha* may be present, as may *Juniperus osteosperma* seedlings. *Pseudoroegneria spicata* dominates the herbaceous understory with 2 to 30% cover. Other herbaceous species commonly present with lesser cover include graminoids *Achnatherum hymenoides, Bouteloua gracilis, Hesperostipa comata, Pleuraphis jamesii, Poa fendleriana, Poa secunda,* and *Bromus tectorum.* Forbs are generally sparse; species likely to be present include *Arenaria hookeri, Leptodactylon pungens, Phlox hoodii, Sphaeralcea coccinea,* and *Stenotus acaulis.*

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Juniperus osteosperma*
Herb (field)	*Opuntia polyacantha*
Herb (field)	*Pseudoroegneria spicata*

Globally

Stratum	**Species**
Tree canopy	*Juniperus osteosperma*
Herb (field)	*Pseudoroegneria spicata*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Bromus tectorum

Globally
Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: G4 (1-Feb-1996).

CLASSIFICATION COMMENTS

Dinosaur National Monument
Data are not available.

Globally
Johnston (1987) describes a similar community from the Piceance Basin of northwestern Colorado in which the canopy is codominated by *Pinus edulis.*

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Dinosaur National Monument Inventory Notes: This association is easily seen from a distance because of the tall bunch grasses and terraces and pedestals they form, contrasting with the light color of the limestone gravel substrate.
Dinosaur National Monument Data Sources: This description is based on 2002 and 2003 field data (7 plots: DINO.0167, DINO.0472, DINO.0594, DINO.0724, DINO.0841, DINO.0843, DINO.1402).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Baker 1984a, Baker and Kennedy 1985, Bourgeron and Engelking 1994, Despain 1973a, Driscoll et al. 1984, Johnston 1987, Jones 1989b, Jones 1992b, Knight et al. 1987, Lesica and DeVelice 1992, MTNHP

2002b, Marriott and Jones 1989, NVNHP 2003, Tausch and Tueller 1977, Western Ecology Working Group n.d., Wight 1965, Wight and Fisser 1968

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	*JUNIPERUS OSTEOSPERMA* 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 may 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 vegetation, there are few species that can be expected throughout the range of this association. Common species include *Ephedra viridis, Gutierrezia sarothrae*, and *Elymus elymoides*. Cryptobiotic crust cover may be high.

DISTRIBUTION

Dinosaur National Monument

This association is known from hogbacks in the vicinity of the Dinosaur Quarry, as well as Cub Creek, Red Wash, Island Park, the hogbacks on the north side of Split Mountain, Warm Springs landslide, and the Yampa Bench.

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

Dinosaur National Monument

This association occupies a variety of low-elevation landscapes in the monument. Stands may be small and linear, straddling ravines and gullies, or several acres, extending across badlands, hogback ridges, and benches. Elevations range from 1500 to 1900 m. Sites documented occur most often on southeast to southwest aspects. Slope angles vary from gentle to very steep. The substrate is often derived from marine shale or limestone but may also be eolian sands or landslide deposits. Soils are rapidly drained sandy loams or clay loams and often extensively covered with cryptobiotic crusts.

Globally

This widespread woodland association occurs on slopes, ridges, benches and mesas at elevations ranging between 1400 and 2200 m (4600-7220 feet). 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 (hydrothermically 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

Dinosaur National Monument

This woodland association is dominated by Juniperus osteosperma with 10 to 60% cover. *Pinus edulis* is typically absent or, if present, contributes minimal cover. The understory vegetation totals less than 10% cover and usually much less. Species present vary greatly among sites, but those most commonly associated include *Ephedra viridis, Gutierrezia sarothrae*, and *Opuntia* spp. Grasses that frequently occur in trace amounts include *Achnatherum hymenoides, Pleuraphis jamesii*, and *Elymus elymoides. Juniperus osteosperma* seedlings typically are present. Cryptogams can be a significant nonvascular component of the community.

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 also 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

Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Juniperus osteosperma*
Short shrub/sapling	*Ephedra viridis*
Herb (field)	*Gutierrezia sarothrae*
Herb (field)	*Achnatherum hymenoides*, *Bromus tectorum*

Globally

Stratum	**Species**
Tree canopy	*Juniperus osteosperma*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Bromus tectorum

Globally

Data are not available.

CONSERVATION STATUS RANK

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

CLASSIFICATION COMMENTS

Dinosaur National Monument

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 hydrothermically 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

Dinosaur National Monument Inventory Notes: This association is widespread throughout the southwest and south-central region of the monument and can be expected wherever substrates with poor water-holding capacity occur on warm exposures.

Dinosaur National Monument Data Sources: This description is based on 2002 and 2003 field data (19 plots: DINO.0007, DINO.0013, DINO.0127, DINO.0401, DINO.0430, DINO.0431, DINO.0433, DINO.0438, DINO.0440, DINO.0445, DINO.0447, DINO.0449, DINO.0468, DINO.0641, DINO.0649, DINO.0650, DINO.0839, DINO.1014, DINO.1017).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Milton and Purdy 1983.

Juniperus scopulorum / Artemisia tridentata Woodland
Rocky Mountain Juniper / Basin Big Sagebrush Woodland

CODE	CEGL000743
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
ALLIANCE	*JUNIPERUS SCOPULORUM* WOODLAND ALLIANCE (A.506) Rocky Mountain Juniper Woodland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Foothill Limber Pine-Juniper Woodland (CES306.955)
Colorado Plateau Pinyon-Juniper Woodland (CES304.767)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association occurs locally in Colorado, the portions of Wyoming surrounding the Bighorn Basin, and Montana's Greenhorn Range. Stands develop on foothills, plateaus, piedmont fans, rockslides and canyons. Elevations range from 1680 to 1830 m (5500-6000 feet) in Montana and 2300 to 2475 m (7545-8120 feet) in Colorado. Slopes are gentle to very steep (5-70%), may be oriented to any aspect, and are frequently rocky. Litter and duff are restricted to plant bases leaving much exposed soil, rock, bedrock and gravel. Bare ground also results from rill and sheet erosion and animal trailing. Soils are variable and include clay loams, sands and silt loams; some soils effervesce violently. Although this is not a riparian association, the best-developed examples occur in gullies and swales. The vegetation is characterized by a sparse to moderately closed, sometimes clumpy canopy of *Juniperus scopulorum* (constituting between 5 and 40% canopy cover) and a somewhat depauperate undergrowth as well, in which a sparse to moderate shrub layer dominated by *Artemisia tridentata* ssp. *vaseyana* or *Artemisia tridentata* ssp. *wyomingensis* is sometimes matched by a well-developed herbaceous layer. Associated shrubs may include *Amelanchier utahensis, Purshia tridentata, Ribes cereum, Symphoricarpos rotundifolius, Prunus virginiana, Purshia tridentata, Juniperus communis, Mahonia repens,* and *Paxistima myrsinites*. The herbaceous layer is diverse in terms of species composition and provides sparse to moderate cover. Graminoids dominate the herbaceous layer, including *Pseudoroegneria spicata, Achnatherum hymenoides, Bouteloua gracilis, Hesperostipa comata, Koeleria macrantha, Carex rossii, Elymus elymoides,* and *Poa fendleriana*. Forbs provide little cover but may include *Eriogonum umbellatum, Cryptantha flavoculata,* and *Physaria rollinsii*.

DISTRIBUTION

Dinosaur National Monument

This association is known from Five Springs, Cottonwood Canyon, Hacking Spring and the Donald Wall Place. It is likely to occur on mid- to high-elevation plateaus and sheltered canyon walls throughout the monument. It may also occur on rocky sections of the banks of the Green and Yampa rivers with an understory dominated by *Artemisia tridentata* ssp. *tridentata*.

Globally

This poorly documented association is known from widely scattered foothills, canyons and plateaus in Colorado, Wyoming and west-central Montana. In Wyoming it is most likely to be found around the margins of the Bighorn Basin (western flank of Bighorn Mountains, northern flank of Owl Creek Mountains, and eastern flank of Absaroka Mountains) and possibly the eastern flank of the Wind River Range. In Montana it has been cursorily documented

only from the foothills and piedmont fans at the northern end of the Gravelly Range; in Colorado it occurs along the Front Range between Denver and the Wyoming stateline (in the same landscape position as in Montana), on the western slope in the Gunnison Basin and in the northwestern part of the state. However, the ranges of the component indicator species are extensive, and the association could occur locally throughout the West.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occupies moderate to steep slopes (up to 25 degrees) oriented to any aspect on the monument's mid- to high-elevation plateaus and canyon walls in a narrow elevational band between 2283 and 2332 m. Litter covers the ground under the tree and shrub canopies, while the interspaces are mostly bare ground due to erosion and animal trailing, or rocks fallen from cliffs above. Soils are sandy or silty loams derived from sandstone, limestone or eolian deposits.

Globally

This association occurs locally in Colorado, the portions of Wyoming surrounding the Bighorn Basin, and Montana's Greenhorn Range. Stands develop on foothills, plateaus, piedmont fans, rockslides and canyons. Elevations range from 1680 to 1830 m (5500-6000 feet) in Montana and 2300 to 2475 m (7545-8120 feet) in Colorado. Slopes are gentle to very steep (5-70%), may be oriented to any aspect, and are frequently rocky. Litter and duff are restricted to plant bases leaving much exposed soil, rock, bedrock and gravel. Soils are variable and include clay loams, sands and silt loams; some soils effervesce violently.

VEGETATION DESCRIPTION

Dinosaur National Monument

Scattered clumps of *Juniperus scopulorum* and an open mixed mountain shrubland understory dominated by *Artemisia tridentata* characterize this association. The *Juniperus scopulorum* canopy is between 2 and 5 m tall and generally provides between 10 and 25% cover. Some *Amelanchier utahensis* shrubs reach this height as well. The shrub layer can have higher cover than the juniper in open stands, or it may be restricted to openings between juniper crowns in more closed stands. Shorter shrubs include *Symphoricarpos oreophilus, Cercocarpus montanus, Prunus virginiana, Purshia tridentata, Mahonia repens*, and *Paxistima myrsinites*. Herbaceous cover is sparse to dense depending on the closure of the shrub canopy. Common species include *Poa fendleriana, Hesperostipa comata, Achnatherum lettermanii, Koeleria macrantha, Carex rossii*, and *Eriogonum umbellatum*.

Globally

This open woodland association is characterized by a sparse to moderately closed, sometimes clumpy canopy of *Juniperus scopulorum* (constituting between 5 and 40% canopy cover) and a somewhat depauperate undergrowth as well, in which a sparse to moderate shrub layer dominated by *Artemisia tridentata* ssp. *vaseyana* or *Artemisia tridentata* ssp. *wyomingensis* is sometimes matched by a well-developed herbaceous layer. Associated shrubs may include *Amelanchier utahensis, Cercocarpus montanus, Holodiscus dumosus, Purshia tridentata, Ribes cereum, Symphoricarpos rotundifolius, Prunus virginiana, Purshia tridentata, Juniperus communis, Mahonia repens*, and *Paxistima myrsinites*. The herbaceous layer is diverse in terms of species composition and provides sparse to moderate cover depending on the degree of canopy closure. Graminoids dominate the herbaceous layer, including *Pseudoroegneria spicata, Achnatherum hymenoides, Achnatherum lettermanii, Achnatherum pinetorum, Bouteloua gracilis, Hesperostipa comata, Koeleria macrantha, Carex rossii, Elymus elymoides*, and *Poa fendleriana*. Forbs provide little cover but may include *Eriogonum umbellatum, Arabis crandallii, Cryptantha flavoculata*, and *Physaria rollinsii*.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Juniperus scopulorum*
Tall shrub/sapling	*Amelanchier utahensis*
Short shrub/sapling	*Artemisia tridentata* ssp. *vaseyana, Artemisia tridentata* ssp. *wyomingensis, Cercocarpus montanus, Symphoricarpos oreophilus*
Herb (field)	*Eriogonum umbellatum*
Herb (field)	*Hesperostipa comata, Melica bulbosa, Poa fendleriana, Poa secunda*

Globally

Stratum	Species
Tree canopy	*Juniperus scopulorum*
Short shrub/sapling	*Artemisia tridentata* ssp. *tridentata*, *Artemisia tridentata* ssp. *vaseyana*, *Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Poa fendleriana*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum, Poa pratensis

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G3Q (30-Nov-1998). This association is represented by fewer than 15 sample plots, but hypothetically it could be relatively common given the current extensive distribution of indicator species for the type and unspecific habitat requirements. Neither of the indicator species are under any particular threat, and presumably the type as currently defined would thus not be imperiled; however, the graminoid component is not clearly understood or defined for this association and could be significantly altered by livestock grazing. A real question exists as to the taxonomy of this entity. If the bunchgrass component is the dominant aspect and canopy cover of *Juniperus scopulorum* and *Artemisia tridentata* is generally under 20%, then this is not technically a woodland (or shrubland). Other occurrences of the type may have been appropriately classed as shrub-steppe or grassland plant associations [see DeVelice et al. (1995)].

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Without tightly defined occurrence specifications, stands of this association may have been classified as shrub-steppe or grassland plant associations because (1) the cover of *Juniperus scopulorum* itself is sometimes so low that these stands would not have been considered woodlands but merely medium-tall temperate or subpolar grasslands with a sparse needle-leaved evergreen layer or even a medium-tall temperate or subpolar grassland with a sparse microphyllous evergreen shrub layer, and (2) alternatively, with sufficient cover of *Juniperus scopulorum* but *Artemisia tridentata* poorly represented, stands could be placed in *Juniperus scopulorum / Pseudoroegneria spicata* Woodland (CEGL000748).

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is not riparian but will likely occur in drainages such as swales, valleys and gullies of medium- to high-elevation regions of the monument. The diagnostic elements of the community are a canopy of *Juniperus scopulorum* with an understory of *Artemisia tridentata* ssp. *vaseyana* or *Artemisia tridentata* ssp. *wyomingensis*.
Dinosaur National Monument Data Sources: This association is described from 2002 field data (2 plots: DINO.0188, DINO.0241) and 2005 accuracy assessment data (7 plots: DINO_AA.A0561, DINO_AA.A1019, DINO_AA.A1021, DINO_AA.A1034, DINO_AA.A1040, DINO_AA.A0557, DINO_AA.A0220).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: S.V. Cooper, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Cooper et al. 1995, DeVelice 1992, DeVelice et al. 1995, Driscoll et al. 1984, Hess 1981, Hess and Alexander 1986, Jennings 1978, Jennings 1979, Johnston 1987, Jones 1992b, MTNHP 2002b, Wasser and Hess 1982, 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	*PINUS EDULIS* - (*JUNIPERUS* 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 up to 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

Dinosaur National Monument

This association is known from sites scattered throughout the central parts of the monument.

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

Dinosaur National Monument

This association occupies steep, colluvial canyon slopes or talus at elevations from 1600 to 1750 m. Sites are generally oriented to the north or northwest. Soils vary from clay to sandy loam, depending on each site's surficial geology.

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

Dinosaur National Monument

This open woodland association is a mix of *Pinus edulis* and *Juniperus osteosperma* with 10 to 20% cover. *Amelanchier utahensis* is the dominant shrub in the understory. Cover ranges from 3 to 20%. *Ephedra viridis* and

Artemisia tridentata ssp. *wyomingensis* are commonly associated with lower cover. Herbaceous species are variable in composition and sparse in cover. *Poa fendleriana* and *Phlox austromontana* are the most consistent species.

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
Dinosaur National Monument

Stratum	Species
Tree canopy	*Juniperus osteosperma*, *Pinus edulis*
Short shrub/sapling	*Amelanchier utahensis*
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*, *Ephedra viridis*
Herb (field)	*Poa fendleriana*

Globally

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

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Bromus tectorum

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
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
Dinosaur National Monument Inventory Notes: This association may have a variety of shrubs but is defined by the presence of *Amelanchier utahensis* and absence of other dominant shrubs. Colluvial slope communities are often characterized by the presence of *Amelanchier utahensis*.
Dinosaur National Monument Data Sources: This description is based on 2002 field data (3 plots: DINO.0003, DINO.0201, DINO.0234).

Local Description Authors: J. Thompson, mod. 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 / Artemisia nova Woodland
Two-needle Pinyon - Utah Juniper / Black Sagebrush Woodland

CODE	CEGL002331
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
ALLIANCE	*PINUS EDULIS* - (*JUNIPERUS* SPP.) WOODLAND ALLIANCE (A.516) Two-needle Pinyon - (Juniper species) Woodland Alliance

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

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

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

DISTRIBUTION

Dinosaur National Monument

Areas of occurrence of this association include Zenobia Basin, Douglas Mountain, Yampa Bench, Plug Hat Rock and Cactus Flat.

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

Dinosaur National Monument

This association occupies moderately exposed ridges, rocky bluffs and benches of the high plateau country in the monument. Elevation ranges from 1900 to 2500 m, slope angles are gentle to moderate and aspects are northeast to southwest. Soils tend to be shallow, and textures vary from sandy to clayey loams depending on geology. The underlying geology may include erosion-resistant sandstone, conglomerate or limestone. The substrate is generally

rocky, consisting of small rocks and gravels. An extensive cryptogamic crust often covers the soil surface.

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

VEGETATION DESCRIPTION
Dinosaur National Monument The tree canopy of this woodland association is codominated by *Pinus edulis* and *Juniperus osteosperma* with 10 to 60% cover. The understory supports a variety of shrubs and herbaceous vegetation. The dominant shrub is dwarf-shrub *Artemisia nova* with 5% to 20% cover. *Artemisia tridentata, Purshia tridentata*, and *Opuntia* spp. regularly occur with minimal cover. Herbaceous species usually total less than 10% cover and include the graminoid species *Poa fendleriana, Poa secunda, Koeleria macrantha, Pseudoroegneria spicata*, and the forb species *Phlox* spp., *Petradoria pumila*, and *Stenotus acaulis*.

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

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Juniperus osteosperma, Pinus edulis*
Herb (field)	*Artemisia nova*
Herb (field)	*Stenotus acaulis*
Herb (field)	*Poa fendleriana*

Globally

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

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Data are not available.

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

CLASSIFICATION COMMENTS

Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE:

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is patchy but common in the high country of the monument, primarily on calcareous substrates such as Madison and Round Valley limestones and Bishop conglomerate.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (9 plots: DINO.0264, DINO.0273, DINO.0289, DINO.0352, DINO.0402, DINO.0456, DINO.0486, DINO.0545, DINO.0608).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Drake, mod. J. Coles and 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	*PINUS EDULIS* - (*JUNIPERUS* 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 ridgetops, mesa edges, outcrops, colluvial slopes, slickrock hills, benches and knolls at moderate elevations of 1484 to 2470 m (4870-8100 feet) 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
Dinosaur National Monument
This common and widespread association occurs on sandstone outcrops and hogbacks throughout the monument, including Split Mountain, Sand Canyon, Ely Creek, Iron Mine Basin, Deerlodge Park, and Red Rock Canyon.

Globally
This plant association is found on the Colorado Plateau and in extreme northwestern Colorado, adjacent Utah, and possibly Wyoming.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occupies sandstone canyon rims and slopes formed by the Weber, Glen Canyon, and Entrada geologic formations. Broad expanses of exposed bedrock are dissected by joints and mottled with depressions that collect soil and water. Elevations range from 1550 to 2300 m. Slopes are moderate to very steep, and sites may occur on slopes oriented to any aspect.

Globally

This woodland association occurs on dry, sandstone ridgetops, 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

Dinosaur National Monument

This woodland association is diverse and composed of species that can take advantage of limited soil in cracks and depressions in the bedrock and endure intense solar radiation and high winds. *Juniperus osteosperma* and *Pinus edulis* form a canopy 2-5 m high, sometimes with scattered emergent *Pinus ponderosa, Pseudotsuga menziesii*, or *Juniperus scopulorum* to 10 m high. Total vegetation cover ranges from 15% to more than 65%. In some sites, the trees may be stunted and canopy cover is around 10%. *Cercocarpus intricatus* is the dominant species in a sometimes scattered shrub stratum, with 5 to 20% cover. Other shrubs associated with this rock garden community include *Fraxinus anomala, Amelanchier utahensis, Ephedra viridis, Holodiscus dumosus, Cercocarpus montanus, Fendlerella utahensis, Glossopetalon spinescens* var. *meionandrum*, and *Philadelphus microphyllus*. Herbaceous species are equally diverse, though with low cover. Grasses especially tend to be sparse, but there may be scattered clumps of *Achnatherum hymenoides, Poa fendleriana,* and *Aristida purpurea*. Common forbs include *Heterotheca villosa, Petradoria pumila, Stenotus acaulis, Petrophyton caespitosum*, and *Machaeranthera grindelioides*.

Globally

The association is characterized by an open tree canopy (10-25% cover) codominated by *Pinus edulis* and *Juniperus osteosperma,* and by *Cercocarpus intricatus* dominating 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 up to 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

Dinosaur National Monument

Stratum	Species
Tree canopy	*Juniperus osteosperma, Pinus edulis*
Short shrub/sapling	*Cercocarpus intricatus*
Herb (field)	*Petradoria pumila, Stenotus acaulis*

Globally

Stratum	**Species**
Tree canopy	*Juniperus osteosperma, Pinus edulis*
Tall shrub/sapling	*Amelanchier utahensis*
Tall shrub/sapling	*Cercocarpus intricatus*
Herb (field)	*Achnatherum hymenoides, Elymus elymoides, Poa fendleriana*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Bromus tectorum, Hymenoxys lapidicola

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
Dinosaur National Monument
Data are not available.

Globally
Compare this association with *Juniperus osteosperma / Cercocarpus intricatus* Woodland (CEGL000733) which 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 to be a variation of the woodland type because of the ecological values of the trees.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Data are not available.
Dinosaur National Monument Data Sources: This description is based on 2002 and 2003 field data (17 plots: DINO.0142, DINO.0143, DINO.0166, DINO.0173, DINO.0204, DINO.0235, DINO.0280, DINO.0308, DINO.0375, DINO.0470, DINO.0510, DINO.0620, DINO.0627, DINO.0651, DINO.0801, DINO.0834, DINO.0836).
Local Description Authors: J. Thompson, mod. J. Coles
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 unpubl. data 2003, Cogan et al. 2004, Driscoll et al. 1984, 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	*PINUS EDULIS* - (*JUNIPERUS* SPP.) WOODLAND ALLIANCE (A.516) Two-needle Pinyon - (Juniper species) Woodland Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Pinyon-Juniper Woodland (CES306.835)

Colorado Plateau Pinyon-Juniper Woodland (CES304.767)
Colorado Plateau Pinyon-Juniper Shrubland (CES304.766)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This woodland association occurs on ridges, mountains and plateaus in the Colorado Plateau of eastern and southern Utah and western Colorado. Sites are moderately steep to steep. Stands in the northern part of the range tend to be on slopes with southerly aspects; in the southern part of the range, northerly aspects are more common. Elevations range from 2400 to 2770 m (7900-9100 feet) in Utah and from 2200 to 2260 m (7200-7400 feet) in Colorado. The unvegetated surface is primarily covered by large rocks, bare soil and bedrock exposures. Downed wood is common. Parent materials are sandstone or quartzite bedrock or colluvium. Soils are rapidly drained and range in texture from clay loam to loamy sand. Total vegetation cover ranges from 13 to 80%. The vegetation is characterized by an open canopy of *Pinus edulis, Juniperus scopulorum*, and *Juniperus osteosperma* trees, with *Cercocarpus ledifolius* trees or shrubs that range in cover from 5 to 30%. The associated short- and dwarf-shrub layer typically provides sparse to low cover and includes *Amelanchier utahensis, Arctostaphylos patula, Artemisia tridentata* ssp. *vaseyana, Cercocarpus montanus, Ericameria nauseosa, Quercus gambelii*, and *Gutierrezia sarothrae*. The herbaceous layer is somewhat diverse in terms of species composition but provides less than 10% total cover. Common graminoids include *Achnatherum hymenoides, Elymus elymoides, Poa fendleriana*, and *Carex* spp. Forbs present may include *Balsamorhiza sagittata, Chenopodium album, Descurainia californica*, and *Petradoria pumila*. Seedling *Pinus edulis* and *Juniperus* spp. are often present.

DISTRIBUTION

Dinosaur National Monument

This association is known primarily from the vicinity of Zenobia Basin and Zenobia Peak in the northeastern part of the monument.

Globally

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

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs on moderate to steep, northwest-facing slopes above 2100 m elevation. Soils are rapidly drained, coarse-textured loamy sands. Bedrock, large rock, organic litter and downed wood contribute a majority of the ground cover. The most common geologic substrate is Uinta Mountain Group quartzite.

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

Dinosaur National Monument The tree canopy of this association is dominated by *Pinus edulis* and *Juniperus osteosperma* or *Juniperus scopulorum*. Tree seedlings of these species are commonly present in the understory. The tall shrub *Cercocarpus ledifolius* may also occur in the tree canopy with its large trunks, wide-spreading branches and heights reaching 4 m. It also occurs as a short shrub, 1-2 m tall. Total cover of *Cercocarpus ledifolius* is 10 to 30%. Other shrubs that commonly occur with low cover include *Amelanchier alnifolia* and *Artemisia tridentata*. Herbaceous vegetation cover is generally sparse and often represented by the perennial bunchgrass *Poa fendleriana*.

Globally

This woodland association is patchy and somewhat rare within the Colorado Plateau. Total vegetation cover ranges from sparse to dense (13-80%). It is characterized by an open canopy, typically 5-10 m tall, of *Pinus edulis*,

Juniperus scopulorum, and *Juniperus osteosperma* trees that provide up to 40% canopy closure, and *Cercocarpus ledifolius* shrubs that range in cover from 5 to 30%. *Cercocarpus ledifolius* may also occur in the tree canopy with its large trunks, wide-spreading branches and heights reaching 4 m. The associated short- and dwarf-shrub layer is low in terms of species composition, typically provides sparse to low cover and includes *Amelanchier utahensis, Arctostaphylos patula, Artemisia tridentata* ssp. *vaseyana, Cercocarpus montanus, Ericameria nauseosa, Quercus gambelii*, and *Gutierrezia sarothrae*. The herbaceous layer is somewhat diverse in terms of species composition but provides less than 10% total cover. Common graminoids include *Achnatherum hymenoides, Elymus elymoides, Poa fendleriana, and Carex* spp. Forbs present may include *Balsamorhiza sagittata, Chenopodium album, Descurainia californica*, and *Petradoria pumila*. Seedling *Pinus edulis* and *Juniperus* spp. are often present.

MOST ABUNDANT SPECIES
Dinosaur National Monument

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

Globally

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

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
This association may be ecotonal, as it tends to occur at the upper end of the range of pinyon-juniper woodlands. However, it covers extensive areas where it does occur and may be considered a legitimate ecological type.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is limited in its distribution within the monument but is frequent within the section of the monument where its occurs. Fire history has also played a role in controlling the distribution of this association, by removing it from otherwise suitable habitat.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (3 plots: DINO.0244, DINO.0253, DINO.0266).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Cogan et al. 2004, 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	*PINUS EDULIS* - (*JUNIPERUS* SPP.) WOODLAND ALLIANCE (A.516) Two-needle Pinyon - (Juniper species) Woodland Alliance
ECOLOGICAL SYSTEM(S):	Southern Rocky Mountain Pinyon-Juniper Woodland (CES306.835) 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 woodland 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 up to 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 *Poa secunda, Pseudoroegneria spicata*, and *Pleuraphis jamesii*. Forbs are diverse but inconsistent among stands and contribute little cover.

DISTRIBUTION

Dinosaur National Monument

Most stands of this sparse woodland association occur on south-facing slopes of Whirlpool and Split Mountain canyons. It was not sampled during the initial classification phase of the mapping project because most stands are difficult and dangerous to access. Sampled stands are located in Moonshine Draw, Whirlpool Canyon at and below Sage Creek, Beach Draw in Split Mountain Canyon, the Yampa Canyon below Haystack Rock, near the Dinosaur Quarry and in Five Springs Draw.

Globally

This association has been documented only from scattered sites in the southern part of Capitol Reef National Park in southeastern 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

Dinosaur National Monument

This sparse woodland association occupies steep colluvial canyon walls and other xeric sites in the canyons. Slopes range from 20 to 32 degrees, are generally oriented to the south or west, and lie between 1580 and 2050 m elevation. Bare soil, rocks and gravel cover most of the unvegetated surface, with lesser cover by litter. Soils are coarse and derive mainly from limestones and sandstones of the Morgan, Round Valley and Weber formations.

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 degrees), are generally oriented to the south or west, and lie between 1558 and 2204 m (5100-7230 feet) elevation. Soils are rocky and are derived mainly from sedimentary rocks.

VEGETATION DESCRIPTION

Dinosaur National Monument 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 dominated by *Ephedra viridis*, usually with few other shrubs present, except for occasional *Fraxinus anomala, Atriplex* spp., and *Cercocarpus intricatus*. The herbaceous layer is generally sparse and poorly developed because of the active slopes, but a few stands have as much as 10% cover by grasses. Species present vary from stand to stand but include *Hesperostipa comata, Pleuraphis jamesii, Phlox hoodii, Tetraneuris acaulis, Koeleria macrantha, Achnatherum hymenoides, Phlox austromontana, Artemisia dracunculus, Pseudoroegneria spicata*, and *Poa secunda*.

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, Tetraneuris acaulis, Koeleria macrantha, Achnatherum hymenoides, Phlox austromontana, Artemisia dracunculus, Pseudoroegneria spicata*, and *Poa secunda*.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	Species
Tree canopy	*Juniperus osteosperma*, *Pinus edulis*
Short shrub/sapling	*Ephedra viridis*
Herb (field)	*Poa secunda*

Globally

Stratum	Species
Tree canopy	*Juniperus osteosperma*, *Pinus edulis*
Short shrub/sapling	*Ephedra viridis*
Herb (field)	*Poa secunda*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

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
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Stands tend to occur on steep, hot slopes that are subject to downslope movement of soil and boulders. A few stands are on xeric substrates in less extreme circumstances, such as dunes and sandy shales.
Dinosaur National Monument Data Sources: This association is described from 2005 accuracy assessment data (7 plots: DINO_AA.A0171, DINO_AA.A0233, DINO_AA.A0946, DINO_AA.A0112, DINO_AA.A0144, DINO_AA.A0172, DINO_AA.C0923).
Local Description Authors: J. Coles

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	*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) 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 feet) 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

Dinosaur National Monument

This association is known from Jones Hole Overlook, Pat's Draw Overlook on the Yampa Plateau, and Jacobson Draw and Big Joe Draw on Douglas Mountain.

Globally

This association is found in western Colorado and eastern Utah.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs on the level benches and gentle to moderate ridges and slopes of the monument's high plateaus. Elevations range from 2000 to 2350 m, and stands are on slopes oriented to the east or west. The soil surface under the tree canopy is covered with litter but tends to be bare or rocky between trees. Soils are sandy loams and rapidly drained.

Globally

This association is found on canyon rims, mesatops, 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

Dinosaur National Monument This woodland association has 10 to 40% cover of *Pinus edulis* and *Juniperus osteosperma* in the tree stratum that is 2-5 m high. *Artemisia tridentata* ssp. *wyomingensis* is a common shrub,

although too sparse to form a layer. *Pinus edulis* and *Juniperus osteosperma* seedlings are usually present. The herbaceous layer can be highly diverse. *Petradoria pumila* strongly dominates with up to 15% cover. Other herbaceous species commonly associated with much lower cover values include *Balsamorhiza sagittata, Leptodactylon pungens, Phlox hoodii, Poa fendleriana, Koeleria macrantha, Poa secunda,* and *Pseudoroegneria spicata.*

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
Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Juniperus osteosperma, Pinus edulis*
Herb (field)	*Balsamorhiza sagittata, Petradoria pumila*

Globally

Stratum	**Species**
Tree canopy	*Juniperus osteosperma, Pinus edulis*
Herb (field)	*Petradoria pumila*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Data are not available.

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
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 to be a variation of the woodland type because of the ecological values of the trees.

CLASSIFICATION CONFIDENCE:

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is distinguished from the similar *Pinus edulis - Juniperus osteosperma / Pseudoroegneria spicata* - Cushion Plant Woodland (CEGL002819) in that *Petradoria pumila* is overwhelmingly dominant in the herbaceous stratum.
Dinosaur National Monument Data Sources: This description is based on 2002 field data (5 plots: DINO.0298, DINO.0404, DINO.0406, DINO.0407, DINO.0543).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Drake, mod. K.A. Schulz

REFERENCES: Western Ecology Working Group n.d.

Pinus edulis - Juniperus osteosperma / Pseudoroegneria spicata - Cushion Plant Woodland
Two-needle Pinyon - Utah Juniper / Bluebunch Wheatgrass - Cushion Plant Woodland

CODE	CEGL002819
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
ALLIANCE	*PINUS EDULIS* - (*JUNIPERUS* SPP.) WOODLAND ALLIANCE (A.516) Two-needle Pinyon - (Juniper species) Woodland Alliance

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

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association has only been documented from Dinosaur National Monument in northwestern Colorado and adjacent eastern Utah. It occurs on the high windswept ridges and valleys of plateaus and mountains at elevations above 1900 m to as high as 2400 m. Slopes are east- to southwest-facing and gentle to moderately steep. Soils are thin, and texture is variable, depending on the geologic substrate, which is typically limestone or derived from limestone, such as Bishop conglomerate. The soil surface is often covered with gravel and large rocks. The vegetation is characterized by a sparse to moderate tree cover of *Pinus edulis* and *Juniperus osteosperma* with an understory of bunch grasses and cushion plants. The shrub stratum has less than 10% cover and lacks diagnostic species. The herbaceous layer is highly diverse with consistent dominant species. *Pseudoroegneria spicata* is typically present with low to moderate cover, but in heavily grazed areas, it may be absent. Other grasses that occur consistently include *Poa secunda, Poa fendleriana, Achnatherum hymenoides,* and *Koeleria macrantha*. Forbs characterized as "cushion" plants include *Stenotus acaulis, Phlox hoodii, Petradoria pumila,* and *Phlox multiflora*. A variety of other forbs also occur in this association, particularly *Balsamorhiza sagittata*.

DISTRIBUTION

Dinosaur National Monument

This association is known from Wild Mountain, Iron Springs Overlook, Limestone Ridge, Peterson Draw, Bower Draw, Cross Mountain, East Cactus Flat, and numerous other locations in the mountain and plateau country of the monument underlain by limestone or Bishop conglomerate.

Globally

This association has only been described from stands in Dinosaur National Monument in northwestern Colorado and adjacent eastern Utah. It likely also occurs on other highlands in the vicinity that are underlain by limestone, such as Cold Springs Mountain.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs on the high windswept ridges and valleys of plateaus and mountains at elevations above 1900 to 2400 m. Slopes are east- to southwest-facing and gentle to moderately steep. Soils are thin, and texture is variable, depending on the geologic substrate, which is typically limestone or derived from limestone, such as the Bishop conglomerate. The soil surface is often covered with gravel and large rocks.

Globally

This association has been documented only from Dinosaur National Monument. Without additional data, there is no global information.

VEGETATION DESCRIPTION

Dinosaur National Monument This woodland association is defined by a sparse to moderate tree cover of *Pinus*

edulis and *Juniperus osteosperma* with an understory of bunch grasses and cushion plants. The shrub stratum has less than 10% cover and lacks diagnostic species. The herbaceous layer is highly diverse with consistent dominant species. *Pseudoroegneria spicata* is typically present with low to moderate cover, but in heavily grazed areas it may be absent. Other grasses that occur consistently include *Poa secunda, Poa fendleriana, Achnatherum hymenoides,* and *Koeleria macrantha*. Forbs described as cushion plants include *Stenotus acaulis, Phlox hoodii, Petradoria pumila,* and *Phlox multiflora*. A variety of other forbs also occur, particularly *Balsamorhiza sagittata*.

Globally
This association has been documented only from Dinosaur National Monument. Without additional data, there is no global information.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	Species
Tree canopy	*Juniperus osteosperma*, *Pinus edulis*
Short shrub/sapling	*Symphoricarpos oreophilus*
Herb (field)	*Balsamorhiza sagittata*, *Stenotus acaulis*

Globally

Stratum	Species
Tree canopy	*Juniperus osteosperma*, *Pinus edulis*
Herb (field)	*Stenotus acaulis*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (12-Jul-2005).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
This association is very similar in habitat requirements and composition to some stands that have been included in *Pinus edulis -Juniperus* spp. / *Pseudoroegneria spicata* Woodland (CEGL000788), especially those included by Baker (1982b, 1983c). Either those plots should be removed from the concept of CEGL000788 and added here, or this association should be combined with CEGL000788.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association, although common within the monument, is restricted to limestone substrates with relatively thin soils.
Dinosaur National Monument Data Sources: This description is based on 2002 and 2003 field data (40 plots: DINO.0108, DINO.0110, DINO.0 225,DINO.0258, DINO.0276, DINO.0283, DINO.0284, DINO.0285, DINO.0292, DINO.0296, DINO.0303, DINO.0342, DINO.0356, DINO.0361, DINO.0405, DINO.0410, DINO.0444, DINO.0455, DINO.0504, DINO.0544, DINO.0546, DINO.0547, DINO.0551, DINO.0552, DINO.0554, DINO.0555, DINO.0556, DINO.0564, DINO.0565, DINO.0583, DINO.0585, DINO.0586, DINO.0612, DINO.0613, DINO.0614, DINO.0629, DINO.0653, DINO.0907, DINO.0913, DINO.1401).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Baker 1982b, Baker 1983c, Western Ecology Working Group n.d.

Pinus edulis - Juniperus osteosperma / Purshia tridentata Woodland
Two-needle Pinyon – Utah Juniper / Antelope Bitterbrush Woodland

CODE	CEGL000789
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
ALLIANCE	*PINUS EDULIS* - (*JUNIPERUS* SPP.) WOODLAND ALLIANCE (A.516) Two-needle Pinyon - (Juniper species) Woodland Alliance
ECOLOGICAL SYSTEM(S):	Colorado Plateau Pinyon-Juniper Shrubland (CES304.766) Colorado Plateau Pinyon-Juniper Woodland (CES304.767) Southern Rocky Mountain Pinyon-Juniper Woodland (CES306.835)
USFWS WETLAND SYSTEM:	Not applicable

CONCEPT SUMMARY

Globally

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

DISTRIBUTION

Dinosaur National Monument

This association is known from Buck Ridge in Zenobia Basin and the sandstone hogbacks near Deerlodge Park. It is likely to be found elsewhere at low to moderate elevations on deep soils derived from limestone or sandstone substrates.

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

Dinosaur National Monument

This association occurs infrequently on ridge slopes at elevations ranging from 1800 to 2300 m. Soils tend to be shallow and sandy, with much exposed bedrock, bare soil and broken rock at the surface. The underlying geology may be limestone or sandstone.

Globally

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

VEGETATION DESCRIPTION

Dinosaur National Monument

The tree canopy of this woodland association is dominated by *Pinus edulis* and *Juniperus osteosperma* with 15 to 25% cover each. The dominant shrub is *Purshia tridentata* with at least 10% cover. The dwarf-shrub *Artemisia nova* is commonly associated with this community. The herbaceous layer is relatively sparse and may include *Poa fendleriana, Pseudoroegneria spicata,* and *Stenotus acaulis.*

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

Dinosaur National Monument

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

Globally

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

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (1-Feb-1996).

CLASSIFICATION COMMENTS

Dinosaur National Monument

Data are not available.

Globally

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

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Dinosaur National Monument Inventory Notes: Purshia tridentata is rarely a dominant shrub in the monument, so this association is uncommon. This association occurs as an inclusion in larger areas of *Pinus edulis - Juniperus osteosperma / Artemisia nova* Woodland (CEGL002331), and *Artemisia nova* is often a codominant shrub.
Dinosaur National Monument Data Sources: The description is based on 2002 and 2004 field data (1 plot:

DINO.0295, 1 observation point: DINO 9041).
Local Description Authors: J. Thompson, mod. 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 / Sparse Understory Woodland
Two-needle Pinyon - Utah Juniper / Sparse Understory Woodland

CODE	CEGL002148
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
ALLIANCE	*PINUS EDULIS* - (*JUNIPERUS* SPP.) WOODLAND ALLIANCE (A.516) Two-needle Pinyon - (Juniper species) Woodland Alliance
ECOLOGICAL SYSTEM(S):	Colorado Plateau Pinyon-Juniper Woodland (CES304.767) Great Basin Pinyon-Juniper Woodland (CES304.773)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This variable woodland association is widespread in parts of western Colorado and eastern Utah. It is found most commonly on mid- to upper slopes, though other topographic positions are possible. It has been sampled at elevations between 1354 and 2389 m and on all aspects. At higher elevations, it tends toward southwestern aspects. Sites range from flat to moderately steep. The ground has variable amounts of litter and often has moderate to high amounts of gravel, rocks, and exposed bedrock. Cryptogamic cover is usually low to moderate, but some sites have up to 55-65% cover. Soils are always rapidly drained to moderately well-drained. Parent materials are also highly variable and can be sandstones, shales, or limestones. The lack of an understory may be due to high rock cover, low soil moisture, or a closed evergreen canopy of pinyon and juniper. This widespread association occurs as relatively sparse to moderately vegetated stands with total vegetation cover ranging from 10-75%. Sparsely vegetated stands (<10% total vegetation cover) composed of only trees are included as a best fit in this woodland association in extremely dry, rocky portions of the Colorado Plateau. The tree canopy is dominated by Pinus edulis and Juniperus osteosperma. Both typically range from 1-35% cover with some stands having canopy cover by one species up to 50%. The tree canopy is short, usually 2-10 m tall, and open to moderately closed. *Fraxinus anomala* has been observed in the canopy of some stands but always at no more than 5% cover. Several shrub species are commonly found in this association, but they occur as widely scattered individuals or an open shrub stratum. Scattered small *Pinus edulis* and *Juniperus osteosperma* are found along with shrubs such as *Amelanchier utahensis, Artemisia tridentata* ssp. *wyomingensis, Cercocarpus montanus, Ephedra viridis, Eriogonum microthecum, Shepherdia rotundifolia,* and *Opuntia* spp. The herbaceous layer is low in cover (<5%) and usually low in diversity. *Achnatherum hymenoides, Bouteloua gracilis, Bromus tectorum, Poa fendleriana,* and *Pleuraphis jamesii* are common graminoids. Forbs are not abundant, but typical species include *Descurainia pinnata, Cryptantha* spp., and *Tetraneuris acaulis*.

DISTRIBUTION
Dinosaur National Monument
This association is widespread throughout the middle and lower elevations of the monument.

Globally
This association is known to occur in western Colorado and eastern Utah.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association occupies colluvial slopes, alluvial terraces, and plateau bluffs and ridges throughout the monument at elevations ranging from 1700 to 2300 m. Slopes range from gentle to moderately steep on all aspects except north.

Soils can be fine- or coarse-textured and are often sandy or rocky. The ground cover is typically overlain by boulders, rock and/or gravel. Bedrock exposure may be high, as may the cover of biological soil crusts. Geologic substrates include eolian sands to limestone, sandstone, conglomerate and shale.

Globally
This woodland association is found most commonly on mid-to upper slopes, though other topographic positions are possible, such as valley floors, plateaus, colluvial slopes, hills, canyon rims, canyon sides, mesas, plains, and benches. It has been sampled at elevations between 1354 and 2389 m and on all aspects. At higher elevations, such as in Black Canyon of the Gunnison National Park it tends toward southwestern aspects. Sites range from flat to moderately steep (0-25 degrees). The ground has variable amounts of litter and often has moderate to high amounts of gravel, rocks, and exposed bedrock. Cryptogamic cover is usually low to moderate, but some sites have up to 55-65% cover. Soils vary in texture and can be loamy sand, silts, loams or silty clay but are always rapidly drained to moderately well-drained. Parent materials are also highly variable and can be sandstones, shales, limestones, among others.

VEGETATION DESCRIPTION
Dinosaur National Monument
This woodland association is characterized by an open to closed canopy of *Pinus edulis* and *Juniperus osteosperma* and a very sparse understory (<5% total cover) of shrubs and herbaceous vegetation. Most understory species occur with 1% or less cover and most commonly include *Purshia tridentata, Artemisia tridentata, Amelanchier utahensis, Bromus tectorum, Poa fendleriana, Achnatherum hymenoides, Pseudoroegneria spicata, Arabis* spp., *Phlox* spp., *Cryptantha* spp., and *Stenotus acaulis*. Tree seedlings are typically present with minimal cover.

Globally
This widespread pinyon-juniper woodland association occurs as relatively sparse to moderately vegetated stands with total vegetation cover ranging from 10-75%. Sparsely vegetated stands (<10% total vegetation cover) composed of only trees are included as a best fit in this woodland association in extremely dry, rocky portions of the Colorado Plateau. The tree canopy is dominated by *Pinus edulis* and *Juniperus osteosperma*. Both typically range from 1-35% cover with some stands having canopy cover by one species up to 50%. The tree canopy is short, usually 2-10 m tall, and open to moderately closed. *Fraxinus anomala* has been observed in the canopy of some stands at Colorado National Monument but always at no more than 5% cover. Several shrub species are commonly found in this association, but they occur as widely scattered individuals or an open shrub stratum. Scattered small *Pinus edulis* and *Juniperus osteosperma* are found along with shrubs such as *Amelanchier utahensis, Artemisia bigelovii, Artemisia tridentata* ssp. *wyomingensis, Cercocarpus montanus, Chrysothamnus viscidiflorus, Coleogyne ramosissima, Ephedra viridis, Eriogonum microthecum, Gutierrezia sarothrae, Shepherdia rotundifolia, Symphoricarpos longiflorus*, and *Opuntia* spp., usually *Opuntia fragilis* or *Opuntia polyacantha*. The herbaceous layer is low in cover (<5%) and usually low in diversity. *Achnatherum hymenoides, Bouteloua gracilis, Bromus tectorum, Poa fendleriana*, and *Pleuraphis jamesii* are common graminoids. Forbs are not abundant, but typical species include *Descurainia pinnata, Cryptantha* spp., and *Tetraneuris acaulis*.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Juniperus osteosperma*, *Pinus edulis*

Globally

Stratum	**Species**
Tree canopy	*Juniperus osteosperma*, *Pinus edulis*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Bromus tectorum

CONSERVATION STATUS RANK
Global Rank & Reasons: G5 (15-Dec-2004).

CLASSIFICATION COMMENTS
Dinosaur National Monument
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
Dinosaur National Monument Inventory Notes: This association includes a number of situations that create a sparse understory beneath a pinyon-juniper canopy. One situation is that of a closed canopy where water and light competition by the overstory trees leave few niches available for shrubs or grasses. A second situation is where the ground surface is covered by so much rock or bedrock that there are few places for plants to grow. A third situation is deep sands where moisture during the growing season is available only to trees that can get their roots down far enough. The fourth situation is that of marine shales, where the sparse tree canopy sequesters all the available moisture.
Dinosaur National Monument Data Sources: The description is based on 2002 and 2003 field data (28 plots: DINO.0216, DINO.0358, DINO.0366, DINO.0413, DINO.0421, DINO.0439, DINO.0448, DINO.0450, DINO.0462, DINO.0463, DINO.0464, DINO.0478, DINO.0496, DINO.0580, DINO.0598, DINO.0606, DINO.0607, DINO.0617, DINO.0682, DINO.0687, DINO.0703, DINO.0722, DINO.0820, DINO.0821, DINO.0822, DINO.0833, DINO.0837, DINO.1016).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Drake, mod. J. Coles and K.A. Schulz

REFERENCES: Western Ecology Working Group n.d.

***Pinus edulis* - *Juniperus* spp. / *Artemisia tridentata* (ssp. *wyomingensis*, ssp. *vaseyana*) Woodland**
Two-needle Pinyon - Juniper species / (Wyoming Big Sagebrush, Mountain Big Sagebrush) Woodland

CODE	CEGL000776
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
ALLIANCE	*PINUS EDULIS* - (*JUNIPERUS* SPP.) WOODLAND ALLIANCE (A.516) Two-needle Pinyon - (Juniper species) Woodland Alliance
ECOLOGICAL SYSTEM(S):	Colorado Plateau Pinyon-Juniper Woodland (CES304.767) Southern Rocky Mountain Pinyon-Juniper Woodland (CES306.835)
USFWS WETLAND SYSTEM:	Not applicable

CONCEPT SUMMARY
Globally
This broadly defined woodland association is common in the Colorado Plateau but also occurs on dry foothills and mesas from north-central New Mexico and southern Colorado west to the eastern Mojave Desert, in extreme northwestern Colorado and adjacent Utah. Elevations range from 1465 to 2500 m (4800-8200 feet). Stands occur most often on flat to gentle slopes on all aspects. The soils are generally poorly developed, moderately deep to deep,

well-drained to rapidly drained loams and sands. Ground cover is variable; bare soil is common, but bedrock, litter, and large or small rocks can also be abundant on some sites. Parent material includes sandstone and shale. The vegetation is characterized by a typically open tree canopy (10-30% cover but ranges up to 50% cover) that is codominated by *Pinus edulis* and *Juniperus* spp. The species of *Juniperus* varies with geography and elevation. Juniperus monosperma is common in north-central New Mexico and southern Colorado. *Juniperus osteosperma* is common from northwestern New Mexico west and north into Arizona and Utah. *Juniperus scopulorum* is more common in higher elevation stands. *Artemisia tridentata* (either ssp. *vaseyana* or ssp. *wyomingensis* depending on location) strongly dominates the sparse to moderately dense short-shrub layer (10-35% cover). *Purshia stansburiana* is typically absent or scarce. Other shrubs present may include *Amelanchier utahensis, Arctostaphylos patula, Cercocarpus montanus, Ephedra viridis, Gutierrezia sarothrae, Quercus gambelii* (typically <5% cover), or species of *Yucca* and *Opuntia*. Herbaceous cover is variable but generally sparse and dominated by graminoids (<5% cover) with scattered forbs.

DISTRIBUTION

Dinosaur National Monument

This common, widespread association is known from Ecklund Draw, Jacobson Draw, Plug Hat Rock, Yampa Bench, Doc's Valley, Starvation Valley, Yampa Plateau, and the Gates of Lodore.

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

Dinosaur National Monument

This association occurs in extensive stands on broad benches, valleys, and plateaus, where soils are deep enough to support a sagebrush understory. The level to gently sloping topography ranges from 1700 to 2300 m in elevation. Soils in most stands are sandy and rapidly drained, but a few sites have clay loam soils.

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

Dinosaur National Monument

This woodland association is characterized by a canopy 2-5 m tall containing both *Pinus edulis* and *Juniperus osteosperma. Juniperus scopulorum* may be present where small streams or shady rock crevices bisect stands. Total tree cover ranges from 10 to 60%. *Artemisia tridentata* ssp. *wyomingensis* or *Artemisia tridentata* ssp. *vaseyana* is the dominant shrub in the understory. Shrub cover averages about 10%. Other shrubs commonly associated with this community include *Cercocarpus montanus, Amelanchier utahensis, Gutierrezia sarothrae,* and *Opuntia* spp. Herbaceous species are highly diverse among sites and contribute minimal to moderate cover. Grasses most commonly present include *Pseudoroegneria spicata, Poa fendleriana, Poa secunda, Hesperostipa comata,* and *Bromus tectorum.* Forbs species include *Petradoria pumila, Stenotus acaulis*, and *Heterotheca villosa*.

Globally

This woodland is characterized by a typically open tree canopy (usually 10-30% cover but ranges up to 50% cover) that ranges from 2 to 10 m tall in most stands. The tree canopy is codominated by *Pinus edulis* and *Juniperus* spp. The species of *Juniperus* varies with geography and elevation. *Juniperus monosperma* is common in north-central New Mexico and southern Colorado. *Juniperus osteosperma* is common in stands reported from northwestern New Mexico, western Colorado, Arizona and Utah. *Juniperus scopulorum* is more common in higher elevation stands. *Artemisia tridentata* strongly dominates the relatively sparse to moderately dense short-shrub layer (10-35% cover); either ssp. v*aseyana* 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
Dinosaur National Monument

Stratum	Species
Tree canopy	*Juniperus osteosperma*, *Pinus edulis*
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*, *Cercocarpus montanus*, *Purshia tridentata*
Herb (field)	*Gutierrezia sarothrae*
Herb (field)	*Poa secunda*, *Pseudoroegneria spicata*

Globally

Stratum	Species
Tree canopy	*Juniperus monosperma*, *Juniperus osteosperma*, *Pinus edulis*
Short shrub/sapling	*Artemisia tridentata* ssp. *vaseyana*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Data are not available.

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
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 to be a variation of the woodland type because of the ecological values of the trees.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Artemisia tridentata ssp. *vaseyana* occurs less commonly than *Artemisia tridentata* ssp. *wyomingensis* in this association on the monument.
Dinosaur National Monument Data Sources: This description is based on 2002 and 2003 field data (16 plots: DINO.0231, DINO.0297, DINO.0354, DINO.0357, DINO.0488, DINO.0490, DINO.0491, DINO.0493, DINO.0494, DINO.0495, DINO.0705, DINO.0813, DINO.0814, DINO.0827, DINO.0828, DINO.0844).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: K.A. Schulz, mod. J. Drake and J. Coles

REFERENCES: Bourgeron and Engelking 1994, Bunting 1987, CONHP 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	*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) Southern Rocky Mountain Pinyon-Juniper Woodland (CES306.835)
USFWS WETLAND SYSTEM:	Not applicable

CONCEPT SUMMARY

Globally

This broadly defined woodland association is common on the Colorado Plateau, occurring on sheltered colluvial slopes, sandstone hogbacks, dry foothills and mesas from north-central New Mexico and southern Colorado west to the Mogollon Rim of Arizona, and in western Colorado and adjacent Utah. It can be found on any slope position, though lower slopes are less common. Elevations range from 1472 to 2480 m (4830-8135 feet). Stands occur on gentle to steep slopes on all aspects. The soils are variable but generally shallow, poorly developed and skeletal, ranging from clayey marl to loamy sands. The unvegetated surface is characterized by bedrock, large and small rocks, and/or bare soil with little litter. Sandstone or shale are the most common parent materials. This association is characterized by an open to moderately dense tree canopy (10-60% cover) dominated by a combination of *Pinus edulis* and *Juniperus* spp. with a shrub layer dominated by *Cercocarpus montanus*. The tree canopy averages 2-5 m tall, but some stands may be as tall as 10 m. *Pinus edulis* and *Juniperus* spp. codominate in most stands, but sometimes one may be more prevalent than the other. The species of *Juniperus* varies with geography and elevation and includes *Juniperus deppeana, Juniperus monosperma, Juniperus osteosperma,* and *Juniperus scopulorum*. The total shrub cover may range from sparse to moderate. *Cercocarpus montanus* is the dominant shrub with up to 35% cover. It typically occurs as a short shrub but can be a tall shrub on some sites. Other shrubs may be present, including *Amelanchier* spp., *Artemisia bigelovii, Artemisia tridentata, Ephedra viridis, Chrysothamnus viscidiflorus, Gutierrezia sarothrae, Fendlera rupicola, Garrya ovata, Mahonia* spp., *Nolina microcarpa, Quercus gambelii, Quercus grisea, Rhus trilobata,* or species of *Yucca* and *Opuntia*. Herbaceous cover is variable, ranging from sparse to moderately dense, and generally dominated by graminoids (>5% cover) with scattered forbs. Extremely open stands of this association, usually occurring on fractured slickrock exposures, may have as little as 5% total vegetation cover and an upper canopy only 2 m tall.

DISTRIBUTION

Dinosaur National Monument

This association occurs in small patches scattered widely throughout the monument, including on Wild Mountain, Douglas Mountain, Stuntz Draw, Plug Hat Rock, East Cactus Flat, Ruple Point, Red Wash, and Viva's Cake Hill.

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

Dinosaur National Monument

This association occurs on gentle to steep hogbacks, mountain slopes, benches and ridges at elevations between 1650 and 2475 m. Stands may occur on slopes oriented to any aspect and tend be rocky or gravelly on the surface. Substrates include colluvium, limestone and sandstone. Soils are typically coarse-textured and rapidly drained.

Globally

This broadly defined woodland association is common on the Colorado Plateau, occurring on sheltered colluvial slopes, sandstone hogbacks, dry foothills and mesas. It can be found on any slope position (upper, middle, or lower), though lower slopes are the least common. Elevations range from 1472 to 2480 m (4830-8135 feet). Stands occur on gentle to steep (3- to 36-degree) slopes on all aspects. The soils are variable but generally shallow, poorly developed and skeletal, ranging from clayey marl to loamy sands. The unvegetated surface is characterized by bedrock, large and small rocks, and/or bare soil. Litter has low cover. Parent materials are most often sandstone or shale.

VEGETATION DESCRIPTION

Dinosaur National Monument

This mixed mountain shrub woodland association consists of a tree canopy of *Juniperus osteosperma* and *Pinus edulis* with 10 to 40% cover, and often more than 5 m high. Occasionally, *Pseudotsuga menziesii* and *Juniperus scopulorum* occur in the tree canopy or as emergents. Young trees and seedlings of the dominant species are often present. The shrub stratum is dominated by *Cercocarpus montanus* with 10 to 20% cover. Other shrubs are always present but occur with lower cover, including *Amelanchier utahensis, Ephedra viridis*, and *Artemisia tridentata* ssp. *wyomingensis, Artemisia tridentata* ssp. *vaseyana, Eriogonum microthecum, Gutierrezia sarothrae,* and *Opuntia* spp. Herbaceous species are highly diverse in composition, although not high in cover. Graminoids that occur consistently include *Poa fendleriana, Achnatherum hymenoides*, and *Pseudoroegneria spicata*. Common forbs include *Cryptantha* spp., *Machaeranthera grindelioides, Petradoria pumila,* and *Phlox hoodii.*

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 *Tetraneuris*. Extremely open stands of this association occurring on exposed and fractured slickrock may have as little as 5% total vegetation cover and an upper canopy only 2 m tall. Biological soil crusts are patchy but may contribute up to 27% cover and are generally well-developed.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Tree canopy	*Juniperus osteosperma, Pinus edulis*
Tall shrub/sapling	*Artemisia tridentata* ssp. *vaseyana, Cercocarpus montanus*
Herb (field)	*Stenotus acaulis*

Globally

Stratum	Species
Tree canopy	*Juniperus monosperma, Juniperus osteosperma, Pinus edulis*
Short shrub/sapling	*Cercocarpus montanus*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Bromus tectorum

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION COMMENTS
Dinosaur National Monument
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 to be a variation of the woodland type because of the ecological values of the trees.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association occurs on rocky, warm slopes and in habitats that might also support *Pinus edulis - Juniperus osteosperma / Cercocarpus intricatus* Woodland (CEGL000779).
Dinosaur National Monument Data Sources: This description is based on 2002 and 2003 field data (18 plots: DINO.0124, DINO.0192, DINO.0222, DINO.0327, DINO.0339, DINO.0350, DINO.0362, DINO.0423, DINO.0507, DINO.0508, DINO.0523, DINO.0576, DINO.0588, DINO.0626, DINO.0631, DINO.0901, DINO.1012, DINO.1418).
Local Description Authors: J. Thompson, mod. J. Coles
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 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	*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 woodland association is widespread throughout the Colorado Plateau, but limited to small stands on specific substrates. Stands tend to occupy the tops, shoulders, upper and middle slopes of ridges, as well as canyon sides. These sites range from moderately to steeply sloping (47% to more than 100% slopes), although a minority of stands occur on gentle slopes with gradients not exceeding 10%. Elevations range between 1483 and 2301 m (4865-7550 feet). Stands at higher elevations and latitudes (e.g., Black Canyon of the Gunnison National Park and Dinosaur National Monument) tend to be oriented to the south or west, but stands at lower elevations occur primarily on north or east aspects. Parent materials are variable but generally include a significant element of marine shale, sometimes redeposited with other rocks as alluvium or colluvium. Soils are rapidly drained and include sandy clay loams, clay loams and sandy loams. Total vegetation cover ranges from sparse (7%) to moderate (50%) in this variable community, with drier, more exposed sites supporting less overall plant cover. The canopy may be very open to moderate (5 to 30%), and consists of both Pinus edulis and Juniperus osteosperma. Either tree species may dominate

the canopy. Shrubs are generally present but do not provide enough cover to constitute a stratum. Common species include *Ephedra viridis, Shepherdia rotundifolia*, *Opuntia* spp., and *Chrysothamnus viscidiflorus*. The herbaceous layer is more conspicuous than the shrub layer in this community, consisting of a variety of grasses, among which *Leymus salinus* is clearly dominant. Total herbaceous cover can range from 5% in sparse stands to more than 30% in more sheltered sites. Common associated herbaceous species include *Achnatherum hymenoides* and *Pleuraphis jamesii.*

DISTRIBUTION

Dinosaur National Monument

This association is known from north-facing limestone slopes on Cross Mountain at the extreme eastern end of the project area.

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

Dinosaur National Monument

This association is known from one site at 1939 m elevation on a steep, northwest-facing slope. The soil is a silt loam and covered by organic litter and rocks. The underlying geology is Madison limestone.

Globally

This woodland association is widespread throughout the Colorado Plateau, but limited to small stands on specific substrates. Stands tend to occupy well-drained, exposed sites on the tops, shoulders, upper and middle slopes of ridges, as well as canyon sides, gullies, ledges, and colluvial slopes. These sites range from moderately to steeply sloping (47% to more than 100% slopes), although a minority of stands occur on gentle slopes with gradients not exceeding 10%. Elevations range between 1483 and 2301 m (4865-7550 feet), with most stands occurring above 1700 m. Stands at higher elevations and latitudes (e.g., Black Canyon of the Gunnison National Park and Dinosaur National Monument) tend to be oriented to the south or west, but stands at lower elevations occur primarily on north or east aspects. Parent materials are variable but generally include a significant element of Paleozoic or Mesozoic marine shale, sometimes redeposited with other rocks as alluvium or colluvium. Soils are rapidly drained and include sandy clay loams, clay loams and sandy loams.

VEGETATION DESCRIPTION

Dinosaur National Monument This woodland association has 30% cover of *Juniperus osteosperma* and *Pinus edulis* in the tree stratum, and seedlings are present. Shrub species are absent. The tall, hearty, perennial bunchgrass *Leymus salinus* has 20% cover. Minor associated herbaceous species include *Poa fendleriana, Bromus tectorum, Koeleria macrantha*, and *Phlox hoodii.*

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 *Tetraneuris acaulis. Bromus tectorum* is common in stands that have experienced disturbance from roads or grazing.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Juniperus osteosperma, Pinus edulis*

Herb (field)	*Leymus salinus*

Globally

Stratum	**Species**
Tree canopy	*Juniperus monosperma, Juniperus osteosperma, Pinus edulis*
Herb (field)	*Leymus salinus*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
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
Dinosaur National Monument
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

Dinosaur National Monument Inventory Notes: Although this association was documented only once, it may occur in small stands in the Cross Mountain area or buffer areas of the monument. It is likely to be found on shale slopes at moderate elevations with easterly exposures.
Dinosaur National Monument Data Sources: This description is based on 2002 field data (1 plot: DINO.0304).
Local Description Authors: J. Thompson, mod. J. Coles
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. / *Poa fendleriana* Woodland
Two-needle Pinyon - Juniper species / Muttongrass Woodland

CODE	CEGL000787
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)
Southern Rocky Mountain Pinyon-Juniper Woodland (CES306.835)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally
This association is widespread and common throughout the Colorado Plateau of Utah, Arizona, New Mexico and Colorado. It occurs on the slopes of canyons, ridges, toeslopes, alluvial fans, benches and plateaus at elevations ranging from 1525 to 2560 m (5000-8400 feet). Stands may occur on slopes ranging from 7 to 48% that are oriented to any aspect. Most stands are on sandy soils, with a few on silt loam or clay loam soils derived from sedimentary, granitic or metamorphic rocks. Total vegetation cover ranges from 40% to more than 75%. This woodland association is characterized by an open to moderately closed, mixed canopy of *Pinus edulis* and *Juniperus osteosperma* 2-10 m tall. In the southern part of the range, *Juniperus monosperma* and *Juniperus scopulorum* may be present in the canopy. The understory is dominated by the bunchgrass *Poa fendleriana* with between 1 and 25% cover. Scattered shrubs fail to form a stratum but may include *Amelanchier utahensis, Artemisia nova, Cercocarpus montanus, Ephedra viridis, Quercus gambelii, Purshia tridentata, Yucca baccata, Opuntia* spp., *Symphoricarpos oreophilus, Fallugia paradoxa*, and *Fendlera rupicola*. Other common herbaceous species (always with less cover than *Poa fendleriana*) include *Achnatherum hymenoides, Koeleria macrantha, Muhlenbergia montana, Blepharoneuron tricholepis, Pascopyrum smithii, Bouteloua gracilis, Balsamorhiza sagittata, Mirabilis multiflora, Penstemon linarioides,* and *Petradoria pumila*.

DISTRIBUTION
Dinosaur National Monument
This association is known to occur in the canyons of the Yampa and Green rivers, on the Yampa Bench and the Yampa Plateau. Sampled sites include Sand Canyon, Iron Mine Basin, Bower Draw, and Plug Hat Rock. It is common on flatirons of Park City Formation limestone on Iron Springs Bench.

Globally
This association occurs at moderate elevations in the Colorado Plateau region of western Colorado, northern Arizona and New Mexico and eastern Utah.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association occurs on the gentle to moderate slopes of canyons, benches and plateaus at elevations ranging from 1525 to 2270 m. Stands may occur on slopes ranging from 7 to 40% and oriented to any aspect. Most stands are on sandy soils, with a few on silt loam or clay loam soils. A third to half the unvegetated ground surface is bare ground, and in some plots large rocks and gravel cover up to a third of the surface. In some cases, cryptogamic crusts and moss cover up to 25% of the soil surface.

Globally
This association is widespread and common throughout the Colorado Plateau of Utah, Arizona, New Mexico and Colorado. It occurs on the gentle to moderate slopes of canyons, ridges, toeslopes, benches and plateaus at elevations ranging from 1525 to 2560 m (5000-8400 feet). Stands may occur on slopes ranging from 7 to 48% and oriented to any aspect. Most stands are on sandy soils, with a few on silt loam or clay loam soils derived from sedimentary, granitic or metamorphic rocks. A third to half the unvegetated ground surface is bare ground, and in some plots large rocks and gravel cover up to a third of the surface. In some cases, cryptogamic crusts and moss or litter cover up to 25% of the soil surface.

VEGETATION DESCRIPTION
Dinosaur National Monument
Pinus edulis and *Juniperus osteosperma* codominate this woodland association with 30 to 60% total cover. Some stands may lack *Pinus edulis*. Seedlings of both species may be present. Shrub species are variable and contribute less than 10% cover. *Poa fendleriana* dominates the herbaceous layer with up to 15% cover. Commonly associated graminoid species include *Achnatherum hymenoides*. Forb species composition is inconsistent among stands and usually contributes minimal cover.

Globally
This woodland association is widespread and relatively common at moderate elevations throughout the Colorado Plateau. Total vegetation cover ranges from 40% to more than 75%. This woodland association is characterized by an open to moderately closed, mixed canopy of *Pinus edulis* and *Juniperus osteosperma* 2-10 m tall. In the southern part of the range, *Juniperus monosperma* and *Juniperus scopulorum* may be present in the canopy. The understory is dominated by the bunchgrass *Poa fendleriana* with between 1 and 25% cover. Scattered shrubs present include

Amelanchier utahensis, Artemisia nova, Cercocarpus montanus, Quercus gambelii, Purshia tridentata, Yucca baccata, Opuntia spp., *Symphoricarpos oreophilus, Fallugia paradoxa*, and *Fendlera rupicola*. Other common herbaceous species (always with less cover than *Poa fendleriana*) include *Achnatherum hymenoides, Koeleria macrantha, Muhlenbergia montana, Blepharoneuron tricholepis, Pascopyrum smithii, Bouteloua gracilis, Balsamorhiza sagittata, Mirabilis multiflora, Penstemon linarioides*, and *Petradoria pumila*.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Tree canopy	*Juniperus osteosperma, Pinus edulis*
Herb (field)	*Poa fendleriana*

Globally

Stratum	Species
Tree canopy	*Juniperus osteosperma, Pinus edulis*
Herb (field)	*Poa fendleriana*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Arabis fernaldiana var. *fernaldiana, Bromus tectorum*

Globally
Arabis fernaldiana var. *fernaldiana, Bromus tectorum*

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Dinosaur National Monument
Data are not available.

Globally
Even if stands have relatively sparse cover of *Poa fendleriana* (<5%), if no other species are present with more than trace cover, they have been placed in this association rather than *Pinus edulis - Juniperus osteosperma* / Sparse Understory Woodland (CEGL002148).

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Dinosaur National Monument Inventory Notes: Woodlands of this association are often interspersed with stands of *Pinus edulis -Juniperus* spp. / *Artemisia tridentata* (ssp. *wyomingensis*, ssp. *vaseyana*) Woodland (CEGL000776) or *Pinus edulis - Juniperus osteosperma / Artemisia nova* Woodland (CEGL002331). Woodland stands that have a relatively sparse understory, as long as it is dominated by *Poa fendleriana*, are placed here.
Dinosaur National Monument Data Sources: The description is based on 2002 and 2003 field data (9 plots: DINO.0185, DINO.0194, DINO.0199, DINO.0249, DINO.0281, DINO.0351, DINO.0452, DINO.0492, DINO.1009).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Baker 1982b, Barnes 1987, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Erdman 1962, Erdman 1969, Erdman et al. 1969, Floyd 2003, Floyd et al. 2001, Isaacson 1967, Johnston 1987, Larson and Moir 1987, Moir and Carleton 1987, USFS 1985a, Western Ecology Working Group n.d.

Pinus flexilis / Juniperus communis Woodland
Limber Pine / Common Juniper Woodland

CODE	CEGL000807
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 FLEXILIS* WOODLAND ALLIANCE (A.540) Limber Pine Woodland Alliance
ECOLOGICAL SYSTEM(S):	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland (CES304.790) Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland (CES306.819) Rocky Mountain Foothill Limber Pine-Juniper Woodland (CES306.955)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This limber pine woodland is found in the montane and subalpine zones of the western United States. It occurs on dry, exposed, rocky sites such as rock outcrops, ridges, slope crests, and high flat benches from 2530 to 3390 m (8300-11,100 feet) in elevation in the southern Rocky Mountains and 1400 to 2530 m (4600-8300 feet) in the northern Rocky Mountains. It also occurs on gentle to moderately steep slopes with variable aspect. Soils are predominantly shallow, coarse-textured, and rapidly drained with high soil-surface temperatures. The tree canopy is generally open in character and comprised predominantly of *Pinus flexilis.* Tree canopy associates include *Pinus contorta* and *Picea engelmannii* at higher elevations and *Pinus ponderosa* at lower elevations, with *Pseudotsuga menziesii* and occasionally *Pinus albicaulis* in the northern portion of the range. A sparse low-shrub layer is present and characterized by *Juniperus communis*. *Arctostaphylos uva-ursi* also has high constancy in this type, although less total cover than *Juniperus communis*. Additional shrubs can include *Jamesia americana, Paxistima myrsinites, Ribes cereum, Symphoricarpos oreophilus, Vaccinium* spp., and *Juniperus horizontalis*. The herbaceous layer is likewise sparse. Species commonly occurring include *Achnatherum hymenoides, Carex geyeri, Carex rossii, Festuca brachyphylla, Leucopoa kingii, Poa fendleriana, Antennaria rosea, Erigeron flagellaris, Lupinus argenteus, Arenaria fendleri, Frasera speciosa, Geranium caespitosum* var. *fremontii, Penstemon virens*, *Potentilla fissa*, and *Sedum lanceolatum*. On calcareous substrates in the northern portion of the range, forbs often include *Clematis columbiana, Arnica cordifolia, Eurybia conspicua, Campanula rotundifolia, Galium boreale*, and *Astragalus miser*. The ground layer has a high proportion of unvegetated surface that is often composed of gravel and rock.

DISTRIBUTION

Dinosaur National Monument

This association is known from the Stuntz Draw as it drains to the north from the Yampa Plateau.

Globally

This limber pine woodland association is found in the montane and subalpine zones of the western United States, from Montana, Idaho, and Oregon south to Colorado and Utah. It may also occur in Nevada and California.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association was sampled at a single site within the mapping area, in the head of ravine at 2300 m elevation, with a slope of 37 degrees and a northwest aspect. The soil is a sandy loam, and organic litter completely covers the ground surface.

Globally

This limber pine woodland is found in the montane and subalpine zones of the western United States. It occurs on dry, exposed, rocky sites such as rock outcrops, ridges, slope crests, and high flat benches from 2530 to 3390 m (8300-11,100 feet) in elevation in the southern Rocky Mountains and 1400 to 2530 m (4600-8300 feet) in the northern Rocky Mountains. It also occurs on gentle to moderately steep slopes with variable aspect. Soils are predominantly shallow, coarse-textured, and rapidly drained with high soil-surface temperatures. The ground layer has a high proportion of unvegetated surface that is often composed of gravel and rock.

VEGETATION DESCRIPTION

Dinosaur National Monument

This association is known from only a single occurrence. *Pinus flexilis* has nearly 60% canopy cover and stands over 10 m tall. The understory is lush with a dense cover of shrubs and grasses. *Juniperus communis* dominates the shrub

layer with 60% cover and is accompanied by 20% cover of *Symphoricarpos oreophilus* and *Paxistima myrsinites*. Graminoids present are *Melica bulbosa, Poa fendleriana*, and *Achnatherum hymenoides.*

Globally
The tree canopy of this woodland association is generally open in character and comprised predominantly of *Pinus flexilis*. Tree canopy associates include *Pinus contorta* and *Picea engelmannii* at higher elevations and *Pinus ponderosa* at lower elevations, with *Pseudotsuga menziesii* and occasionally *Pinus albicaulis* in the northern portion of the range. A sparse low-shrub layer is present and characterized by *Juniperus communis*. *Arctostaphylos uva-ursi* also has high constancy in this type, although less total cover than *Juniperus communis*. Additional shrubs can include *Jamesia americana, Paxistima myrsinites, Ribes cereum, Symphoricarpos oreophilus, Vaccinium* spp., and *Juniperus horizontalis*. The herbaceous layer is likewise sparse. Species commonly occurring include *Poa fendleriana, Achnatherum hymenoides, Carex geyeri, Carex rossii, Festuca brachyphylla, Leucopoa kingii, Antennaria rosea, Erigeron flagellaris, Lupinus argenteus, Arenaria fendleri, Frasera speciosa, Geranium caespitosum* var. *fremontii, Penstemon virens, Potentilla fissa*, and *Sedum lanceolatum*. On calcareous substrates in the northern portion of the range, forbs often include *Clematis columbiana, Arnica cordifolia, Eurybia conspicua, Campanula rotundifolia, Galium boreale*, and *Astragalus miser*.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Pinus flexilis*
Short shrub/sapling	*Juniperus communis*
Short shrub/sapling	*Symphoricarpos oreophilus*
Herb (field)	*Paxistima myrsinites*

Globally

Stratum	**Species**
Tree canopy	*Pinus flexilis*
Short shrub/sapling	*Juniperus communis* var. *montana*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
There is overlap in concept between this association (CEGL000807) and *Pinus flexilis / Arctostaphylos uva-ursi* Woodland (CEGL000802). Both associations include stands with woodland understory codominated by *Arctostaphylos uva-ursi* and *Juniperus communis*. Rangewide analysis and review of plots classified to both associations are needed to determine if these similar associations should be combined or somehow refined to better represent the vegetation structure of these stands that occur along the Rocky Mountain cordillera. See Achuff et al. (1997, 2002a) and Johnston (1987) for reviews of some of the pertinent literature. The northern expressions of this type that occur on calcareous substrates differ floristically from the non-calcareous expressions in the rest of the geographic range. With further data, these may warrant recognition as a different type.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: The north-facing ravines in this area have been investigated and no

other *Pinus flexilis* populations were found. The *Pinus flexilis* trees were not healthy, showing drought stress and possibly the effects of a bark beetle infestation.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (1 plot: DINO.0189).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: S.L. Neid, mod. J. Coles and M.S. Reid

REFERENCES: Achuff et al. 1997, Achuff et al. 2002a, Alexander 1986, Baker 1984a, Bourgeron and Engelking 1994, Burns and Honkala 1990a, CONHP unpubl. data 2003, Cole 1982, Driscoll et al. 1984, Hess 1981, Hess and Alexander 1986, Hoffman and Alexander 1980, Johnston 1987, Johnston and Hendzel 1985, Johnston et al. 2001, Jones 1992b, Jones and Ogle 2000, Kagan et al. 2000, MTNHP 2002b, NVNHP 2003, Pfister et al. 1977, Steele et al. 1981, Steele et al. 1983, Wasser and Hess 1982, Western Ecology Working Group n.d.

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	*PINUS PONDEROSA* WOODLAND ALLIANCE (A.530) Ponderosa Pine Woodland Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This open ponderosa pine woodland is described from the southern Rocky Mountains on sites at 2200 to 2865 m (7215-9400 feet) 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
Dinosaur National Monument
This association is known from Douglas Mountain.

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
Dinosaur National Monument
This association occupies sites where at least a veneer of soil has formed over slabs of Uinta Mountain Group sandstone. Elevations range between 2200 and 2400 m, slopes are moderate, and the aspect tends to be easterly. The ground cover is typically litter under the live vegetation, with bare soil and occasional rocks or bedrock exposures between plants.

Globally
This open ponderosa pine woodland is described from the southern Rocky Mountains on sites at 2200 to 2865 m (7215-9400 feet) 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.

VEGETATION DESCRIPTION
Dinosaur National Monument
This woodland association is structurally and floristically diverse. The tree canopy is typically composed of *Pinus ponderosa* with 10 to 30% cover standing 10 to 15 m tall. The subcanopy may include young *Pinus ponderosa* or mature *Pinus edulis, Juniperus osteosperma,* and *Juniperus scopulorum* with less than 10% cover. Tree seedlings of these species are also commonly present. The shrub layer is highly diverse and is dominated by *Artemisia tridentata* ssp. *vaseyana* with 10% cover. *Amelanchier utahensis, Purshia tridentata, Symphoricarpos oreophilus, Ericameria nauseosa,* and dwarf-shrubs *Gutierrezia sarothrae, Mahonia repens, Paxistima myrsinites,* and *Opuntia fragilis* may be present with less cover. Herbaceous species are sparse, diverse, and vary among sites. Grasses commonly present include *Bromus tectorum, Elymus elymoides, Poa secunda*, and *Achnatherum hymenoides*. Forbs include *Eriogonum umbellatum, Phlox multiflora, Achillea millefolium,* and *Heterotheca villosa*.

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 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
Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Pinus ponderosa*
Short shrub/sapling	*Amelanchier alnifolia, Symphoricarpos oreophilus*
Short shrub/sapling	*Artemisia tridentata* ssp. *vaseyana, Purshia tridentata*
Herb (field)	*Mahonia repens*
Herb (field)	*Phlox multiflora*
Herb (field)	*Carex rossii, Poa secunda*

Globally

Stratum	**Species**
Tree canopy	*Pinus ponderosa* var. *scopulorum*
Herb (field)	*Artemisia tridentata* ssp. *vaseyana*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Bromus inermis, Bromus tectorum, Poa pratensis

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (26-May-2005).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association has limited distribution within the monument. It was not found on Split Mountain, which is the other major area of ponderosa pine woodlands.
Dinosaur National Monument Data Sources: This description is based on 2002 field data (2 plots: DINO.0301, DINO.0589).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: K.A. Schulz

REFERENCES: Driscoll et al. 1984, Johnston and Huckaby 2001, Mauk and Henderson 1984

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 feet), 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 ledifoliu*s. 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 also 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 contribute little cover.

DISTRIBUTION
Dinosaur National Monument
This association is known from Pot Creek and Five Springs Draw in the northern section of the monument.

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

Dinosaur National Monument

This association occurs at elevations above 2000 m on Douglas Mountain and Wild Mountain. Exposed bedrock is often associated with the Pinus ponderosa woodlands, and soils are coarse-textured and rapidly drained.

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 feet) in Oregon and 2070 to 2590 m (6800-8500 feet) 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

Dinosaur National Monument

This multi-layered woodland association is dominated by 10 to 20% cover of *Pinus ponderosa*. Tree heights range from 15 to 20 m. Scattered *Pseudotsuga menziesii* may also be present. *Pinus edulis* and *Juniperus osteosperma* may occur in the subcanopy. Seedlings of all tree species are likely to occur. Tall shrubs, 2-5 m high, include Cercocarpus ledifolius with 10% cover and *Amelanchier utahensis* with less cover. Other shrubs present vary in composition among sites and have minimal cover. Typical herbaceous species that occur include *Carex rossii, Poa fendleriana*, and *Heterotheca villosa*.

Globally

This woodland association is characterized by an open canopy up to 20 m tall of *Pinus ponderosa* with a subcanopy or tall-shrub layer of *Cercocarpus ledifolius* up 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 also 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

Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Pinus ponderosa*
Tall shrub/sapling	*Cercocarpus ledifolius*

Globally

Stratum	**Species**
Tree canopy	*Pinus ponderosa* var. *scopulorum*
Tall shrub/sapling	*Cercocarpus ledifolius*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

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

CLASSIFICATION COMMENTS

Dinosaur National Monument

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
Dinosaur National Monument Inventory Notes: There are extensive areas of this association on shallow soils over Uinta Mountain Group geology, throughout the northern third of the monument, especially on the west end of Douglas Mountain.
Dinosaur National Monument Data Sources: This description was derived from 2002 field data (2 plots: DINO.0207, DINO.0539).
Local Description Authors: J. Thompson, mod. J. Coles
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 / Juniperus scopulorum Woodland
Ponderosa Pine / Rocky Mountain Juniper Woodland

CODE	CEGL000861
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
ALLIANCE	*PINUS PONDEROSA* WOODLAND ALLIANCE (A.530) Ponderosa Pine Woodland Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This ponderosa pine community is found along the eastern edge of the Rocky Mountains from the southwestern United States to the Canadian border, and on escarpments into the adjacent Great Plains. Stands have been found on moderate slopes with a variety of aspects, although north- and east-facing are most common. The soils are clay loams, sandy loams, and silt loams. The vegetation contains a moderately open to closed canopy that is 10-20 m tall. *Pinus ponderosa* is the sole dominant species. *Juniperus scopulorum* forms a subcanopy 2-4 m tall. Other shrubs, such as *Cercocarpus montanus* and *Rhus trilobata* var. *trilobata*, are also common. The herbaceous layer is sparse to absent. The plants that do occupy this stratum are mostly graminoids typical of dry prairie, such as Bouteloua curtipendula, *Bouteloua gracilis, Carex filifolia, Piptatherum micranthum, Poa pratensis*, and *Schizachyrium scoparium*.

DISTRIBUTION
Dinosaur National Monument
This association occurs in the high-elevation regions of the monument and specifically Pot Creek, Ecklund Draw, Zenobia Basin and Ruple Point.

Globally
This community is found along the eastern edge of the Rocky Mountains and on escarpments into the adjacent Great Plains, extending from the United States-Canadian border in Montana and North Dakota south to New Mexico.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association occupies plateaus and foothills at elevations typically above 2000 m. Slope angles are gentle to moderate with variable aspects. The substrate is rapidly drained sandy loam interspersed with patches of bedrock.

Globally
This community has been found primarily on slopes between 16-45% with a variety of aspects. In the central and southern portions of its range, it is predominantly on dry-mesic north-or east-facing slopes. In more mesic local climates or with heavier soils this community can exist on south-facing slopes. In North Dakota, Girard et al. (1989) found Pinus ponderosa stands on level to gently sloping (0-15%) mostly south-facing slopes. Throughout its range, the type can be found on bedrock of sandstone, limestone, or shale. Soils are usually well-drained, shallow, very stony, clay loams, silt loams, and sandy loams.

VEGETATION DESCRIPTION
Dinosaur National Monument
This association is characterized by an open canopy (10 to 40% cover) of *Pinus ponderosa*, 10 to 20 m tall, and a subcanopy dominated *by Juniperus scopulorum, Pinus edulis*, and/or *Juniperus osteosperma*. Young trees and tree seedlings of all these species are commonly scattered in the understory. Shrubs are scattered and range from a trace to 5% cover, including *Artemisia tridentata, Purshia tridentata, Amelanchier alnifolia,* and *Ribes cereum*. The herbaceous layer does not exceed 5% cover, and common species include *Carex rossii, Poa fendleriana, Bromus tectorum, Heterotheca villosa,* and *Sedum lanceolatum*.

Globally
This community has a dense to moderately open canopy of *Pinus ponderosa* that is typically 10-20 m high. Most of the trees in the canopy are 20-40 cm dbh (Hoffman and Alexander 1987). *Juniperus scopulorum* forms a subcanopy that is 2-4 m high and is also moderately dense to open. There is usually a shrub layer that contains *Cercocarpus montanus, Rhus trilobata, Symphoricarpos occidentalis*, and *Yucca glauca. Prunus virginiana* is common in Nebraska stands. The herbaceous layer can be sparse or nearly absent, especially under areas of dense canopy or on very steep, eroding slopes. Total vegetation cover averaged 33% in seven stands in southeastern Montana (Brown 1971). Litter can accumulate to a depth of 10 cm or more where conifers are dense (Thilenius et al. 1995). Where the herbaceous layer is well-developed it is dominated by prairie graminoids. These include *Bouteloua curtipendula, Bouteloua gracilis, Carex filifolia, Piptatherum micranthum, Poa pratensis, Pseudoroegneria spicata*, and *Schizachyrium scoparium.*

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Pinus ponderosa*
Tree subcanopy	*Juniperus scopulorum*

Globally

Stratum	**Species**
Tree canopy	*Pinus ponderosa*
Tree subcanopy	*Juniperus scopulorum*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Bouteloua gracilis, Cercocarpus montanus, Rhus trilobata

CONSERVATION STATUS RANK
Global Rank & Reasons: G4 (1-Sep-1999). This type is fairly widespread across the states where it occurs, though it is not known to be common in any part of its range. Protection status across the range of this type is unknown.

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Type needs a thorough regional review. Stands in the Black Hills have been described by Marriott and Faber-Langendoen (2000).

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Data are not available.
Dinosaur National Monument Data Sources: This association is described from 2004 field data (4 plots: DINO.0217, DINO.0232, DINO.0243, DINO.0506).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Drake and D. Faber-Langendoen

REFERENCES: Brown 1971, Driscoll et al. 1984, Girard et al. 1989, Hoffman and Alexander 1987, Johnston 1987, MTNHP 2002b, Midwestern Ecology Working Group n.d., NDNHI n.d., Roberts 1980, Steinauer 1989, Steinauer and Rolfsmeier 2000, Thilenius et al. 1995, Von Loh et al. 2000, Watson 1912

Pinus ponderosa / Rockland Woodland
Ponderosa Pine / Rockland Woodland

CODE	CEGL000877
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
ALLIANCE	*PINUS PONDEROSA* WOODLAND ALLIANCE (A.530) Ponderosa Pine Woodland Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This sparse *Pinus ponderosa* woodland occurs on extensive bedrock outcrop substrate in the southern Rocky Mountains from northern Colorado south to New Mexico and Arizona. It occurs over exposures of sandstone, basalt or granite on gentle to steep slopes (10-60%) with primarily south-facing aspects, although it can occur on other aspects provided the bedrock substrate is present. Elevation range for this association is from 2000 to 2760 m (6560-9040 feet). Soils are shallow (<10 cm) and restricted to joints in bedrock outcrops. The sparse canopy is dominated by Pinus ponderosa with up to 50% cover. Trees are often stunted and grow from rock fissures. *Pseudotsuga menziesii, Juniperus osteosperma, Juniperus scopulorum, Pinus edulis,* or *Pinus strobiformis* may be present as associates. Natural regeneration of canopy species tends to be very slow. Shrub and herb layers are variable and sparse. Shrubs tend to occur in scattered patches between boulders and bedrock. Species can include *Amelanchier* spp., *Quercus gambelii, Quercus grisea, Arctostaphylos uva-ursi, Cercocarpus montanus, Fallugia paradoxa, Jamesia americana, Juniperus communis, Purshia tridentata, Ribes cereum, Symphoricarpos oreophilus,* or *Yucca* spp. Herbaceous cover is likewise patchy. *Muhlenbergia montana* occurs with highest constancy. Additional graminoids include *Muhlenbergia virescens, Festuca arizonica, Elymus arizonicus, Calamagrostis purpurascens, Carex geophila, Bouteloua curtipendula, Blepharoneuron tricholepis, Poa fendleriana,* and *Schizachyrium scoparium.* Forbs are variable but can be diverse. In addition to the sparse *Pinus ponderosa* canopy, exposed bedrock is diagnostic for this association and can have from 50-90% cover. Lichen and moss growing on exposed bedrock can be extensive.

DISTRIBUTION
Dinosaur National Monument
This association is known from Split Mountain, Pot Creek, Ecklund Draw, Buck Ridge, Ruple Point, Yampa Plateau, Five Springs Draw, and Zenobia Peak. The Mowry shale site is in Deerlodge Park.

Globally
This *Pinus ponderosa* woodland on bedrock outcrop substrate occurs in the southern Rocky Mountains from northern Colorado and Utah south to New Mexico and Arizona.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument

This association occupies areas of shallow soils with much exposed bedrock at the highest elevations of the monument. Sites typically occur on Uinta Mountain Group and Weber sandstones at elevations ranging from 2000 to 2400 m. A majority of the ground surface is sandstone slabs and large rocks and boulders, although the rock may be obscured by pine needle litter. Soils are coarse-textured and rapidly drained. An atypical site occurs on an exposure of Mowry shale at 1700 m elevation.

Globally
This sparse *Pinus ponderosa* woodland occurs over extensive bare rock outcrops on gentle to steep slopes (10-60%) with primarily south-facing aspects, although it can occur on other aspects provided the bedrock substrate is present. Elevation ranges from 2000 to 2760 m (6560-9040 feet). Soils are shallow (<10 cm) and restricted to crevices in bedrock outcrops. The exposed substrate may be granite, sandstone, basalt or quartzite. Up to 90% the ground surface is sandstone slabs and large rocks and boulders, although the rock may be obscured by pine needle litter. In addition to the sparse *Pinus ponderosa* canopy, exposed bedrock is diagnostic for this association.

VEGETATION DESCRIPTION
Dinosaur National Monument
This woodland association has a simple structure for a woodland. The open tree canopy, over 15 m tall, is dominated by *Pinus ponderosa*. Canopy cover ranges from 10 to 50%. There is no developed subcanopy, but scattered individuals of *Pinus ponderosa, Juniperus scopulorum, Juniperus osteosperma*, and *Pinus edulis* provide 1 to 10% cover. Conifer tree seedlings are also commonly present. Scattered shrubs in the understory may include *Amelanchier* spp., *Purshia tridentata, Artemisia tridentata*, and *Symphoricarpos oreophilus*; however, shrub cover rarely exceeds 5%. The herbaceous understory is sparse but diverse. Species most commonly present include *Poa fendleriana, Elymus elymoides, Bromus tectorum, Heterotheca villosa, Arenaria congesta, Sedum lanceolatum*, and *Petradoria pumila*.

Globally
The sparse canopy of this rock outcrop woodland is dominated by *Pinus ponderosa* with 10-50% cover. Trees are often stunted and grow from rock fissures. *Pseudotsuga menziesii, Pinus strobiformis, Juniperus scopulorum, Juniperus osteosperma*, or *Pinus edulis* may be present as associates. Natural regeneration of canopy species tends to be very slow because of the lack of suitable germination sites. Shrub and herb layers are variable and sparse. Shrubs tend to occur in scattered patches between boulders and bedrock. Species can include *Amelanchier* spp., *Artemisia tridentata, Symphoricarpos oreophilus, Quercus gambelii, Quercus grisea, Arctostaphylos uva-ursi, Cercocarpus montanus, Fallugia paradoxa, Jamesia americana, Juniperus communis, Purshia tridentata, Ribes cereum*, or *Yucca* spp. Herbaceous cover is likewise patchy. *Muhlenbergia montana* occurs with highest constancy. Additional graminoids include *Muhlenbergia virescens, Festuca arizonica, Elymus arizonicus, Calamagrostis purpurascens, Carex geophila, Bouteloua curtipendula, Blepharoneuron tricholepis, Poa fendleriana, Elymus elymoides*, and *Schizachyrium scoparium*. Forbs are variable but can be diverse. Species can include *Solidago* spp., *Artemisia ludoviciana, Geranium* spp., *Heterotheca villosa, Sedum lanceolatum, Arenaria congesta, Petradoria pumila, Packera fendleri*, and *Potentilla fissa*. In addition to the sparse *Pinus ponderosa* canopy, exposed bedrock is diagnostic for this association and can have from 50-90% cover. Lichen and moss growing on exposed bedrock can be extensive.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Pinus ponderosa*
Tree subcanopy	*Juniperus osteosperma, Juniperus scopulorum, Pinus edulis*

Globally

Stratum	**Species**
Tree canopy	*Pinus ponderosa* var. *scopulorum*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Bromus tectorum

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This community is typical of uplands on hard sandstones or impermeable shales, especially on Douglas Mountain and Split Mountain. Soils are shallow, and stands are typically open with much exposed bedrock and a sparse shrub layer. Ponderosa pines may be stunted in the most exposed areas.
Dinosaur National Monument Data Sources: This description is based on 2002 field data (18 plots: DINO.0144, DINO.0215, DINO.0217, DINO.0232, DINO.0243,DINO.0257, DINO.0300, DINO.0374, DINO.0485, DINO.0506, DINO.0526, DINO.0528, DINO.0536, DINO.0560, DINO.0569, DINO.0590, DINO.0593, DINO.0604).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: S.L. Neid, mod. J. Coles

REFERENCES: Alexander et al. 1987, Bourgeron and Engelking 1994, Driscoll et al. 1984, Fitzhugh et al. 1987, Larson and Moir 1986, Larson and Moir 1987, Lindsey 1951, Western Ecology Working Group n.d.

Pseudotsuga menziesii / Acer negundo Woodland
Douglas-fir / Box-elder Woodland

CODE	CEGL002754
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Conical-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.b.)
ALLIANCE	*PSEUDOTSUGA MENZIESII* WOODLAND ALLIANCE (A.552) Douglas-fir Woodland Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This mixed-canopy woodland association has been documented from cold, narrow, high-gradient tributary canyons in Dinosaur National Monument and Mesa Verde National Park in western Colorado and northeastern Utah. Elevations range from 1600 to 2344 m (5250-7740 feet). Sites are rocky and subject to periodic flash flooding. The canopy consists of *Pseudotsuga menziesii* with a subcanopy of *Acer negundo*. Other tree species present include *Populus angustifolia* and *Juniperus scopulorum*. The shrub layer is variable but may include *Amelanchier utahensis, Prunus virginiana, Rosa woodsii, Rhus trilobata,* and *Symphoricarpos oreophilus*. Herbaceous species have low to moderate cover.

DISTRIBUTION
Dinosaur National Monument
This association is known from ravines feeding into Rippling Brook and Jones Hole Creek. It is also likely to occur in other steep, north- and east-facing ravines tributary to the Green River.

Globally
This association has been documented from Mesa Verde National Park and Dinosaur National Monument in western

Colorado and in northeastern Utah.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association straddles steep, rocky ravines, with easterly or northerly aspects. Elevation ranges from 1600 to 2344 m. The sandy clay substrate is strewn with large rocks, boulders, wood and leaf litter. These steep ravines are especially subject to flash flood and debris flow events.

Globally

This mixed-canopy woodland association has been documented from cold, narrow, high-gradient tributary canyons in Dinosaur National Monument and Mesa Verde National Park in western Colorado and northeastern Utah. Elevations range from 1600 to 2344 m (5250-7740 feet). Sites are rocky and subject to periodic flash flooding. Substrates are coarse-textured soils derived from alluvium.

VEGETATION DESCRIPTION

Dinosaur National Monument

This association is characterized by a dense tree canopy and subcanopy. *Pseudotsuga menziesii* dominates the tree canopy and is 10 to 15 m tall; *Acer negundo* dominates the subcanopy. Other trees that may be present in either canopy are *Populus angustifolia* and *Juniperus scopulorum*. Shrub species cover is variable and may include *Rosa woodsii, Prunus virginiana* var. *melanocarpa, Amelanchier utahensis*, and *Rhus trilobata*. Herbaceous species are absent or have minimal cover.

Globally

This mixed-canopy woodland association consists of *Pseudotsuga menziesii* with a subcanopy of *Acer negundo*. Other tree species present include *Populus angustifolia* and *Juniperus scopulorum*. The mixed shrub layer is variable but may include *Amelanchier utahensis, Prunus virginiana, Rhus trilobata, Ribes aureum, Rosa woodsii*, and *Symphoricarpos oreophilus*. Herbaceous species have low to moderate cover. Common species include *Carex occidentalis, Thalictrum fendleri*, and other mesic species.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Pseudotsuga menziesii*
Tree subcanopy	*Acer negundo*
Short shrub/sapling	*Rosa woodsii*

Globally

Stratum	**Species**
Tree canopy	*Pseudotsuga menziesii*
Tree subcanopy	*Acer negundo*
Short shrub/sapling	*Rosa woodsii, Symphoricarpos oreophilus*
Herb (field)	*Carex occidentalis*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (12-Apr-2005).

CLASSIFICATION COMMENTS

Dinosaur National Monument

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is limited to narrow, deep, cool canyons. Also, the combination of dominant species adds to its uniqueness. These sites are also very difficult to access and are not likely to be documented often.
Dinosaur National Monument Data Sources: This association is described from 2002 field data (1 plot: DINO.0228, and 2 observation points: DINO.9018, DINO.9155).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: K.A. Schulz

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	*PSEUDOTSUGA MENZIESII* WOODLAND ALLIANCE (A.552) Douglas-fir Woodland Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This 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 ridgetops, plateau rims or colluvial upper slopes. Elevations range from 1220 m (4000 feet) in central Oregon to over 2750 m (9025 feet) in southern Utah. Sites are often subject to year-round winds and intense insolation, which contribute to reduced snowpacks 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. 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
Dinosaur National Monument
This association is known from Douglas Mountain and Cottonwood Canyon on the Yampa Bench.

Globally
This is a fairly 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
Dinosaur National Monument

This association occupies rocky ridges, sandstone rims or protected colluvial slopes at elevations above 2300 m. Soils are shallow, sandy and strewn with leaf litter, downed wood and boulders.

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 ridgetops, plateau rims or upper colluvial slopes. Elevations range from 1220 m (4000 feet) in central Oregon to over 2750 m (9025 feet) in southern Utah. Sites are often subject to year-round winds and intense insolation, which contribute to reduced snowpacks 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
Dinosaur National Monument
This woodland association is characterized by *Pseudotsuga menziesii*, as one to several trees, 10 m tall with 5 to 10% cover. *Pseudotsuga menziesii* may also occur in the subcanopy, typically 2-5 m tall, and accompanied by *Cercocarpus ledifolius, Juniperus scopulorum, Juniperus osteosperma,* and *Pinus edulis,* totaling 10 to 30% cover. Shrubs most commonly present in the next lower stratum include *Amelanchier utahensis* and *Symphoricarpos oreophilus*. Herbaceous species are inconsistent among sites and have minimal cover.

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
Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Pseudotsuga menziesii*
Tall shrub/sapling	*Cercocarpus ledifolius*

Globally

Stratum	**Species**
Tree canopy	*Pseudotsuga menziesii*
Tall shrub/sapling	*Cercocarpus ledifolius*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

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 very threatened, nor are they particularly sensitive. They are important for wildlife, are fairly unique, and are pretty different in character throughout their range. With additional study, it is likely that this type will be split into two additional 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
Dinosaur National Monument
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 also 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
Dinosaur National Monument Inventory Notes: Cercocarpus ledifolius may occur in tree or shrub form.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (1 plot: DINO.0538, 1 observation point: DINO.9421).
Local Description Authors: J. Thompson, mod. J. Coles
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	*PSEUDOTSUGA MENZIESII* WOODLAND ALLIANCE (A.552) Douglas-fir Woodland Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This 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 feet) 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 may include the graminoids *Carex rossii, Achnatherum hymenoides, Hesperostipa comata, Poa fendleriana*, and *Poa secunda*.

DISTRIBUTION

Dinosaur National Monument

This association is unusual in the monument. It was sampled near the Canyon Overlook (Harper's Corner Road) and near Zenobia Peak.

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 also in the foothills of southwestern Colorado.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs on steep (30-35 degrees), west- to northwest-facing slopes on upper canyon walls between 2223 and 2572 m elevation. Litter covers most of the ground surface, with lesser cover by rocks, bare soil and gravel. Soils are coarse and derived from sandstone or quartzite colluvium of the Weber Sandstone or Uinta Mountain Group.

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 feet) 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

Dinosaur National Monument

This xeric Douglas-fir woodland type is restricted in the monument. Total vegetation is around 35%. The open canopy consists of *Pseudotsuga menziesii* trees up to 25 m tall with between 15 and 35% cover. A subcanopy of scattered Juniperus osteosperma and *Pinus edulis* trees occupies openings between the Douglas-fir crowns and provides up to 15% additional cover. The shrub layer may have as much or more cover than the tree canopy; it ranges between 15 and 25%. *Cercocarpus montanus* is the dominant shrub; other shrubs generally present include *Amelanchier* spp., *Cercocarpus intricatus, Philadelphus microphyllus, Symphoricarpos oreophilus*, and occasionally more mesic shrubs such as *Prunus virginiana*. The herbaceous layer does not exceed 10% cover and is dominated by *Poa fendleriana*. Other herbaceous species present vary among sites but may include *Stenotus acaulis, Achnatherum nelsonii, Poa secunda, Achnatherum hymenoides*, and *Eriogonum umbellatum*.

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

Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Pseudotsuga menziesii*
Tree subcanopy	*Pinus edulis*
Short shrub/sapling	*Cercocarpus intricatus, Cercocarpus montanus*
Herb (field)	*Poa fendleriana*

Globally

Stratum	Species
Tree canopy	*Pseudotsuga menziesii*
Tall shrub/sapling	*Cercocarpus montanus*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
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
Dinosaur National Monument Inventory Notes: Plots were on drier slopes; in adjacent mesic stands, *Symphoricarpos oreophilus* dominates the understory. In areas with soil cover, a *Pseudotsuga menziesii* forest exists, but there is still cover from pinyon and juniper.
Dinosaur National Monument Data Sources: This association is described from 2005 accuracy assessment data (3 plots: DINO_AA.A0012, DINO_AA.A0024, DINO_AA.A0030).
Local Description Authors: J. Coles
Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Youngblood and Mauk 1985

Pseudotsuga menziesii / Poa fendleriana Woodland
Douglas-fir / Muttongrass Woodland

CODE	CEGL002809
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Conical-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.b.)
ALLIANCE	*PSEUDOTSUGA MENZIESII* WOODLAND ALLIANCE (A.552) Douglas-fir Woodland Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This woodland association is only known from a few stands in Curecanti National Recreation Area in western Colorado and from Dinosaur National Monument in Utah. Stands occupy the slopes of canyons and gulches and are on moderately steep to steep (38-70%) sites, between 2178 and 2363 m elevation, and are oriented to northerly aspects.

Soils are rapidly drained, coarse-textured and derived from sedimentary rocks. The vegetation is characterized by an open to moderately dense (25 to 50%) tree canopy 10-35 m tall composed of *Pseudotsuga menziesii*, with an open to moderately dense herbaceous layer dominated by the short bunchgrass *Poa fendleriana* providing 5 to 25% cover. Single trees of *Pinus ponderosa* may occur in the canopy, and scattered sapling *Pseudotsuga menziesii* and *Juniperus scopulorum* 2-10 m tall form an open subcanopy. Shrubs are generally present but too sparse to constitute a stratum; *Cercocarpus montanus, Cercocarpus intricatus, Artemisia tridentata, Ribes* spp., *Quercus gambelii*, and *Symphoricarpos oreophilus* are common species. The remaining herbaceous layer is mostly composed of graminoids, such as *Achnatherum hymenoides, Elymus elymoides, Koeleria macrantha, Poa secunda*, and sparse cover of forbs. *Pseudoroegneria spicata* is absent. Lichens and mosses provide to 25% cover.

DISTRIBUTION

Dinosaur National Monument

This association is rare in the monument and was sampled only once, on Split Mountain.

Globally

This association is only known from the Curecanti National Recreation Area in western Colorado along the Gunnison River and West Elk Creek. It was also sampled on Split Mountain in Dinosaur National Monument in eastern Utah and at Canyon de Chelly in Arizona. More survey and classification work are needed to document the global range of this association.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs on a steep (32 degrees), northeast-facing slope on upper canyon walls at 2178 m elevation. Litter and dead wood cover most of the ground surface, with lesser cover by rocks and gravel. Soils are coarse and derived from sandstone colluvium.

Globally

This woodland association is known from only a handful of stands in the Curecanti National Recreation Area and Dinosaur National Monument in western Colorado. More survey and classification work are needed to document the global range of this association. Stands occur on the slopes of canyons and gulches and are on moderately steep to steep (38-70%) sites, between 2178 and 2363 m (7155-7750 feet) elevation, and are oriented to northwest to northeast aspects. Litter, rocks and downed wood cover most of the unvegetated surface. Soils are rapidly drained sandy loam or loamy sand derived from sandstone, alluvium or shale.

VEGETATION DESCRIPTION

Dinosaur National Monument

This xeric Douglas-fir woodland type was sampled once in the monument on a sheltered but well-drained slope. Total vegetation cover does not exceed 45%. The open canopy consists of *Pseudotsuga menziesii* trees up to 15 m tall with 30% cover. A few large *Pinus ponderosa* are also scattered throughout the canopy, with not more than 10% cover. A subcanopy of scattered *Juniperus osteosperma* and *Pinus edulis* trees occupies openings between the Douglas-fir crowns and provides up to 5% additional cover. *Cercocarpus intricatus* was the only shrub recorded in the sparse understory, with trace cover. The herbaceous layer does not exceed 10% cover and is dominated by *Poa fendleriana*. *Pseudoroegneria spicata* is absent. No forb species were recorded in the sample plot.

Globally

The vegetation is characterized by an open to moderately dense (25 to 50%) tree canopy 10-35 m tall composed of *Pseudotsuga menziesii*, with an open to moderately dense herbaceous layer dominated by the short bunchgrass *Poa fendleriana* providing 5 to 25% cover. Large *Pinus ponderosa* may be scattered throughout the canopy, with not more than 10% cover. Scattered young *Pseudotsuga menziesii* and *Juniperus scopulorum* 2-10 m tall form a subcanopy. Shrubs are generally present but do not provide enough cover to constitute a stratum; *Cercocarpus montanus, Cercocarpus intricatus, Artemisia tridentata, Ribes cereum, Ribes inerme, Quercus gambelii*, and *Symphoricarpos oreophilus* are common species. The remaining herbaceous layer is moderately diverse and mostly composed of graminoids, such as *Achnatherum hymenoides, Elymus elymoides, Koeleria macrantha*, and *Poa secunda. Pseudoroegneria spicata* is absent. Forbs are sparse and inconsistent among sites; recorded species include *Arenaria congesta, Artemisia frigida, Clematis* sp., and *Erigeron* sp. Lichens and mosses provide up to 25% cover.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Tree canopy	*Pseudotsuga menziesii*
Herb (field)	*Poa fendleriana*

Globally

Stratum	Species
Tree canopy	*Pseudotsuga menziesii*
Herb (field)	*Poa fendleriana*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (27-Jun-2005).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
This association has only been documented from two locations in Curecanti National Recreation Area and one site in Dinosaur National Monument in western Colorado and adjacent Utah. More survey and classification work are needed to change the provisional status of this association.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This point is a dry Douglas-fir woodland with some large ponderosa pine, pinyon and juniper coming in. This point has sparse understory, with one *Cercocarpus intricatus* shrub and clumps of *Poa fendleriana*.
Dinosaur National Monument Data Sources: This association is described from 2005 accuracy assessment data (1 plot: DINO_AA.A0040).
Local Description Authors: J. Coles
Global Description Authors: K.A. Schulz and J. Coles

REFERENCES: Western Ecology Working Group n.d.

Pseudotsuga menziesii / Pseudoroegneria spicata Woodland
Douglas-fir / Bluebunch Wheatgrass Woodland

CODE	CEGL000908
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Conical-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.b.)
ALLIANCE	*PSEUDOTSUGA MENZIESII* WOODLAND ALLIANCE (A.552) Douglas-fir Woodland Alliance
ECOLOGICAL SYSTEM(S):	Middle Rocky Mountain Montane Douglas-fir Forest and Woodland (CES306.959) Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823) Northern Rocky Mountain Ponderosa Pine Woodland and Savanna (CES306.030)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This dry Douglas-fir woodland type occurs in scattered stands throughout the interior northwestern United States and British Columbia. Slopes are generally steeper than 20% and can exceed 70% in the southern part of the range. Elevations range from 500 m (1640 feet) in British Columbia to around 2200 m (7200 feet) in northwestern Colorado. Aspect likewise varies, with warm southerly aspects preferred in the northern part of the range to cool, sheltered north-facing slopes at the southern extreme. Soils may be derived from any mineral parent material but are generally coarse-textured, rocky and poorly developed due to constant downslope movement. The vegetation is characterized by an open canopy of *Pseudotsuga menziesii* with 25 to 35% cover, often accompanied by scattered *Pinus ponderosa* or, less often, *Pinus flexilis*. Shrubs such as *Amelanchier alnifolia, Prunus virginiana, Ribes cereum, Purshia tridentata, Spiraea betulifolia, Symphoricarpos oreophilus, Arctostaphylos uva-ursi*, and *Mahonia repens* are generally present but have less than 10% total cover. The herbaceous layer is diverse and has moderate to high cover of grasses. *Pseudoroegneria spicata* is the dominant grass with up to 35% cover. Other graminoids present may include *Carex geyeri* and *Festuca idahoensis* in the northern part of the range and *Melica bulbosa* and *Poa fendleriana* in the southern part of the range. Forbs are diverse: *Balsamorhiza sagittata* is the most consistent species, but most stands have a dozen species of forbs or more. *Bromus tectorum* is common to abundant in degraded stands.

DISTRIBUTION

Dinosaur National Monument

This association is rare in the monument and was sampled near Harper's Corner. It may occur in small stands on the upper parts of any of the north-facing walls of Whirlpool, Split Mountain and Yampa canyons.

Globally

This type has been reported from interior British Columbia (McLean 1970), central Montana (Pfister 1977), eastern Washington, northeastern Oregon (Cole 1982), central Idaho (Steele et al. 1981) and northwestern Colorado. It is likely to occur in Utah. The range of the principal species extends south into Arizona and New Mexico and north throughout western Canada, so it may be more widespread than is currently known.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occupies steep (up to 37 degrees), northwest-facing slopes on upper canyon walls between 2190 and 2260 m elevation. Litter covers most of the ground surface, with lesser cover by rocks and gravel. Soils are coarse and derived from sandstone colluvium.

Globally

This xeric Douglas-fir woodland type is documented from scattered stands in Montana, Idaho, Oregon, Washington and Colorado. Stands occupy moderate to steep, dry slopes (U.S.) or alluvial fans (Canada), usually at or near the lower elevational limit of Douglas-fir. In British Columbia, this association occupies west- and south-facing slopes below 1000 m (3280 feet); in Oregon, stands occur on south-facing slopes below 1600 m (5250 feet); in Idaho the range is south-facing slopes between 1160 and 2290 m (3800-7500 feet); stands in west-central and central Montana extend from 1525 to 1980 m (5000-6500 feet); and Colorado stands are oriented to the north at around 2200 m (7200 feet). Slopes are generally steeper than 20% and can exceed 70% in the southern part of the range. Soils are coarse-textured, rapidly drained, usually rocky and are derived from sedimentary, metamorphic, volcanic and granitic parent materials.

VEGETATION DESCRIPTION

Dinosaur National Monument

This xeric Douglas-fir woodland type is restricted to shallow soils on steep, sheltered, north-facing slopes. Total vegetation cover rarely exceeds 55%. The open canopy consists of *Pseudotsuga menziesii* trees up to 20 m tall with between 15 and 35% cover. A subcanopy of scattered *Juniperus osteosperma* and *Pinus edulis* trees occupies openings between the Douglas-fir crowns and provides up to 10% additional cover. Shrubs are present but do not constitute a layer; common species include *Symphoricarpos oreophilus* and *Artemisia tridentata* ssp. *vaseyana*. The herbaceous layer is well-developed and diverse. *Pseudoroegneria spicata* is the dominant species with up to 15% cover and is generally accompanied by *Poa fendleriana* as a codominant. *Petradoria pumila* was the only other herbaceous species recorded in the two sample plots.

Globally
This association is characterized by an open canopy of *Pseudotsuga menziesii* with 25 to 35% cover, often accompanied by scattered *Pinus ponderosa* or, less often, *Pinus flexilis*. Shrubs such as *Amelanchier alnifolia, Prunus virginiana, Ribes cereum, Purshia tridentata, Spiraea betulifolia, Symphoricarpos oreophilus, Arctostaphylos uva-ursi*, and *Mahonia repens* are generally present but have less than 10% cover. The herbaceous layer is diverse and has moderate to high cover of grasses; the higher the tree canopy cover, the lower the herbaceous cover. *Pseudoroegneria spicata* is the dominant grass with up to 35% cover. Other graminoids present include *Carex geyeri* and *Festuca idahoensis* in the northern part of the range and *Poa fendleriana* in the southern part of the range. Forbs are diverse: *Balsamorhiza sagittata, Achillea millefolium, Petradoria pumila, Lomatium dissectum, Lupinus leucophyllus, Maianthemum racemosum, Antennaria* sp., and *Fragaria vesca* are among the more common species. *Bromus tectorum* is common to abundant in degraded stands.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	Species
Tree canopy	*Pseudotsuga menziesii*
Tree subcanopy	*Juniperus osteosperma*, *Pinus edulis*
Herb (field)	*Poa fendleriana*, *Pseudoroegneria spicata*

Globally

Stratum	Species
Tree canopy	*Pseudotsuga menziesii*
Herb (field)	*Pseudoroegneria spicata*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Bromus tectorum

CONSERVATION STATUS RANK
Global Rank & Reasons: G4 (1-Feb-1996). Because *Pseudotsuga menziesii* and *Pseudoroegneria spicata* are broadly distributed throughout the interior western United States and Canada, it is likely that this association is more widespread than current documentation shows. Stands are likely to be small, isolated and scattered except in the central part of the range of the two principal species (Montana, Idaho, Oregon).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
This association is restricted to cool, steep slopes where rock outcrops and shallow soils create a relatively xeric microclimate. The diagnostic features of this type are an open canopy of *Pseudotsuga menziesii* with a primarily herbaceous understory dominated by *Pseudoroegneria spicata*.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is restricted to cool, steep slopes where rock outcrops and shallow soils create a relatively xeric microclimate. The diagnostic features of this type are an open canopy of *Pseudotsuga menziesii* with a primarily herbaceous understory dominated by *Pseudoroegneria spicata*.
Dinosaur National Monument Data Sources: This association is described from 2005 accuracy assessment data (2 plots: DINO_AA.A0008, DINO_AA.A0023).
Local Description Authors: J. Coles
Global Description Authors: J. Coles

REFERENCES: Bourgeron and Engelking 1994, Cole 1977b, Cole 1982, Cooper et al. 1987, Driscoll et al. 1984, Kagan et al. 2000, MTNHP 2002b, McLean 1970, Pfister 1977, Pfister et al. 1977, Steele et al. 1981

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	*CERCOCARPUS LEDIFOLIUS* 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 feet) in Oregon and around 2750 m (9025 feet) 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 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.

DISTRIBUTION

Dinosaur National Monument

This association is limited to rocky soils of the Lodore Formation and Uinta Mountain Group at the highest elevations of the park. Sample plots are located on Zenobia Peak and in Jack Springs Draw. It is likely to occur throughout the range of Cercocarpus ledifolius woodlands on Douglas Mountain.

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

Dinosaur National Monument

This Great Basin woodland occupies moderate to steep mountain slopes and benches (11 to 31 degrees) oriented to any aspect. Elevations are among the highest in the park; stands were sampled between 2200 and 2580 m. Soils are generally coarse and rocky and are derived from Lodore Formation and Uinta Mountain Group.

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 feet) in Oregon and around 2750 m (9025 feet) in Utah and Colorado. Aspects are variable with slopes ranging from 0-60%.

VEGETATION DESCRIPTION

Dinosaur National Monument

This evergreen, broadleaf woodland is characterized by a moderate (20 to 30% cover) canopy dominated by *Cercocarpus ledifolius* trees or tall shrubs. The shrub-dominated understory varies greatly in cover depending on the degree of *Cercocarpus* canopy closure; closed-canopy stands have around 20% cover, whereas the more open stands have upwards of 30% shrub cover. *Artemisia tridentata* ssp. *vaseyana* or *Artemisia tridentata* ssp. *wyomingensis* dominates the shrub layer; associated species include *Amelanchier alnifolia, Cercocarpus montanus, Ribes cereum, Paxistima myrsinites,* and *Symphoricarpos oreophilus*. The herbaceous layer is likewise variable in cover and composition, ranging between 5 and 25% cover. Common graminoids include *Poa secunda* and *Achnatherum nelsonii*; common forbs include *Petradoria pumila, Balsamorhiza sagittata*, and *Allium acuminatum*.

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
Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Amelanchier alnifolia*, *Ribes cereum*, *Symphoricarpos oreophilus*
Short shrub/sapling	*Artemisia tridentata* ssp. *vaseyana*, *Cercocarpus ledifolius*, *Cercocarpus montanus*
Herb (field)	*Koeleria macrantha, Poa secunda, Pseudoroegneria spicata*

Globally

Stratum	**Species**
Tree canopy	*Cercocarpus ledifolius*
Short shrub/sapling	*Artemisia tridentata*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum, Poa bulbosa

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
Dinosaur National Monument
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

Dinosaur National Monument Inventory Notes: The presence of *Artemisia tridentata* in the understory reflects the presence of slightly deeper soils and drier conditions than other types of *Cercocarpus ledifolius* woodlands. Younger stands tend to be in the form of mixed tall shrublands; mature stands are mid-sized, single-trunked trees with a sparser shrub and herbaceous understory.
Dinosaur National Monument Data Sources: This association is described from 2005 accuracy assessment data (3 plots: DINO_AA.A0842, DINO_AA.B0454, DINO_AA.A0444).
Local Description Authors: J. Coles
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.

Elaeagnus angustifolia Semi-natural Woodland
Russian-olive Semi-natural Woodland

CODE	CEGL005269
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	*ELAEAGNUS ANGUSTIFOLIA* SEMI-NATURAL WOODLAND ALLIANCE (A.3566) Russian-olive Semi-natural Woodland Alliance
ECOLOGICAL SYSTEM(S):	Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821) Western Great Plains Floodplain (CES303.678) 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:	Not applicable

CONCEPT SUMMARY
Globally
This widespread Russian-olive woodland type is found in the northern Great Plains, Colorado Plateau, and probably throughout much of the western United States and adjacent Canada. It is a naturalized species that has been widely planted in hedgerows for windbreaks. It has since spread to a variety of native habitats, particularly more mesic ones, such as near streams and rivers, although small upland stands are also known. The vegetation is dominated by *Elaeagnus angustifolia*, sometimes accompanied by *Tamarix* spp. Remnant *Populus fremontii* trees may remain as canopy emergents. Stands may be small and linear. The vegetation is dominated by the tree *Elaeagnus angustifolia* with a variety of native and introduced species in the shrub and herbaceous layers. Associated species have not been characterized. Canopy closure is between 40 and 50%., Shrub cover is provided by *Salix exigua* and *Amorpha fruticosa. Pascopyrum smithii, Sporobolus airoides, Distichlis spicata,* and *Hordeum jubatum* comprise the herbaceous layer in some stands; in others the understory is dominated by introduced species, such as *Lepidium latifolium*, *Descurainia sophia*, and *Bassia scoparia*.

DISTRIBUTION
Dinosaur National Monument
This association occurs in small reaches along the Green and Yampa rivers and is best developed along the Green River below Green River campground.

Globally
This widespread Russian-olive woodland type is reported from the northern Great Plains, Colorado Plateau, and probably occurs throughout much of the western United States and adjacent Canada along rivers and streams, where it replaces native *Populus* spp.- and *Acer negundo*-dominated forests and woodlands.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument
This association occupies riverbanks and terraces at elevations on the Green River below 1600 m. The soil texture is sandy alluvium, and the nonvegetated ground cover is primarily organic litter.

Globally
This woodland type is naturalized throughout the interior West and Great Plains, probably spreading as a result of *Elaeagnus angustifolia* being widely planted in hedgerows for windbreaks. It has spread to a variety of native habitats, particularly more mesic ones, such as riverbanks, stream terraces and shorelines. Stands also occur in upland basins and drainages. Stands may be small and linear, but many extend for great distances along streams. Adjacent vegetation includes other riparian shrublands and wetlands dominated by *Salix exigua* or *Scirpus* and/or *Schoenoplectus* spp. Upland vegetation is variable.

VEGETATION DESCRIPTION
Dinosaur National Monument
Dense cover of *Elaeagnus angustifolia* characterizes this riparian woodland association. *Tamarix ramosissima* may be present with lesser cover. The tall-shrub layer may include *Rhus trilobata , Artemisia tridentata* ssp. *tridentata*, and *Chrysothamnus linifolius*. The herbaceous understory is variable in composition and abundance. Some species known to occur include *Eleocharis palustris, Glycyrrhiza lepidota, Lepidium latifolium, Spartina pectinata, Xanthium strumarium*, and *Bromus tectorum*.

Globally
The vegetation is dominated by the tree *Elaeagnus angustifolia* with a variety of native and introduced species in the shrub and herbaceous layers. Canopy closure is open to moderately dense (25-50% cover). In the Colorado Plateau, *Tamarix ramosissima* may be present in the tree canopy with less cover than *Elaeagnus angustifolia*, or relict *Populus deltoides* or *Populus fremontii* trees may remain as canopy emergents. Shrubs in the understory include *Salix exigua, Rhus trilobata, Artemisia tridentata* ssp. *tridentata, Chrysothamnus linifolius*, and *Amorpha fruticosa*. The herbaceous understory is variable in composition and abundance depending on location. Some species known to occur include *Atriplex patula, Distichlis spicata, Eleocharis palustris, Euthamia occidentalis, Glycyrrhiza lepidota, Grindelia* sp., *Hordeum jubatum, Muhlenbergia asperifolia, Pascopyrum smithii, Spartina pectinata*, and *Sporobolus airoides*. Exotic herbaceous species may be common to abundant, including *Bassia scoparia, Bromus tectorum, Descurainia Sophia, Lepidium latifolium*, and *Xanthium strumarium*.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Elaeagnus angustifolia, Tamarix ramosissima*
Tall shrub/sapling	*Rhus trilobata*
Tall shrub/sapling	*Artemisia tridentata* ssp. *tridentata*
Herb (field)	*Glycyrrhiza lepidota, Lepidium latifolium, Xanthium strumarium*
Herb (field)	*Eleocharis palustris, Spartina pectinata*

Globally

Stratum	**Species**
Tree canopy	*Elaeagnus angustifolia*
Shrub/sapling (tall & short)	*Amorpha fruticosa*
Tall shrub/sapling	*Salix exigua, Tamarix ramosissima*
Herb (field)	*Distichlis spicata, Pascopyrum smithii, Sporobolus airoides*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Elaeagnus angustifolia, Lepidium latifolium, Tamarix ramosissima

Globally
Lepidium latifolium

CONSERVATION STATUS RANK
Global Rank & Reasons: GNA (invasive) (5-Nov-1999).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Populus deltoides- and *Populus fremontii*-dominated associations may have significant cover of *Elaeagnus angustifolia* in the tree canopy but are generally considered native woodlands until *Elaeagnus angustifolia* comprises more than 80-90% of the tree cover. Some stands have a nearly closed tree canopy (80% cover) or may have significant gaps in the tree canopy.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Russian-olive is not widespread in the monument.
Dinosaur National Monument Data Sources: This association is described from 2002 field data (2 plots: DINO.0635, DINO.0636).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: D. Faber-Langendoen, mod. J. Coles and K.A. Schulz

REFERENCES: Great Plains Flora Association 1986, Midwestern Ecology Working Group n.d., NDNHI n.d., Von Loh et al. 1999

Acer negundo - Celtis laevigata var. *reticulata* Woodland
Box-elder - Netleaf Hackberry Woodland

CODE	CEGL002599
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	*ACER NEGUNDO* TEMPORARILY FLOODED WOODLAND ALLIANCE (A.642) Box-elder Temporarily Flooded Woodland 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: Not applicable

CONCEPT SUMMARY
Globally
This association has been described only from the Yampa and Green river corridors in Dinosaur National Monument in northwestern Colorado and adjacent eastern Utah. It may occur rarely in isolated stands in canyons throughout the southwestern U.S. Stands are found on gently to moderately angled colluvial slopes or alluvial terraces and at the base of canyon walls, high enough above the river channel so as to flood only rarely, but low enough that tree roots can still tap the water table. Elevation is below 1800 m. Nonvegetated ground cover is primarily litter with 15% large rock or gravel. Shade from canyon walls and a "mulch" of surface rock are some of the environmental factors influencing the vegetation. *Acer negundo* and *Celtis laevigata* var. *reticulata* codominate the tree canopy of this association, with a total canopy cover ranging from 45 to 60%. *Acer negundo* usually has higher cover than *Celtis laevigata* var. *reticulata*. Shrub layers are insignificant. The herbaceous layer is dominated by *Bromus tectorum* with cover ranging from 20 to 60%.

DISTRIBUTION
Dinosaur National Monument
This association is occasionally found on talus slopes in canyons and ravines that empty into the Green River. The best-developed examples are located on middle and lower terraces of the Green River floodplain in the vicinity of the confluence with the Yampa River.

Globally
This association has been documented only from Dinosaur National Monument in northwestern Colorado and adjacent eastern Utah.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association occurs on gently to moderately angled colluvial slopes on or adjacent to alluvial terraces, with southerly aspects, at the base of canyon walls. Elevation is below 1800 m, and nonvegetated ground cover is primarily litter with 15% large rock or gravel. Runoff and shade from canyon walls, and boulders, collecting water at their bases, are some of the environmental factors influencing the vegetation.

Globally
This association has been documented only from Dinosaur National Monument. Without additional data, there is no global information.

VEGETATION DESCRIPTION
Dinosaur National Monument
Acer negundo and *Celtis laevigata* var. *reticulata* codominate the tree canopy of this association. Total tree canopy cover ranges from 45 to 60% with *Acer negundo* usually having higher cover than *Celtis laevigata* var. *reticulata*. Shrub layers are insignificant. The herbaceous layer is dominated by *Bromus tectorum* with cover ranging from 20 to 60%.

Globally
This association has been documented only from Dinosaur National Monument. Without additional data, there is no global information.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Acer negundo, Celtis laevigata var. reticulata*
Herb (field)	*Bromus tectorum*

Globally
Data are not available.

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Data are not available.

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Five sites were assigned to this vegetation type. However, three of those plots provide limited environmental information, and the environmental description is based on the other two plots and may be incomplete. This association is superficially similar to *Acer negundo* / Disturbed Understory Woodland (CEGL002693), but the diagnostic characteristic of this association is the presence of both *Acer negundo*

and *Celtis laevigata* var. *reticulata* in the canopy of a riparian woodland.
Dinosaur National Monument Data Sources: This association is described from field data plots collected in the 1990s and in 2002 (5 plots: DINO.0320, DINO.0322, GR015, GR018, GR022).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Carsey et al. 2003a, Western Ecology Working Group n.d.

Acer negundo / Disturbed Understory Woodland
Box-elder / Disturbed Understory Woodland

CODE	CEGL002693
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	*ACER NEGUNDO* 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: Palustrine

CONCEPT SUMMARY
Globally
This riparian association is found in the Colorado Plateau and other areas of the southwestern U.S. on upper alluvial terraces below 2015 m (6600 feet) elevation. Sites are on gentle slopes or flat areas near permanent or temporary streams but are rarely flooded because of their location on high, abandoned stream terraces. Soils are usually sandy. The tree canopy of this association is open to moderately closed and 5-15 m tall. The dominant tree species is Acer negundo with scattered *Acer glabrum, Juniperus osteosperma,* or *Juniperus scopulorum.* There is a sparse shrub layer up to 2 m tall with *Artemisia tridentata, Ericameria nauseosa, Fraxinus anomala, Rhus trilobata, Ribes cereum, Tamarix ramosissima,* and (in the south) *Quercus gambelii*. Herbaceous cover and species composition are variable. The herbaceous stratum may be sparse or dominated by native and introduced species typically found in disturbed areas. *Bromus tectorum* is common. Other typical species are *Heterotheca villosa, Poa pratensis, Sisymbrium altissimum, Lepidium latifolium, Taraxacum officinale,* and *Verbascum thapsus*.

DISTRIBUTION
Dinosaur National Monument
This is the most common riparian woodland association in the monument. It can be found on sandy upper riparian terraces adjacent to the Yampa and Green rivers and their larger tributaries. It was documented at sites located in Warm Springs, Harding Hole, Outlaw Park, Winnie's Rapid, Pot Creek, North Cub Creek, Jones Hole Creek, Wade and Curtis Campground and Bobby Island.

Globally
This association has been sampled in the Colorado Plateau from northwestern Colorado to southwestern Utah and northeastern Arizona; it is likely widespread elsewhere in the southwestern U.S.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This common riparian association occurs on upper stream terraces above the banks of intermittent and permanent streams at elevations below 1800 m. The substrate is flat to moderately sloping and positioned between the level floodplain and steeper upland slopes or canyon walls. Soils are sandy alluvium. Leaf litter and box-elder trunks and limbs contribute significantly to the ground cover. Large rocks or boulders may be present. Although this woodland seems always to be associated with canyon watercourses, it is positioned above the current floodplain and rarely, if ever, floods. Most occurrences are in the canyon sections of the monument; broader valleys tend to support cottonwood woodlands in the same habitats. This association occurs on upper level alluvial terraces at elevations below 1800 m.

Examples of this association typically occupy high terraces adjacent to the Green and Yampa rivers in wider parts of the canyons. Terraces are flat to gently sloping with sandy alluvial soils.

Globally
This association is found on flat to gently sloping riparian sites near permanent or temporary streams below 2015 m (6600 ft) elevation. Sites are usually found on terraces several meters above the active floodplain and below the steeper upland slopes on any aspect. They rarely flood. Soils are usually sandy alluvium and can range from well-drained to poorly drained. The ground surface is largely covered by large rocks, litter, wood, or bare soil.

VEGETATION DESCRIPTION
Dinosaur National Monument
Acer negundo dominates the canopy in this woodland association. Canopy cover ranges from moderate to closed (20 to 80%) and 5 to 15 m in height. Other tree species that may occur with less cover are *Juniperus osteosperma* and *Juniperus scopulorum*. Shrub cover is minimal, usually not exceeding 10% and 2 m in height. *Artemisia tridentata* ssp. *tridentata, Rhus trilobata, Tamarix ramosissima*, and *Ericameria nauseosa* are often present and occasionally form a shrub layer in stands with a more open tree canopy. Herbaceous species composition and abundance are highly variable among sites. However, most sites are dominated by *Bromus tectorum*, cover ranging from 10 to 80%. Other herbaceous species most commonly documented in this association include *Linanthus ciliatus* var. *neglectus, Heterotheca villosa, Sisymbrium altissimum, Iva axillaris, Lepidium latifolium, Distichlis spicata, Pascopyrum smithii*, and *Poa pratensis*.

Globally
This woodland association has an open to moderately closed (10-80%) tree canopy and moderate to dense total vegetation cover. The tree canopy is between 5 and 15 m tall and dominated by *Acer negundo*. *Acer negundo* is also present as seedlings and saplings. Other trees that can be present are *Acer glabrum, Juniperus osteosperma*, and *Juniperus scopulorum*. Shrub cover is sparse, though it can be more prominent when the tree canopy is open. The shrub stratum is usually less than 2 m tall and contains species such as *Artemisia tridentata* ssp. *tridentata, Ericameria nauseosa, Fraxinus anomala, Rhus trilobata, Ribes cereum, Tamarix ramosissima*, and (in the south) *Quercus gambelii*. Herbaceous cover and species composition are variable. The herbaceous stratum is dominated by native and introduced species typically found in disturbed areas. *Bromus tectorum* is common. Other typical components of the herbaceous stratum are *Heterotheca villosa, Poa pratensis, Lepidium latifolium, Sisymbrium altissimum, Taraxacum officinale*, and *Verbascum thapsus*.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Acer negundo*
Short shrub/sapling	*Ericameria nauseosa*
Short shrub/sapling	*Artemisia tridentata* ssp. *tridentata*
Herb (field)	*Iva axillaris*

Globally

Stratum	**Species**
Tree canopy	*Acer negundo*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Agrostis stolonifera, Bromus inermis, Bromus tectorum, Elymus repens, Lepidium latifolium, Poa pratensis, Tamarix ramosissima

Globally
Bromus tectorum, Poa pratensis

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE:

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Dominance by *Acer negundo* and location on sandy high terraces are diagnostic. Identification in the field should be straightforward. Understory species may vary but generally consist of weedy species dominated by *Bromus tectorum*. If a shrub layer is present, *Ericameria nauseosa* is generally the most conspicuous species, although *Atriplex canescens* and/or *Artemisia tridentata* ssp. *tridentata* may dominate or codominate the shrub layer. The understory may also be sparsely vegetated. This association is common and often located in easily accessible areas along rivers and streams in the monument. A number of designated river campgrounds are situated in stands of this association.
Dinosaur National Monument Data Sources: This association is described from field data plots and observation points collected in the 1990s and in 2002-2003 (14 plots: DINO.0015, DINO.0131, DINO.0164, DINO.0313, DINO.0314, DINO.0315, DINO.0319, DINO.0621, DINO.0692, DINO.1413, DINO.1415, GR001, GR007, GR010, and 6 observation points: DINO.8001, DINO.8007, DINO.8012, DINO.8410, DINO.9108, DINO.9687).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Drake, mod. J. Coles and K.A. Schulz

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

Acer negundo / Rhus trilobata Woodland
Box-elder / Threeleaf Sumac 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	*ACER NEGUNDO* 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
Dinosaur National Monument
This rare association is known from Dry Woman Canyon. It is likely to occur in small patches in rocky ravines throughout the monument.

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
Dinosaur National Monument
This association occurs in a spring seep on a moderately angled, northwest-facing, concave slope in the Round Valley Formation at elevations below 1800 m. The nonvegetated ground cover is primarily litter, with scattered large rocks and patches of bedrock. Soil texture is loamy sand.

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
Dinosaur National Monument
Vegetation is vigorous and diverse in this ravine association. *Acer negundo* comprises the tree canopy layer with 20% cover and up to 10 m in height. *Rhus trilobata* dominates the shrub layer, with 20% cover and height range of 2 to 5 m. *Amelanchier utahensis* and *Salix exigua* occur with minimal cover. Species codominating the herbaceous layer are *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*.

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
Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Acer negundo*

Globally

Stratum	**Species**
Tree canopy	*Acer negundo*
Tall shrub/sapling	*Fraxinus anomala, Rhus trilobata*
Short shrub	*Amelanchier utahensis*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 3- Weak

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is described from a single plot; the full diversity of this type within the monument is not known.
Dinosaur National Monument Data Sources: This association is described from 2003 field data (1 plot: DINO.0688).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: M. Reid

REFERENCES: Western Ecology Working Group n.d.

Populus angustifolia - Juniperus scopulorum Woodland
Narrowleaf Cottonwood - Rocky Mountain Juniper Woodland

CODE	CEGL002640
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Deciduous woodland (II.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous woodland (II.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous woodland (II.B.2.N.)
FORMATION	Temporarily flooded cold-deciduous woodland (II.B.2.N.b.)
ALLIANCE	*POPULUS ANGUSTIFOLIA* TEMPORARILY FLOODED WOODLAND ALLIANCE (A.641) Narrowleaf Cottonwood Temporarily Flooded Woodland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY
Globally
This semi-riparian woodland association occurs in north-central Wyoming, western Colorado and northern New Mexico on terraces or slopes of gorges, ravines, and moderate-sized intermittent or perennial drainages between 1740 and 2400 m (5725-7875 feet) elevation. This type usually occurs on high, dry stream terraces with level slopes and a sandy surface soil texture. Stands are infrequently flooded (10- to 100-year recurrence intervals). The vegetation is characterized by moderately open canopies (25-60% cover) dominated by *Populus angustifolia*, with *Juniperus scopulorum* or occasionally *Juniperus monosperma, Betula occidentalis,* or *Pinus edulis* in the subcanopy. An open grassy understory with abundant *Sporobolus cryptandrus* is characteristic, although other grasses such as *Carex geyeri, Juncus balticus, Leymus cinereus,* and *Poa fendleriana* may also be present. In disturbed stands the native grasses may have been replaced by exotic species such as *Bromus inermis*. Although shrubs are uncommon, those present, such as *Brickellia californica, Quercus gambelii, Artemisia tridentata, Mahonia repens, Purshia tridentata, Rosa woodsii,* and *Symphoricarpos oreophilus,* reflect relatively dry site conditions. The herbaceous understory also reflects open, dry site conditions. Facultative and upland forbs such as *Thalictrum fendleri, Achillea millefolium, Maianthemum stellatum, Solidago nemoralis,* and *Penstemon barbatus* are common. In open areas *Bouteloua curtipendula* is common. Regardless of the drier conditions, a variety of native wetland indicators can occur, including *Juncus effusus, Glyceria striata, Carex nebrascensis, Agrostis exarata, Rudbeckia laciniata, Equisetum arvense, Epilobium ciliatum, Mertensia ciliata,* and *Equisetum laevigatum*. Many stands have decadent *Populus angustifolia* trees that are being replaced by *Juniperus scopulorum*. Other stands periodically flood and retain a large amount of woody debris. In all cases the vegetation and topographic position indicate a community that is becoming isolated from the water table. As the water table drops, the facultative and obligate wetland plants will be replaced by upland species.

DISTRIBUTION
Dinosaur National Monument

This association is known from Pot Creek and Starvation Valley. It is uncommon but may occur in other mid-elevation valley streams throughout the monument.

Globally
This association has been documented in north-central Wyoming, western Colorado and northern New Mexico. It may occur in Utah.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This riparian association occurs on high terraces along gentle to steep, intermittent or perennial streams at elevations ranging from 1900 to 2100 m. Soils are sandy alluvium and strewn with organic litter, downed wood and rocks.

Globally
The community is found in mountainous regions of north-central Wyoming, western Colorado and northern New Mexico on terraces or slopes of gorges, ravines, and moderate-sized intermittent or perennial drainages with elevations ranging from 1740 to 2400 m (5725-7875 feet). This type usually occurs on higher and drier terraces that have a relatively flat surface topography, and they are mostly composed of sandy alluvial sediments. As a result, stands are infrequently flooded (10- to 100-year recurrence intervals). Soils are young, weakly developed Entisols. Thick organic layers (Mollisols) have had time to develop in some stands. Soils tend to be dry, well-drained and mostly sandy or silty at the surface, although commonly gravelly/cobbly with depth. Some of the lower terraces may be very moist at depths within the rooting zone, particularly during seasonal high water events.

VEGETATION DESCRIPTION
Dinosaur National Monument
This association is characterized by a tree canopy of *Populus angustifolia* with 10 to 30% cover and a subcanopy of *Juniperus scopulorum* with 10 to 30% cover. *Pinus edulis* may also be present. Shrubs are absent or present with minimal cover. The herbaceous layer is variable in cover and composition. The composition of the herbaceous layer can range from a dense sod-forming monoculture of *Bromus inermis* to a highly diverse mixture of mostly native grasses and forbs.

Globally
The species composition and percent cover in this association are variable and depend on aspect, elevation, and streamflow, in addition to the degree of disturbance by recreational use and livestock grazing. This type is characterized by mature, moderately open stands (25-60% cover) dominated by *Populus angustifolia*, with *Juniperus scopulorum* or occasionally *Juniperus monosperma*, *Betula occidentalis*, or *Pinus edulis* in the subcanopy. Total biomass and canopy cover are usually low. An open grassy understory with abundant *Sporobolus cryptandrus* is characteristic, although other grasses such as *Carex geyeri, Juncus balticus, Leymus cinereus,* and *Poa fendleriana* may also be present. In disturbed stands the native grasses may have been replaced by exotic species such as *Bromus inermis*. Cottonwood reproduction occurs vegetatively from root sprouts, and young junipers are common. Although shrubs are uncommon, those present, such as *Brickellia californica, Quercus gambelii, Artemisia tridentata, Mahonia repens, Purshia tridentata, Rosa woodsii*, and *Symphoricarpos oreophilus*, reflect relatively dry site conditions. The herbaceous understory also reflects the open, drier site conditions. Facultative and upland forbs such as *Thalictrum fendleri, Achillea millefolium, Maianthemum stellatum, Solidago nemoralis*, and *Penstemon barbatus* are common. In open areas *Bouteloua curtipendula* is common. Regardless of the drier conditions, a variety of native wetland indicators can occur: *Juncus effusus, Glyceria striata, Muhlenbergia racemosa, Carex nebrascensis, Agrostis exarata, Rudbeckia laciniata, Equisetum arvense, Epilobium ciliatum, Mertensia ciliata, Lycopus asper, Equisetum laevigatum,* and *Asclepias incarnata*.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Populus angustifolia*
Tree subcanopy	*Juniperus scopulorum*
Herb (field)	*Sporobolus cryptandrus*

Globally

Stratum	**Species**

Tree canopy	*Populus angustifolia*
Tree subcanopy	*Juniperus scopulorum*
Herb (field)	*Sporobolus cryptandrus*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus inermis

Globally
Bromus inermis

CONSERVATION STATUS RANK
Global Rank & Reasons: G2G3 (7-Apr-1998).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
These mature riparian forests occupy some of the driest sites in the floodplain. Some stands may be directly adjacent to the stream but still situated several meters above it due to downcut streambanks, or they may be dry because the stream only flows intermittently. In these stands, the cottonwoods have limited self-sustaining capabilities except vegetatively by root sprouts. Many of the trees are often decadent or dying, and junipers are commonly growing up under them, colonizing the drying terraces. Further, the presence of juniper in these and other floodplain communities is often considered invasive. *Juniper*, as a codominant in these communities, is at least viewed as an indicator that flooding occurs infrequently. Only the largest of floods will remove these communities.
This type is a refinement of the *Populus angustifolia / Juniperus scopulorum* Association reported by Muldavin (1991) for northern New Mexico and Kittel et al. (1994, 1996) for Colorado. It is synonymous with *Populus angustifolia / Physocarpus monogynus - Padus virginiana* in Bighorn National Forest, Wyoming (Girard et al. 1997), and *Populus angustifolia - Juniperus scopulorum* in New Mexico (Durkin et al. 1995a). Padus virginiana is an old name for *Prunus virginiana*.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Data are not available.
Dinosaur National Monument Data Sources: This association is described from 2002 and 2003 field data (2 plots: DINO.0230, DINO.0708).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: Muldavin et al., mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Carsey et al. 2003a, Cooper and Cottrell 1990, Durkin et al. 1994b, Durkin et al. 1995a, Girard et al. 1997, Kittel et al. 1994, Kittel et al. 1996, Kittel et al. 1999a, Kittel et al. 1999b, Muldavin 1991, Muldavin et al. 2000a, Western Ecology Working Group n.d.

Populus angustifolia / Betula occidentalis Woodland
Narrowleaf Cottonwood / Water Birch Woodland

CODE	CEGL000648
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Deciduous woodland (II.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous woodland (II.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous woodland (II.B.2.N.)
FORMATION	Temporarily flooded cold-deciduous woodland (II.B.2.N.b.)
ALLIANCE	*POPULUS ANGUSTIFOLIA* TEMPORARILY FLOODED WOODLAND ALLIANCE (A.641) Narrowleaf Cottonwood Temporarily Flooded Woodland Alliance

ECOLOGICAL SYSTEM(S): Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland

(CES304.045)
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This lush, deciduous, riparian woodland occurs in mountains and canyons of Nevada, Utah, Idaho, Wyoming, and Colorado on stream terraces or floodplains bordering streams. Elevation ranges from 1450-2600 m. This community is one of the wetter *Populus angustifolia* plant associations, which indicates a perennial source of water. Some stands occur on hillside seeps. Substrate is well-drained, rocky and coarse-textured alluvial soil. Water tables are generally between 0.5-4 m below the surface. The upper tree canopy is open (typically less than 60% cover) and is dominated by *Populus angustifolia*, with *Acer negundo* occasionally codominating in late-seral stands. *Pseudotsuga menziesii* and *Juniperus scopulorum* are scattered in some stands. *Betula occidentalis* forms a moderate to dense short-tree/tall-shrub canopy, often forming a thicket along the stream. Other species, such as *Alnus incana, Acer grandidentatum, Acer glabrum, Amelanchier alnifolia*, and several species of *Salix*, including *Salix lutea, Salix lucida* ssp. *lasiandra*, and *Salix bebbiana*, may be present. The moderately dense short-shrub layer may include *Cornus sericea, Paxistima myrsinites, Rosa* spp., *Mahonia repens, Ribes aureum, Symphoricarpos* spp., and *Rhus trilobata* on drier sites. The herbaceous layer may be sparse to dense, depending on the density of the shrub and tree layers. Common species include *Equisetum arvense, Osmorhiza berteroi, Carex pellita, Maianthemum stellatum, Achillea millefolium*, and the introduced species *Bromus inermis, Poa pratensis*, and *Taraxacum officinale*. The dominance of *Betula occidentalis* separates this association from other *Populus angustifolia* riparian woodlands.

DISTRIBUTION

Dinosaur National Monument

This association is known from a small canyon on the south side of Split Mountain. It is likely to occur in narrow side canyons of low to middle elevations throughout the monument.

Globally

This association occurs in the mountains and canyons of Utah, Nevada, Idaho, Wyoming, and Colorado. These riparian woodlands are a major type in the Wasatch Mountains but appear to be a minor association elsewhere.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This riparian association occupies perennial streambanks in narrow canyons or the seeps of rocky, concave slopes. Elevation is below 2000 m. The microclimate is cool from the shade of canyon walls and persistently moist from flowing water. The soils are sandy alluvium.

Globally

This lush, deciduous, riparian woodland occurs in mountains and narrow canyons of Nevada, Utah, Idaho, Wyoming, and Colorado on stream terraces or floodplains bordering streams. Elevation ranges from 1450-2600 m (4760-8525 feet). This community is one of the wetter *Populus angustifolia* plant associations, which indicates a perennially high water table. Some stands occur on hillside seeps. Substrates are typically well-drained, coarse-textured, rocky alluvium. Soils often have a surface layer of partially decomposed organic matter 5-10 cm (2-4 inches) thick. Subsurface layers are very coarse, with 10-60% gravel or cobbles. Subsurface textures range from clay loams to loamy sands (Padgett et al. 1989, Kittel et al. 1999b, Carsey et al. 2003a). Water tables are generally between 0.5-4 m below the surface.

VEGETATION DESCRIPTION

Dinosaur National Monument

This is a dense, deciduous riparian association with *Populus angustifolia* dominating the tree canopy with 10 to 30% cover, and *Betula occidentalis* dominating a moderately dense tall-shrub layer. The herbaceous layer is variable in composition and cover and may include *Phragmites australis, Agrostis stolonifera*, and *Equisetum laevigatum*.

Globally

The upper tree canopy is open (typically 10-60% cover) and is dominated by *Populus angustifolia*, with *Acer negundo* occasionally codominating in late-seral stands. *Pseudotsuga menziesii* and *Juniperus scopulorum* are scattered in some stands. *Betula occidentalis* forms a moderate to dense short-tree/tall-shrub canopy, often forming a

thicket along the stream. Other species, such as *Alnus incana, Acer grandidentatum, Acer glabrum, Amelanchier alnifolia*, and several species of *Salix*, including *Salix lutea, Salix ligulifolia, Salix irrorata, Salix lucida* ssp. *lasiandra*, and *Salix bebbiana*, may be present. The moderately dense short-shrub layer may include *Cornus sericea, Mahonia repens, Paxistima myrsinites, Prunus virginiana, Rosa* spp., *Rhus trilobata, Ribes aureum, Ribes inerme, Rubus parviflorus, Symphoricarpos* spp., and *Rhus trilobata* on drier sites. The herbaceous layer may be sparse to dense, depending on the density of the shrub and tree layers. Common species include *Achillea millefolium, Angelica ampla, Equisetum* spp., *Osmorhiza berteroi, Carex pellita, Carex utriculata, Glyceria striata, Maianthemum stellatum, Phragmites australis, Rudbeckia laciniata*, and the introduced species *Agrostis gigantea, Bromus inermis, Dactylis glomerata, Poa pratensis, Melilotus* spp., *Taraxacum officinale*, and *Trifolium repens* (Padgett et al. 1989, Kittel et al. 1999b, Carsey et al. 2003a). The dominance of *Betula occidentalis* separates this association from other *Populus angustifolia* riparian woodlands.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Tree canopy	*Populus angustifolia*
Tree subcanopy	*Betula occidentalis*
Herb (field)	*Agrostis stolonifera, Phragmites australis*
Herb (field)	*Equisetum laevigatum*

Globally

Stratum	Species
Tree canopy	*Populus angustifolia*
Tall shrub/sapling	*Betula occidentalis*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Agrostis stolonifera

Globally
Bromus inermis, 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. Although this association appears stable, the condition of high-quality occurrences is extremely threatened because of easy access to this relatively low-elevation community. Development, heavy recreational use, expansion and maintenance of roads and railroads, improper grazing, and modification of hydrologic processes threaten this community with the introduction of non-native species, accelerated erosion, and damage to native vegetation. Hydrologically modified streams may lack the processes necessary to regenerate the Populus angustifolia tree canopy.

CLASSIFICATION COMMENTS

Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Dinosaur National Monument Inventory Notes: It may be difficult to access the narrow slot canyon sites where this association tends to occur.
Dinosaur National Monument Data Sources: This association is described from 2002 field data (1 plot: DINO.0169).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: K.A. Schulz, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Carsey et al. 2003a, Carsey et al. 2003b, Cooper and Cottrell 1990, Driscoll et al. 1984, IDCDC 2005, Jones 1992b, Jones and Ogle 2000, Kittel et al. 1994, Kittel et al. 1996, Kittel et al. 1997a, Kittel et al. 1999a, Kittel et al. 1999b, Komarkova 1986, NVNHP 2003, Olson and Gerhart 1982, Padgett et al. 1988b, Padgett et al. 1989, Smith 1994b, Walford 1996

Populus angustifolia / Rhus trilobata Woodland
Narrowleaf Cottonwood / Threeleaf Sumac 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	*POPULUS ANGUSTIFOLIA* TEMPORARILY FLOODED WOODLAND ALLIANCE (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 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 feet), 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 that is 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 upland species.

DISTRIBUTION

Dinosaur National Monument

This association is known from Beach Draw in Split Mountain Canyon, Cub Creek, and near Josie's Cabin. It is likely to occur along any of the perennial tributary streams of the monument where low gradients allow for the development of cottonwood gallery forests.

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

Dinosaur National Monument

This association occurs on middle terraces on the banks of perennial tributary streams. Most stands are on level ground, but one plot was on a 14-degree slope facing northeast. Elevations range between 1523 and 1722 m. Bare

soil and litter cover most of the unvegetated surface, with lesser cover provided by large rocks fallen from the cliffs above. One plot has high cover by exposures of Chinle shale. Soils are sandy or silty loams derived from Glen Canyon sandstone, Chinle shale or alluvium.

Globally
This deciduous riparian woodland occurs on toeslopes 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 feet), 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
Dinosaur National Monument
This riparian association is characterized by an open canopy 5 to 10 m high of mature *Populus angustifolia* and/or *Populus X acuminate* trees with between 10 and 40% cover. A sparse subcanopy consisting of scattered *Juniperus osteosperma* or *Pinus edulis* may be present with up to 15% cover. The shrub layer is patchy, consisting primarily of dense clumps of *Rhus trilobata* (5 to 25% cover) with other shrubs growing in the openings between clumps. Associated shrubs reflect the drying conditions of the stream terrace and include Artemisia tridentata ssp. tridentata, *Ericameria nauseosa*, and *Cercocarpus montanus*. The herbaceous is variable and includes both mesic and xeric species. The exotic grasses *Phragmites australis* and *Bromus tectorum* may be dominant, but other species present may include *Maianthemum stellatum, Juncus* spp., *Hesperostipa comata, Equisetum arvense, Eleocharis palustris*, and *Clematis ligusticifolia*.

Globally
The association has an open upper tree canopy that is 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
Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Juniperus osteosperma, Pinus edulis*
Tree canopy	*Populus angustifolia, Populus x acuminata*
Tall shrub/sapling	*Rhus trilobata*
Tall shrub/sapling	*Artemisia tridentata* ssp. *tridentata*
Herb (field)	*Clematis ligusticifolia*
Herb (field)	*Maianthemum stellatum*
Herb (field)	*Phragmites australis*

Globally

Stratum	**Species**
Tree canopy	*Populus angustifolia*
Tall shrub/sapling	*Rhus trilobata*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument

Bromus tectorum

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 rangewide. 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
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This riparian association is likely to occur in cool drainages with low gradients.
Dinosaur National Monument Data Sources: This association is described from 2005 accuracy assessment data (5 plots: DINO_AA.A1414, DINO_AA.A1463, DINO_AA.A1496, DINO_AA.A1530, DINO_AA.A1535).
Local Description Authors: J. Coles
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 angustifolia / Salix exigua* Woodland**
Narrowleaf Cottonwood / Coyote Willow Woodland

CODE	CEGL000654
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Deciduous woodland (II.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous woodland (II.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous woodland (II.B.2.N.)
FORMATION	Temporarily flooded cold-deciduous woodland (II.B.2.N.b.)
ALLIANCE	*POPULUS ANGUSTIFOLIA* TEMPORARILY FLOODED WOODLAND ALLIANCE (A.641) Narrowleaf Cottonwood Temporarily Flooded Woodland Alliance
ECOLOGICAL SYSTEM(S):	North American Warm Desert Lower Montane Riparian Woodland and Shrubland (CES302.748) Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)
USFWS WETLAND SYSTEM:	Palustrine

CONCEPT SUMMARY
Globally
The type is widespread in mountainous regions of the San Juan, Pecos, and Rio Grande river basins in northern and central New Mexico and widely distributed throughout the Rocky Mountain region and Intermountain West. It is

found in wide to narrow valleys at mid- to upper elevations from 1670 to 2360 m (5480-7750 feet). It occurs on streamside alluvial bars that border perennial rivers and intermittent streams of low to moderate gradients (0.7-2.8%). In Colorado, this riparian woodland occupies point bars, gravel bars, benches and low areas that are flooded annually. It is a very common plant community of young seedling and sapling *Populus angustifolia* intermixed with *Salix exigua*. Sites are typically flooded every five years, sometime more often, and most are within the 25-year floodplain. Stream channel materials are usually coarse and comprised of cobbles or gravel. Soils are young and weakly developed Entisols with wet (aquic) conditions within the top 50 cm or at least within rooting depth. They are well-drained sands and sandy loams mixed with gravels and cobbles. This type is characterized by middle-aged stands of *Populus angustifolia* in an open upper canopy, with a shrubby understory dominated by *Salix exigua*. *Populus angustifolia* saplings (derived from root sprouts) are common beneath the canopy. Other shrubs such as *Salix irrorata* may be well-represented but clearly subordinate to *Salix exigua*. The herbaceous layer is very diverse, with 98 species recorded for the type, 23 of which are native wetland indicators.

DISTRIBUTION

Dinosaur National Monument

This association is known from Starvation Valley, a remote canyon within the monument boundaries. It is likely to occur occasionally in similar remote side canyons where the water table is high throughout the growing season.

Globally

This association is widespread in mountainous parts of the San Juan, Pecos, and Rio Grande river basins in northern and central New Mexico and widely distributed throughout the Rocky Mountain region and Intermountain West.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This riparian woodland occupies low sandy stream terraces in narrow canyons and on alluvial deposits in cliff alcoves at elevations below 2000 m. Though canyon walls contribute to a shady, cool environment, this association is positioned so it receives full sun much of the day. Streamflow may be seasonal or perennial.

Globally

The type is found in wide valleys to narrow canyons at mid to upper elevations from 1670 to 2360 m (5480-7750 feet). It occurs on streamside alluvial bars that border perennial rivers and intermittent streams of low to moderate gradients (0.7-2.8%). In the Colorado Plateau, some stands occupy canyon alcoves. Sites are typically flooded every five years, sometime more often, and most are within the 25-year floodplain. Stream channel materials are usually coarse and comprised of cobbles or gravel. Soils are young and weakly developed Entisols with wet (aquic) conditions within the top 50 cm or at least within rooting depth. They are well-drained sands and sandy loams mixed with gravels and cobbles.

VEGETATION DESCRIPTION

Dinosaur National Monument

This riparian association is characterized by an open, mixed tree canopy of *Populus angustifolia, Populus deltoides* ssp. *wislizeni*, and *Acer negundo,* and sparse to moderately dense tall-shrub layer dominated by *Salix exigua. Salix monticola* may also be present. Depending on hydrologic conditions and canopy closure, the herbaceous layer may be sparse to dense and is generally highly diverse. Some species known to occur with greater than 1% cover in perennially wet conditions include *Equisetum* spp., *Juncus* spp., *Typha latifolia*, and the rare species *Cirsium ownbeyi* and *Epipactis gigantea*.

Globally

This type is characterized by middle-aged stands of *Populus angustifolia* in an open upper canopy, with a shrubby understory dominated by *Salix exigua*. *Populus angustifolia* saplings (derived from root sprouts) are common beneath the canopy. The canopy may contain individuals of *Populus deltoides* ssp. *deltoides* or *Acer negundo*. Other shrubs, such as *Salix irrorata* or *Salix monticola*, may be well-represented but clearly subordinate to *Salix exigua*. Depending on hydrologic conditions and canopy closure, the herbaceous layer may be sparse to dense and is generally highly diverse, with 98 species recorded for the type, 23 of which are native wetland indicators. The most common and abundant native wetland species are *Eleocharis palustris, Juncus balticus, Juncus saximontanus, Equisetum arvense, Equisetum laevigatum, Epilobium ciliatum, Prunella vulgaris, Schoenoplectus pungens,* and *Schoenoplectus tabernaemontani*. The most consistent grass is the introduced *Agrostis stolonifera* or *Agrostis gigantea*. Other forb species can also be prevalent, including *Melilotus officinalis, Glycyrrhiza lepidota,* and *Xanthium strumarium*.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Tree canopy	*Populus angustifolia, Populus deltoides* ssp. *wislizeni*
Tall shrub/sapling	*Salix exigua*
Herb (field)	*Equisetum laevigatum*

Globally

Stratum	Species
Tree canopy	*Populus angustifolia*
Tall shrub/sapling	*Salix exigua*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Cirsium ownbeyi, Epipactis gigantea

Globally
Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G4 (7-Apr-1998).

CLASSIFICATION COMMENTS

Dinosaur National Monument
Data are not available.

Globally
Several other *Salix* species may be present, and the canopy may have other species of *Populus* as well.

The community is widely distributed on younger depositional bars of moderate-sized streams with unregulated flows and few diversions. Since the stands are well-adapted to flooding, they are well-suited for streambank stabilization. Typically found in wider valleys where ranches and livestock are common, the coarse-textured soils are not susceptible to compaction. However, the streamside location of these stands makes them prone to heavy usage by livestock. Without careful management, woody components such as saplings and shrubs decrease. Under continuous pressure from grazing, these stands have limited self-sustainability and are eventually replaced by non-cottonwood-dominated stands prone to streambank erosion. Managers should maintain a buffer strip of cottonwoods along streambanks to avoid erosion. When grazing pressure is lessened, regrowth of cottonwoods is rapid, riparian shrubs return, and streambanks become more stable. In addition, species diversity and wildlife habitat increase. *Populus angustifolia* and *Salix exigua* are obligate riparian species which require flooding for reproduction, growth, and maintenance. Depending on the depth of the water table, these stands will respond positively to fire disturbance with rapid regrowth. Both species are highly palatable to beaver and livestock, and potential usage is high.

Medina (1986) described a *Populus acuminata / Salix exigua* community type in southwestern New Mexico that is very similar to this one. A *Populus angustifolia / Salix exigua* Subseries has been identified by the U.S. Forest Service's Terrestrial Ecosystem Survey for northern New Mexico (Stuever and Hayden 1997a). This type has been well-documented in Colorado (Ramaley 1942, Woodbury et al. 1961, Hess 1981, Baker 1984a, Hess and Alexander 1986, Johnston 1987, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1996) and in Nevada (Manning and Padgett 1995).

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Dinosaur National Monument Inventory Notes: Data are not available.
Dinosaur National Monument Data Sources: This association is described from 2002 field data (2 plots: DINO.0633, DINO.0689).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: E. Muldavin et al., mod. J. Coles

REFERENCES: Baker 1984a, Beidleman 1954, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Carsey et al. 2003a, DeLeuw, Cather & Company 1977, Driscoll et al. 1984, Durkin et al. 1994b, Durkin et al. 1995a, Hess 1981, Hess and Alexander 1986, Johnston 1987, Keammerer 1974a, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1996, Kittel et al. 1997a, Kittel et al. 1999a, Kittel et al. 1999b, Manning and Padgett 1995, Medina 1986, Muldavin et al. 2000a, Ramaley 1942, Richard et al. 1996, Stuever and Hayden 1997a, Western Ecology Working Group n.d., Woodbury et al. 1961

Populus deltoides (ssp. *wislizeni*, ssp. *monilifera*) / *Distichlis spicata* Woodland (Rio Grande Cottonwood, Plains Cottonwood) / Saltgrass Woodland

Cottonwood / Saltgrass Floodplain Woodland

CODE	CEGL000939
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Deciduous woodland (II.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous woodland (II.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous woodland (II.B.2.N.)
FORMATION	Temporarily flooded cold-deciduous woodland (II.B.2.N.b.)
ALLIANCE	*POPULUS DELTOIDES* TEMPORARILY FLOODED WOODLAND ALLIANCE (A.636) Eastern 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) Western Great Plains Floodplain (CES303.678) Northwestern Great Plains Canyon (CES303.658) Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)
USFWS WETLAND SYSTEM:	Palustrine

CONCEPT SUMMARY

Globally

This riparian woodland association is described from major river systems of eastern Colorado, primarily the South Platte and Arkansas rivers and their major tributaries in the plains. It also occurs in the floodplains of the Yampa and Green rivers in northwestern Colorado. Stands may also occur in western Nebraska, New Mexico, eastern Wyoming and northeastern Utah. Sites are floodplains of major streams and rivers at elevations ranging from 1000 to 1700 m (3280-5600 feet). The floodplains of these rivers are typically wide and flat with a variety of depositional features present. Stands occur on higher terraces away from the active floodplain, where the soil surface is drier, but trees are able to tap the deeper water table. Flooding is infrequent on these terraces. Soils are well-drained, alkaline, poorly developed and typically derived from alluvium, eolian deposits and shale. A relatively open canopy of the broad-leaved deciduous tree *Populus deltoides* characterizes these woodlands, with cover varying from roughly 20% to over 70%. Other deciduous trees are occasionally present, including the natives *Salix amygdaloides* and *Acer negundo*, and several introduced species such as *Fraxinus pennsylvanica*, *Tamarix* spp., *Ulmus* spp., and *Elaeagnus angustifolia*. The shrub layer is poorly developed or entirely absent. Shrubs, when present, include *Ribes aureum, Rosa woodsii, Salix exigua, Symphoricarpos orbiculatus, Toxicodendron radicans*, and introduced *Tamarix* spp. The sparse to dense herbaceous layer is dominated by the perennial grass *Distichlis spicata* (6-70% cover). Herbaceous cover varies with tree canopy closure in that the more open woodlands have denser graminoid cover. *Sporobolus cryptandrus, Elymus canadensis*, and *Pascopyrum smithii* are other common perennial grasses. Many other graminoid and forb species may be common, including several introduced species, especially in disturbed stands.

DISTRIBUTION

Dinosaur National Monument

This association is known from Bobby's Hole on the Green River and in Deerlodge Park on the Yampa River. Stands are generally small and isolated along the monument's river corridors. It is likely that this community develops in abandoned meanders and overflow channels where fine sediment collects, drainage is slow and soils become alkaline.

Globally
This association occurs on the high plains east of the Rocky Mountain front in Colorado, as well as on the Colorado Plateau. Similar associations are reported for eastern Wyoming and western Nebraska (Jones and Walford 1995, G. Steinauer pers. comm. 1997). This association is likely also to occur in New Mexico and northeastern Utah.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association occurs on flat alluvial terraces several meters above the river level and can be described as an abandoned floodplain community. The soil is a clay loam, and leaf litter, downed trees and tree limbs are the primary nonvegetated ground cover. Elevation is close to 1700 m.

Globally
This type occurs on floodplains of major streams and rivers within the western portion of the Great Plains, as well as on the floodplains of larger streams of the Colorado Plateau. The climate is semi-arid and continental. Annual precipitation can fluctuate widely, varying from less than 25.4 cm (10 inches) to over 40.6 cm (16 inches), which falls mostly as summer rains in the Great Plains and is more evenly distributed throughout the year in the Colorado Plateau. Winters are short, with extreme variations in temperatures. Summers are long and hot.

Geologically, the region is underlain by sedimentary rock, which in some areas approaches the surface. Overlying layers, both on the uplands and within the river valleys, are primarily unconsolidated sediments. Deposits on the Great Plains are primarily Pleistocene glacial outwash, with some areas of eolian deposits (loess and sandhills). On the Colorado Plateau, rivers flow alternately through narrow canyons of sandstone and other resistant rocks and broad valleys formed in softer shales, where alluvium deposited over millennia forms broad floodplains. Elevations range from about 1070 to 1525 m (3500-5000 feet) on the Great Plains and are generally below 1710 m (5600 feet) on the Plateau River valleys. Both regions have gentle slopes, falling an average of 7 to 9 feet per mile.

The floodplains of these rivers are typically wide and flat. A variety of depositional and erosional features are present within the floodplain, such as active channels, overflow channels, terraces and alluvial fans. This association occurs on higher terraces away from the active floodplain, where the soil surface is drier, but trees are able to tap the deeper water table. Flooding is infrequent on these terraces. Soils are derived from alluvium, eolian deposits and sometimes shales. They are not well-developed and have a typical structure of bands or lenses of sand, clay, silt and gravel. They are low in organic matter and often are alkaline.

VEGETATION DESCRIPTION
Dinosaur National Monument
Populus deltoides ssp. *wislizeni* comprises the mature tree canopy with 90% cover and is 10 to 15 m high. The tall-shrub layer consists of *Tamarix ramosissima* with 20% cover, reaching 5 m in height. The herbaceous layer is dominated by *Elymus canadensis* with 30% cover, *Distichlis spicata*, 20% cover, and *Equisetum laevigatum*, 10% cover. The cottonwood is generally not reproducing.

Globally
This association is characterized by a relatively open canopy of the broad-leaved deciduous tree *Populus deltoides* ssp. *monilifera* in the Great Plains and the eastern third of New Mexico; *Populus deltoides* ssp. *wislizeni* occurs in western Colorado and New Mexico. Canopy cover varies from roughly 20% to more than 70%. In most stands the trees are large and uniformly sized, but density varies from 45 to 115 trees per hectare. Young *Populus deltoides* are absent from the community. Other deciduous trees are occasionally present, including the natives Salix amygdaloides and *Acer negundo*, and introduced species such as *Fraxinus pennsylvanica, Tamarix* spp., *Ulmus americana*, and *Elaeagnus angustifolia*. The shrub layer is poorly developed or absent, but broad-leaved deciduous shrubs occasionally occur. Species can include *Ericameria nauseosa, Ribes aureum, Rosa woodsii, Rhus trilobata, Salix exigua*, *Symphoricarpos orbiculatus*, and *Toxicodendron radicans*. The herbaceous layer is dominated by the perennial grass *Distichlis spicata*, with highly variable cover (from 6% to over 70%). This variation is apparently related to the degree of tree canopy closure in that more open stands of *Populus* have denser graminoid cover in the understory. *Sporobolus cryptandrus, Elymus canadensis*, and *Pascopyrum smithii* are other common perennial grasses but with less cover. The remainder of the herbaceous layer typically is a mix of graminoid, horsetail and forb species, and in most stands includes many introduced species, both annual and perennial. Total herbaceous cover is highly variable. Cryptograms are very uncommon.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Tree canopy	*Populus deltoides* ssp. *wislizeni*
Tall shrub/sapling	*Tamarix ramosissima*
Herb (field)	*Distichlis spicata, Elymus canadensis*
Herb (field)	*Equisetum laevigatum*

Globally

Stratum	Species
Tree canopy	*Populus deltoides* ssp. *monilifera*
Herb (field)	*Distichlis spicata, Sporobolus cryptandrus*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Bromus tectorum, Poa pratensis, Tamarix ramosissima

Globally
Bassia scoparia, Elymus repens, Tamarix chinensis, Tamarix ramosissima

CONSERVATION STATUS RANK

Global Rank & Reasons: G2 (4-Nov-1997). This association occurs along low-elevation rivers in a semi-arid region where agricultural activities and hydrologic modifications have had great impacts. Existing occurrences occur on the high plains east of the Rocky Mountain front in north-central and northeastern Colorado and along the Yampa River in northwestern Colorado. Similar associations have been reported for eastern Wyoming and western Nebraska (Jones and Walford 1995, G. Steinauer pers. comm. 1997). The *Populus deltoides* ssp. *wislizeni* form of this association is likely to occur also in western New Mexico and northeastern Utah. Water impoundments have altered the natural flood regimes; floodplains are used for pastures, hay fields and livestock grazing. Introduced species have invaded and, in the case of *Tamarix*, have increased soluble salts in the soils. The area of *Populus deltoides* (ssp. *wislizeni*, ssp. *monilifera*) / *Distichlis spicata* Woodland (CEGL000939) on the Arkansas River is small and apparently is decreasing due to the above reasons. The acreages of this association along the Arkansas and South Platte rivers are 2761 and 17,166 acres, respectively (1970 data). Stands along the Yampa River in and near Dinosaur National Monument total less than 10 acres. Most stands on the South Platte are composed of older trees.

CLASSIFICATION COMMENTS

Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Dinosaur National Monument Inventory Notes: This association does not differ much visually from other upland cottonwood stands in the monument. The significant cover of saltgrass is the main diagnostic element separating this association from other cottonwood associations.
Dinosaur National Monument Data Sources: This association is described from 2002 field data (1 plot: DINO.0133).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: M.S. Reid, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Carsey et al. 2003a, Christy 1973, Crouch 1961a, Crouch 1961b, Crouch 1978, Crouch 1979a, Crouch 1979b, Driscoll et al. 1984, Fitzgerald 1978, Jackson 1972, Jackson and Lindauer 1978, Jones and Walford 1995, Lindauer 1970, Lindauer 1983, Lindauer and Christy 1972, Lindauer and Fitzgerald 1974, Lindauer and Ward 1968, Lindauer et al. 1973, Masek 1979, McEachern 1979, Reid et al. 1994, Steinauer pers. comm., UNESCO 1973, Western Ecology Working Group n.d.

Populus deltoides ssp. *wislizeni* / *Acer negundo* Woodland
Rio Grande Cottonwood / Box-elder Woodland

CODE	CEGL002336
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Deciduous woodland (II.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous woodland (II.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous woodland (II.B.2.N.)
FORMATION	Temporarily flooded cold-deciduous woodland (II.B.2.N.b.)
ALLIANCE	*POPULUS DELTOIDES* TEMPORARILY FLOODED WOODLAND ALLIANCE (A.636) Eastern 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: Not applicable

CONCEPT SUMMARY

Globally

This association is described from its occurrences on narrow alluvial terraces in the canyons of the Yampa and Green rivers in northwestern Colorado and occurs farther south in southeastern Utah. Stands occupy wet areas of slot canyons and the rocky or sandy banks of the main channels. Soils are sandy and derived from alluvium, and may have large rocks scattered over the ground surface. The canopy consists of *Populus deltoides* ssp. *wislizeni* with between 40 and 55% cover, with a subcanopy dominated by *Acer negundo* with a cover of 10 to 45%. Other trees in the subcanopy may include *Juniperus osteosperma* and *Celtis laevigata* var. *reticulata*. Clumps of *Rhus trilobata, Fraxinus anomala,* or *Amelanchier utahensis* range from 15 to 30% cover, and there may be scattered individuals of *Chrysothamnus viscidiflorus, Krascheninnikovia lanata,* and *Opuntia polyacantha*. *Bromus tectorum* dominates the herbaceous layer with 10 to 20% cover. Other herbaceous species present, each with 1 to 5% cover, include *Elymus repens, Leymus cinereus, Sporobolus airoides, Distichlis spicata,* and *Lepidium latifolium.*

DISTRIBUTION

Dinosaur National Monument

This association is known from Echo Park and Moonshine Draw and may occur on upper alluvial terraces elsewhere along the Yampa River, as well as on the Green River below Echo Park, where the floodplain is broad enough to support the growth of cottonwoods.

Globally

This association is currently only described from the canyons of the Yampa and Green rivers in Dinosaur National Monument in northwestern Colorado and from Natural Bridges National Monument in Utah. It is likely to occur elsewhere in the southwestern U.S. No other distributional information is available.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs on flat to moderately sloping alluvial terraces within broad river floodplains. Elevation is below 1700 m, aspect is variable, and nonvegetated ground cover is primarily organic litter with some large rock. Sandy loam soils derived from alluvium comprise the primary substrate.

Globally

This association occurs on flat to moderately sloping alluvial terraces within broad river floodplains, or in slot canyons where alluvial terrace development is enough to support cottonwoods. Reported elevation ranges from 1650 to 1730 m, aspect is variable, and nonvegetated ground cover is primarily organic litter with some large rock. Sandy loam soils derived from alluvium comprise the primary substrates. Downed wood can be abundant.

VEGETATION DESCRIPTION

Dinosaur National Monument

Populus deltoides ssp. *wislizeni* comprises the tree canopy of this woodland association with 40 to 50% cover and

heights of 10 to 20 m. In the subcanopy, *Acer negundo* dominates with a cover of 20 to 40%. *Celtis laevigata* var. *reticulata* may also occur. The tall-shrub layer contributes 10% cover and may include *Rhus trilobata and Juniperus osteosperma*. There is no developed short-shrub layer, but scattered shrubs less than 1 m high include *Chrysothamnus viscidiflorus, Krascheninnikovia lanata,* and *Opuntia polyacantha*. *Bromus tectorum* dominates the herbaceous layer with 10 to 20% cover. Other herbaceous species present, each with 1 to 5% cover, include *Elymus repens, Leymus cinereus, Sporobolus airoides, Distichlis spicata,* and *Lepidium latifolium.*

Globally
Total vegetation cover often exceeds 100%. This riparian association is characterized by a tree canopy, typically 10-20 m tall, of *Populus deltoides* ssp. *wislizeni* and a subcanopy of *Acer negundo* trees. In some locations *Celtis laevigata* var. *reticulata* may also be important in the subcanopy. Typically, there is an abundant shrub layer of species typical to dry riparian terraces, such as *Fraxinus anomala, Rhus trilobata,* and *Amelanchier utahensis*; occasionally *Pinus edulis* or *Juniperus osteosperma* saplings or seedling occur in the shrub layer. There is no developed short-shrub layer, but scattered shrubs less than 1 m high might include *Chrysothamnus viscidiflorus, Krascheninnikovia lanata,* and *Opuntia polyacantha*. The herbaceous layer is diverse in composition but usually has sparse cover; species can include *Achnatherum hymenoides, Hesperostipa comata, Leymus cinereus, Sporobolus airoides, Distichlis spicata, Piptatherum micranthum, Heterotheca villosa, Machaeranthera canescens, Packera multilobata,* and *Thelypodium integrifolium*. The vine *Clematis ligusticifolia* can have high cover in some stands. Exotic species such as *Bromus tectorum, Elymus repens,* and *Lepidium latifolium* can be abundant.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Populus deltoides* ssp. *wislizeni*
Tree subcanopy	*Acer negundo, Celtis laevigata var. reticulata*
Herb (field)	*Bromus tectorum*

Globally

Stratum	**Species**
Tree canopy	*Populus deltoides* ssp. *monilifera*
Tree subcanopy	*Acer negundo*
Tall shrub/sapling	*Amelanchier utahensis, Fraxinus anomala, Rhus trilobata*
Herb (field)	*Clematis ligusticifolia*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum, Elymus repens, Lepidium latifolium

Globally
Bromus tectorum, Elymus repens, Lepidium latifolium

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (12-Jan-2005).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
This association has only been described from Dinosaur and Natural Bridges national monuments. Until further inventory is completed, global information is scanty.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association can easily be identified in the field where cottonwood and box-elder occur together.
Dinosaur National Monument Data Sources: This association is described from 2002 and 2003 field data (3 plots:

DINO.0020, DINO.0325, DINO.0691).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles, mod. M.S. Reid

REFERENCES: Western Ecology Working Group n.d.

Populus deltoides ssp. *wislizeni* / Disturbed Understory Woodland
Rio Grande Cottonwood / Disturbed Understory Woodland

CODE	CEGL003810
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Deciduous woodland (II.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous woodland (II.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous woodland (II.B.2.N.)
FORMATION	Temporarily flooded cold-deciduous woodland (II.B.2.N.b.)
ALLIANCE	*POPULUS DELTOIDES* TEMPORARILY FLOODED WOODLAND ALLIANCE (A.636) Eastern Cottonwood Temporarily Flooded Woodland Alliance
ECOLOGICAL SYSTEM(S):	North American Warm Desert Lower Montane Riparian Woodland and Shrubland (CES302.748) Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)
USFWS WETLAND SYSTEM:	Not applicable

CONCEPT SUMMARY
Globally
This association has only been described from Canyon de Chelly and Dinosaur national monuments, but it is likely to occur on abandoned floodplain terraces of low-gradient rivers and streams throughout the eastern Colorado Plateau of Colorado, Utah, New Mexico and northeastern Arizona. The association is best developed on level valley bottom sites that no longer flood and that have been subjected to a long history of domestic livestock grazing. The vegetation underneath the open gallery canopy of *Populus deltoides* ssp. *wislizeni* consists primarily of upland plants and is dominated by invasive exotic species such as *Bromus tectorum, Elymus repens, Acroptilon repens, Lepidium latifolium*, and *Poa pratensis*. Relict native grasses, shrubs and forbs may be present with relatively low cover.

DISTRIBUTION
Dinosaur National Monument
This association is common in the larger parks along the Green and Yampa rivers. Sampled sites include Island Park, Deerlodge Park, Rainbow Park and Split Mountain.

Globally
The range of *Populus deltoides* ssp. *wislizeni* extends from extreme southwestern Wyoming through Colorado west of the Continental Divide to northwestern New Mexico and northeastern Arizona; this association is likely to be common throughout this range on the high terraces of well-developed floodplains. It is currently known from Arizona, Colorado and Utah.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association occurs on high terraces or abandoned oxbows adjacent to the banks of the Green and Yampa rivers. It is a common type in most of the broad valleys that separate the major canyons. Most stands are on level ground, but one plot was on a 6-degree slope facing northwest. Elevations range between 1488 and 1717 m. Litter and bare soil cover most of the unvegetated surface, with only minor contributions from dead wood. Soils are sandy or silty and derived from alluvium.

Globally
This Colorado Plateau association is documented from canyons and broad valley bottoms that support developed floodplains with multiple terraces. Landforms include abandoned stream terraces and oxbows high enough above stream level that they rarely flood. The vegetation is isolated from the water table. Stands tend to occur on level to

gently sloping sites, that in northwestern Colorado lie between 1488 and 1720 m elevation. Soils are poorly developed and derived from sandy or silty alluvium, and large dead cottonwood branches and trunks litter the ground. Litter cover may be dense in some stands.

VEGETATION DESCRIPTION

Dinosaur National Monument

This riparian association is characterized by a canopy 10 to 20 m high of mature *Populus deltoides* ssp. *wislizeni* trees with between 10 and 40% cover. Most stands have tree cover between 10 and 30%. A sparse subcanopy consisting of scattered *Elaeagnus angustifolia, Acer negundo, Juniperus scopulorum,* or *Tamarix ramosissima* may be present with up to 2% cover. Shrubs may be present but do not contribute enough cover to constitute a layer; common species include *Artemisia tridentata* ssp. *tridentata, Ericameria nauseosa, and Salix exigua*. Herbaceous species provide substantial understory cover, and most species are exotic. The exotic grasses *Bromus tectorum, Poa pratensis,* or *Elymus repens* (or a hybrid of *Pascopyrum smithii* and *Elymus repens*) can contribute up to 65% cover. Other stands may have high cover of the exotic forb species *Lepidium latifolium, Acroptilon repens,* or *Sisymbrium altissimum*. Relict native species may occur scattered throughout stands, including *Hesperostipa comata, Sporobolus cryptandrus, Iva axillaris,* and *Heterotheca villosa*.

Globally

Because stands of this association are isolated from flood events and from the water table, the canopy generally consists of mature to decadent gallery stands of *Populus deltoides* ssp. *wislizeni* with no saplings or seedlings present. Canopy closure ranges between 10 and 40%. Other trees present in the canopy or subcanopy may include individuals or clumps of *Acer negundo, Juniperus scopulorum,* or exotic species *Elaeagnus angustifolia* and *Tamarix ramosissima*. The understory is composed primarily of upland plants, although relict riparian species such as *Salix exigua* or *Juncus balticus* may be present. Herbaceous species, especially invasive exotics, dominate the understory; the exotic grasses *Bromus tectorum, Bromus rigidus, Poa pratensis,* or *Elymus repens* (or a hybrid of *Pascopyrum smithii* and *Elymus repens*) can contribute up to 65% cover. Other stands have high cover of the exotic forbs *Lepidium latifolium, Acroptilon repens,* or *Sisymbrium altissimum*. Relict native species may occur scattered throughout stands, including *Hesperostipa comata, Sporobolus cryptandrus, Iva axillaris,* and *Heterotheca villosa*. Shrubs such as *Artemisia tridentata* ssp. *tridentata* and *Ericameria nauseosa* are often present, although they do not contribute enough cover (less than 5%) to constitute a stratum.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Populus deltoides* ssp. *wislizeni, Tamarix ramosissima*
Herb (field)	*Acroptilon repens, Chenopodium album, Heterotheca villosa, Iva axillaris, Lepidium latifolium, Sisymbrium altissimum*
Herb (field)	*Agropyron cristatum, Bromus tectorum, Hesperostipa comata, Pascopyrum smithii, Poa pratensis*

Globally

Stratum	**Species**
Tree canopy	*Populus deltoides* ssp. *wislizeni*
Herb (field)	*Acroptilon repens, Lepidium latifolium*
Herb (field)	*Bromus rigidus, Bromus tectorum*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Bromus tectorum, Elymus repens, Lepidium latifolium, Poa pratensis, Salsola tragus, Sisymbrium altissimum, Tamarix ramosissima

Globally

Acroptilon repens, Bromus rigidus, Bromus tectorum, Elymus repens, Lepidium latifolium, Poa pratensis, Salsola tragus, Sisymbrium altissimum, Tamarix ramosissima

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (11-May-2006).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
According to Gwen Kittel, University of Colorado graduate student Mary Ellen Ford is revising the taxonomy of western cottonwood species. If the taxonomic community accepts her work, *Populus fremontii* may be reduced to a subspecies of *Populus deltoides*. In this case, there will be four subspecies of *Populus deltoides*: ssp. *deltoides* of the eastern and midwestern states, ssp. *monilifera* of the Great Plains, ssp. *wislizeni* of western Colorado and the upper Rio Grande River drainage, and ssp. *fremontii* of the desert southwest. Associations based on ssp. *deltoides* in any case should be kept separate from the other three, as there is no overlap in ranges. Associations based on the three western subspecies should probably be considered as a single set, rather than three sets of parallel associations. The name of this association would therefore change to something like "*Populus deltoides* (ssp. *fremontii*, ssp. *monilifera*, ssp. *wislizeni*) / Disturbed Understory Woodland."

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This riparian association occurs in all the larger parks and valleys of the monument. It typically takes the form of decadent cottonwood gallery woodland with an understory carpeted in weedy grasses or forbs. Most stands have a lot of downed trees and branches covering the ground.
Dinosaur National Monument Data Sources: This association is described from 2005 accuracy assessment data (22 plots: DINO_AA.A1157, DINO_AA.A1306, DINO_AA.A1308, DINO_AA.A1309, DINO_AA.A1310, DINO_AA.A1311, DINO_AA.A1312, DINO_AA.A1313, DINO_AA.A1314, DINO_AA.A1315, DINO_AA.A1317, DINO_AA.A1319, DINO_AA.A1320, DINO_AA.A1321, DINO_AA.A1323, DINO_AA.A1324, DINO_AA.A1326, DINO_AA.A1328, DINO_AA.A1329, DINO_AA.A1331, DINO_AA.B1274, DINO_AA.A1316).
Local Description Authors: J. Coles
Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Western Ecology Working Group n.d.

Populus deltoides ssp. *wislizeni* / *Rhus trilobata* Woodland
Rio Grande Cottonwood / Threeleaf Sumac Woodland

CODE	CEGL000940
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Deciduous woodland (II.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous woodland (II.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous woodland (II.B.2.N.)
FORMATION	Temporarily flooded cold-deciduous woodland (II.B.2.N.b.)
ALLIANCE	*POPULUS DELTOIDES* TEMPORARILY FLOODED WOODLAND ALLIANCE (A.636) Eastern 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 woodland association is documented from the Colorado, Yampa and San Miguel/Dolores river basins in western Colorado and northeastern Utah below 1680 m (5500 feet) in elevation. An ecologically similar association with a different subspecies of cottonwood, *Populus deltoides* ssp. *monilifera*, is known from southeastern Colorado. Both of these associations represent a late-seral stage of maturing cottonwoods. The trees are usually large and widely spaced with thick patches of *Rhus trilobata* in between and underneath the overstory canopy. *Populus*

deltoides ssp. *wislizeni* with a *Rhus trilobata* understory form this late-seral plant association. *Populus angustifolia* becomes an important overstory component at higher elevations in the Colorado River basin. Other shrubs commonly present are *Artemisia tridentata* ssp. *tridentata, Cornus sericea, Chrysothamnus linifolius, Symphoricarpos* spp., *Shepherdia argentea, Tamarix ramosissima* (an exotic), and *Salix exigua*. The forb understory is usually sparse and consists mainly of *Cirsium arvense* (an exotic), *Asclepias speciosa*, and *Melilotus officinalis* (another exotic). Graminoid cover ranges from 10-30% and consists mostly of introduced species such as *Poa pratensis, Bromus inermis*, and *Elymus repens*.

DISTRIBUTION

Dinosaur National Monument

This association is known from a site in the vicinity of the pipeline that crosses the west end of the monument north of Split Mountain.

Globally

This woodland association is documented from the Colorado, Yampa, and San Miguel/Dolores river basins in western Colorado and adjacent Utah.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association was sampled in the depression of a developed spring. The center of the site is moist with mucky soil, while the outer margins are drier. Leaf litter comprises 85% of the nonvegetated ground cover. Elevation is below 1700 m.

Globally

This type is found along moderately large, snow-fed rivers on the west slope of Colorado and adjacent Utah, from roughly 1370 to 1720 m (4500-5640 feet) elevation. Climate is continental, with hot summers and cold winters. Precipitation is less than 38.1 cm (15 inches) annually. Sites where this association occurs vary from point bars and other depositional features (early-seral stands) to alluvial terraces (mature stands) that may be many meters away from the main channel and several meters above the high-water mark. It also occurs in depressions associated with upland springs. Mature cottonwoods are able to tap deeper water tables than seedlings. Soils are derived from alluvium and are deep, stratified sandy loams with cobbles. Point bars within the channels are composed of fresh alluvial sands and gravels.

VEGETATION DESCRIPTION

Dinosaur National Monument

This association has multiple layers. *Populus deltoides* ssp. *wislizeni* forms the tree canopy, has 30% cover and is 20 m high. Tall shrubs present include *Rhus trilobata* and *Artemisia tridentata* ssp. *tridentata*, with total cover less than 10%. *Chrysothamnus linifolius* comprises the short-shrub layer with 10% cover. The herbaceous layer is dominated by *Carex nebrascensis* with 10% cover. A number of other herbaceous species are present with minimal cover.

Globally

This association is dominated by broad-leaved deciduous species, both in the tree canopy and shrub layer. *Populus deltoides* ssp. *wislizeni* dominates the canopy, with cover varying from 15% to over 50%. Older, more mature stands will be characterized by a few large (up to 1 m dbh) trees with less canopy cover but large basal areas. Other trees occasionally present include *Populus angustifolia* and *Populus X acuminata*. The understory has a shrub layer also of varying cover but characterized by the presence of *Rhus trilobata*. Density and cover of shrubs, including *Rhus*, are related to the degree of livestock grazing, the age of the stand, and the density of the tree canopy. Middle-aged stands have dense *Rhus* cover, while in older stands individual shrubs are widely spaced. Other shrubs commonly present include *Artemisia tridentata* ssp. *tridentata, Chrysothamnus linifolius, Forestiera pubescens, Rosa woodsii*, and *Symphoricarpos occidentalis*, and the woody liana *Clematis ligusticifolia*. The herbaceous layer is generally sparse to moderately so, with an average cover less than 30%. Species composition varies somewhat, and many stands have abundant introduced grass species. Graminoids present in relatively undisturbed stands may include *Juncus balticus, Carex nebrascensis, Eleocharis palustris, Distichlis spicata, Elymus trachycaulus*, and *Hordeum jubatum*. Forbs are sparse.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**

Tree canopy	*Populus deltoides* ssp. *wislizeni*
Short shrub/sapling	*Chrysothamnus linifolius*
Herb (field)	*Carex nebrascensis*

Globally

Stratum	**Species**
Tree canopy	*Populus angustifolia, Populus deltoides* ssp. *wislizeni*
Shrub/sapling (tall & short)	*Clematis ligusticifolia*
Tall shrub/sapling	*Salix exigua*
Tall shrub/sapling	*Rhus trilobata*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Agropyron cristatum, Bromus tectorum, Poa pratensis

Globally
Bromus inermis, Elymus repens, Melilotus officinalis, Poa pratensis, Symphoricarpos occidentalis

CONSERVATION STATUS RANK
Global Rank & Reasons: G2 (5-Nov-1997). This association has only been documented from river floodplains of the lower Colorado, Yampa, and San Miguel rivers in extreme western Colorado (Keammerer 1974a, 1974b, Kittel and Lederer 1993). It has also been tentatively reported to occur in degraded stands along the Rio Grande in northern New Mexico. Nearly all the existing stands are considered to be in decline due to altered hydrology from upstream impoundments and the long-term effects of livestock grazing. *Populus* regeneration is poor at all sites, and tamarisk (Tamarix ramosissima) is invading stands of this type on the lower Colorado River near Grand Junction, Colorado.

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is likely to be uncommon. The stand of cottonwoods is not associated with a river, but with an isolated ravine, where cottonwoods are less likely to get established.
Dinosaur National Monument Data Sources: This association is described from 2002 field data (1 plot: DINO.0432).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: M.S. Reid, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Carsey et al. 2003a, Driscoll et al. 1984, Keammerer 1974a, Keammerer 1974b, Kittel and Lederer 1993, Kittel et al. 1999a, Reid 1990, U.S. Bureau of Reclamation 1976, UNESCO 1973, Western Ecology Working Group n.d.

Arctostaphylos patula - Artemisia tridentata (ssp. *vaseyana*, ssp. *wyomingensis*) Shrubland
Greenleaf Manzanita - (Mountain Big Sagebrush, Wyoming Big Sagebrush) Shrubland

CODE	CEGL002694
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Evergreen shrubland (III.A.)
PHYSIOGNOMIC GROUP	Temperate broad-leaved evergreen shrubland (III.A.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate broad-leaved evergreen shrubland (III.A.2.N.)
FORMATION	Sclerophyllous temperate broad-leaved evergreen shrubland (III.A.2.N.c.)
ALLIANCE	*ARCTOSTAPHYLOS PATULA* SHRUBLAND ALLIANCE (A.788) Greenleaf Manzanita Shrubland Alliance

ECOLOGICAL SYSTEM(S): Great Basin Semi-Desert Chaparral (CES304.001)

Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This mixed mountain shrubland association is characteristic of windswept highlands in the Colorado Plateau. It occurs in isolated patches on plateaus and mesas with gentle to moderate slopes and variable aspects. Elevations range from 1950 to 2500 m (6400-8200 feet). Most of the unvegetated surface is covered by litter, with occasional bedrock exposures. Soils are generally thin, coarse-textured, rapidly drained and derived from sandstone. This association often has a total vegetative cover of 60-85%. It is dominated by moderate to dense cover of *Arctostaphylos patula*. *Artemisia tridentata* ssp. *vaseyana* or *Artemisia tridentata* ssp. *wyomingensis* may be present to codominant. *Amelanchier alnifolia, Amelanchier utahensis, Tetradymia canescens, Ericameria nauseosa, Yucca* spp., and *Opuntia* spp. are also commonly present and may contribute 5 to 20% cover. The herbaceous layer is very sparse but will often include *Carex rossii, Comandra umbellata, Eriogonum umbellatum, Poa fendleriana,* and *Bouteloua gracilis.*

DISTRIBUTION

Dinosaur National Monument

This association is known from the high plateaus of Stuntz Ridge and Buckwater Ridge in the south-central region of the monument.

Globally

This association has been described from Zion National Park in southwestern Utah and Dinosaur National Monument in northwestern Colorado. It is likely to occur in isolated stands throughout the Colorado Plateau and Great Basin.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs on level to gently sloping plateaus and mesas at elevations ranging from 2200 to 2500 m. Sites typically occur on sandstone geologic formations. Soils are coarse-textured and rapidly drained.

Globally

This association occurs in isolated patches on windward sites on plateaus and mesas in the Colorado Plateau. It is likely also to be found within the Great Basin. Sites may be gently to moderately sloping with variable aspect. Elevations range from 1950 to 2500 m (6400-8200 feet). Most of the unvegetated surface is covered by litter, with occasional bedrock exposures. Soils are generally thin, coarse-textured, rapidly drained and derived from sandstone.

VEGETATION DESCRIPTION

Dinosaur National Monument

This mixed mountain shrubland association is dominated by moderate to dense cover of *Arctostaphylos patula*. *Artemisia tridentata* ssp. *vaseyana* or *Artemisia tridentata* ssp. *wyomingensis* is associated with lesser cover, typically 10%. *Amelanchier alnifolia* or *Amelanchier utahensis* are also commonly present and emerging above the shorter shrub layer contributing 5 to 20% cover. Common associated herbaceous species are *Carex rossii* and *Poa fendleriana*, both with minimal percent cover.

Globally

This mixed mountain shrubland association is characteristic of windswept highlands in the Colorado Plateau and has a total vegetation cover of 60- 85%. It is dominated by moderate to dense cover of *Arctostaphylos patula. Artemisia tridentata* ssp. *vaseyana* or *Artemisia tridentata* ssp. *wyomingensis* may be present to codominant. *Amelanchier alnifolia, Amelanchier utahensis, Tetradymia canescens, Ericameria nauseosa, Yucca* spp., and *Opuntia* spp. are also commonly present and may contribute 5 to 20% cover. The herbaceous layer is very sparse but will commonly include *Carex rossii, Comandra umbellata, Eriogonum umbellatum, Poa fendleriana,* and *Bouteloua gracilis.*

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Tall shrub/sapling	*Amelanchier alnifolia, Amelanchier utahensis*
Short shrub/sapling	*Arctostaphylos patula, Artemisia tridentata* ssp. *vaseyana, Artemisia tridentata* ssp. *wyomingensis*

Globally

Stratum	**Species**
Tall shrub/sapling	*Arctostaphylos patula, Artemisia tridentata* ssp. *vaseyana*
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is uncommon in the monument.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (2 plots: DINO.0190, DINO.0310).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

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

Ceanothus velutinus Shrubland
Tobacco-brush Shrubland

CODE	CEGL002167
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Evergreen shrubland (III.A.)
PHYSIOGNOMIC GROUP	Temperate broad-leaved evergreen shrubland (III.A.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate broad-leaved evergreen shrubland (III.A.2.N.)
FORMATION	Sclerophyllous temperate broad-leaved evergreen shrubland (III.A.2.N.c.)
ALLIANCE	*CEANOTHUS VELUTINUS* SHRUBLAND ALLIANCE (A.787) Tobacco-brush Shrubland Alliance
ECOLOGICAL SYSTEM(S):	Rocky Mountain Lodgepole Pine Forest (CES306.820) Rocky Mountain Aspen Forest and Woodland (CES306.813) Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)
USFWS WETLAND SYSTEM:	Not applicable

CONCEPT SUMMARY
Globally
Patches of this early-seral shrubland occur on montane slopes in western Colorado, northwestern Wyoming and the Black Hills of South Dakota, although it is likely to be more common and widespread than is currently reported. Stands have been recorded above 1400 m (4500 feet) elevation in South Dakota and as high as 2690 m (8825 feet) in western Colorado. Typical occurrences are an acre or two in size and are somewhat isolated, as they are usually part of a mosaic of post-burn vegetation types. Sites range from moderate to steep (14-73% slope) and tend to prefer

cooler north or east aspects. Parent materials are variable, and soils are well-drained, rocky and generally coarse in texture. *Ceanothus velutinus* is a slow-growing shrub; it may take 20 years following fire before the shrub will dominate a stand. The vegetation in mature stands is dominated by a uniform layer of 1- to 2-m tall shrubs. *Ceanothus velutinus* is the major dominant, although there may be a few scattered *Symphoricarpos* spp., *Mahonia repens, Artemisia tridentata, Cercocarpus* spp., *Rosa* spp., *Amelanchier* sp., and *Prunus virginiana*, among others. A variety of herbaceous species may be present, including *Carex geyeri, Achnatherum* spp., *Hesperostipa comata, Elymus* spp., *Heterotheca villosa, Balsamorhiza sagittata, Eriogonum umbellatum, Geranium viscosissimum, Thalictrum* sp., and *Campanula rotundifolia*, and may occur in the looser "openings" in the shrub layer, but *Ceanothus velutinus* can form a dense canopy and shade out the ground layer. Seedlings and saplings of *Populus tremuloides* or *Pseudotsuga menziesii* may have nearly as much cover as the shrub layer.

DISTRIBUTION

Dinosaur National Monument

This association occurs on the high ridges and slopes of Douglas Mountain.

Globally

This shrubland is found in the Black Hills of South Dakota, western Colorado and northwestern Wyoming. It is likely to be locally abundant throughout the Rocky Mountains.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs at high elevations (above 2500 m) on gentle to moderate slopes with various aspects. Its soils are typically silty or sandy loams of rocky ridges and slopes. Stands are usually quite small in size and part of a mosaic of post-burn vegetation types.

Globally

Patches of this early-seral montane shrubland occur on mesic slopes and mountains in western Colorado, northwestern Wyoming and the Black Hills of South Dakota. Stands have been recorded above 1400 m (4500 feet) elevation in South Dakota and as high as 2690 m (8825 feet) in western Colorado. Typical occurrences are an acre or two in size and are somewhat isolated, as they are usually part of a mosaic of post-burn vegetation types. Sites range from moderate to steep (14-73% slope) and tend to prefer cooler north or east aspects. Parent materials are variable, and soils are well-drained, rocky and generally coarse in texture.

VEGETATION DESCRIPTION

Dinosaur National Monument

Dominance of *Ceanothus velutinus* in association with a high diversity of other shrubs and herbaceous species characterizes this shrubland community. *Ceanothus velutinus* is the only consistently occurring species and has 5 to 20% cover. Other shrubs that may occur with sparse cover are Symphoricarpos oreophilus, *Cercocarpus* spp., *Prunus virginiana*, and *Rosa woodsii*. Common herbaceous species include *Achnatherum* spp., *Hesperostipa comata, Elymus* spp., and *Heterotheca villosa*.

Globally

Ceanothus velutinus is a slow-growing shrub; it may take 20 years following fire before the shrub will dominate a stand. The vegetation is dominated by a uniform layer of 1- to 2-m tall shrubs. *Ceanothus velutinus* is the major dominant, although there may be a few scattered *Spiraea betulifolia, Symphoricarpos* spp., *Mahonia repens, Artemisia tridentata, Cercocarpus* spp., *Rosa* spp., *Amelanchier* sp., and *Prunus virginiana*, among others. A variety of herbaceous species may be present, including *Carex geyeri, Achnatherum* spp., *Hesperostipa comata, Elymus* spp., *Heterotheca villosa, Balsamorhiza sagittata, Eriogonum umbellatum, Geranium viscosissimum, Thalictrum* sp., and *Campanula rotundifolia*, and may occur in the looser "openings" in the shrub layer, but *Ceanothus velutinus* can grow together quite densely and shade out the ground layer. In mature stands, seedlings and saplings of the regenerating aspen or Douglas-fir forest may have nearly as much cover as the shrub layer.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Ceanothus velutinus*

Globally

Stratum	**Species**
Short shrub/sapling	*Ceanothus velutinus*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (3-Oct-1996).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Most of the major habitat typing studies in the western U.S. do not characterize seral types, so it should not be any surprise that this type is poorly described and sampled. The alliance and association concepts remain somewhat tentative and need review as more data become available. This type is likely to be widespread in the Rocky Mountains of Colorado, Wyoming and Montana, but was originally described from observations by D. Ode (pers. comm. 1999) at three sites in the Black Hills: (1) on the northwest-facing top slope of Terry Peak, present since at least the 1960s; (2) on north-facing slopes of Mt. Theodore Roosevelt located just north of Deadwood; and (3) in a powerline corridor near Spearfish Peak above Spearfish Canyon. The biggest stands might be in the Bear Lodge, but the largest seen is 2-3 acres on Terry Peak, surrounded by aspen; it generally does not occur under the aspen. Thilenius (1971) reports *Ceanothus velutinus* in his *Populus tremuloides / Spiraea betulifolia / Lathyrus ochroleucus* type as having a constancy of 25%, compared with much higher constancies (>85%) for *Spiraea betulifolia* and *Symphoricarpos albus* (H. Marriott pers. comm. 1999). Thilenius (1971) also describes a *Ceanothus velutinus* shrubland type on old forest burns in the Igneous Cone area of the northern Hills (this refers to the zone of Tertiary igneous features (knobs, buttes, etc.). It also occurs under the *Pinus ponderosa* canopy on unburned sites in the region. It is difficult to know from his report how significant these stands are and whether they constitute an association, as he also recognizes *Pinus flexilis* and *Pinus contorta* types for the Black Hills, both of which are really only minor (though unusual) species populations in other *Pinus ponderosa* types.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association typically occurs in small patches in a mosaic of post-burn communities. It is not common and usually occurs under somewhat constrained environmental conditions, such as post-fire disturbance and cool, moist climate conditions of high elevations and northerly exposures.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (2 plots: DINO.0530, DINO.0537).
Local Description Authors: J. Thompson, mod J. Coles
Global Description Authors: D. Ode, mod. D. Faber-Langendoen, G. Kittel, J. Coles

REFERENCES: Anderson 2001a, Marriott pers. comm., Midwestern Ecology Working Group n.d., Ode pers. comm., Thilenius 1971

Cercocarpus intricatus Montane Shrubland
Littleleaf Mountain-mahogany Montane Shrubland

CODE	CEGL002587
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Evergreen shrubland (III.A.)
PHYSIOGNOMIC GROUP	Temperate broad-leaved evergreen shrubland (III.A.2.)

PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate broad-leaved evergreen shrubland (III.A.2.N.)
FORMATION	Sclerophyllous temperate broad-leaved evergreen shrubland (III.A.2.N.c.)
ALLIANCE	*CERCOCARPUS INTRICATUS* SHRUBLAND ALLIANCE (A.2659) Littleleaf Mountain-mahogany Shrubland 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 montane association occurs on exposed peaks, ridges and plateaus in the Colorado Plateau of western Colorado and eastern Utah. Elevations range from 1850 to 2650 m (6070-8700 feet). Sites are on level to gentle slopes that may be oriented to any aspect. Plants are rooted in cracks and potholes in the limestone or sandstone bedrock. Exposed bedrock, gravel and large rock cover much of the surface area. Soil collects only in depressions and crevices of the rocky surface and is generally a poorly developed sandy loam. The vegetation is dominated by low-statured *Cercocarpus intricatus* with more than 10% cover. Other shrubs with lesser cover commonly associated include *Amelanchier utahensis, Cercocarpus montanus, Ephedra viridis, Eriogonum corymbosum*, and *Symphoricarpos oreophilus*. The herbaceous layer is diverse but sparse in cover and may include the graminoids *Leymus salinus, Poa fendleriana, Pseudoroegneria spicata, Poa fendleriana, Achnatherum hymenoides, Koeleria macrantha*, and the cushion forbs *Arenaria fendleri, Petrophyton caespitosum*, and *Phlox* spp. Scattered individuals of *Pinus edulis* or *Juniperus osteosperma* may occur in stunted, shrublike form rarely exceeding 2 m in height and not exceeding 5% cover.

DISTRIBUTION

Dinosaur National Monument

This association was sampled on Tanks Peak and may occur in small patches on other high peaks and ridges.

Globally

This association is documented from Blue Mountain within Dinosaur National Monument in northwestern Colorado as well as from slickrock sites in Canyonlands National Park in eastern Utah. It probably also occurs on other high limestone ridges in northwestern Colorado, such as Douglas Mountain and Cold Springs Mountain. It may also occur in analogous habitats in southwestern Wyoming and elsewhere in the Colorado Plateau.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs at high elevations (above 2500 m) of windblown mountain peaks and ridges. Limestone bedrock, gravel, and large rock cover much of the surface area. The soil, filling the depressions and crevices of the rocky surface, is a poorly developed sandy loam.

Globally

This montane association occurs on exposed peaks, ridges and plateaus in the Colorado Plateau of western Colorado and eastern Utah. Elevations range from 1850 to 2650 m (6070-8700 feet). Slopes are gentle, and sites may be oriented to any aspect. Plants are rooted in cracks and potholes in the limestone or sandstone bedrock. Exposed bedrock, gravel and large rock cover much of the surface area. Soil collects only in depressions and crevices of the rocky surface and is generally a poorly developed sandy loam.

VEGETATION DESCRIPTION

Dinosaur National Monument

This association is dominated by *Cercocarpus intricatus* with more than 20% cover. Other shrubs with lesser cover commonly associated include *Amelanchier utahensis, Cercocarpus montanus*, and *Symphoricarpos oreophilus*. The herbaceous layer is diverse but sparse in cover and includes *Pseudoroegneria spicata, Poa fendleriana, Achnatherum hymenoides, Koeleria macrantha*, and the cushion forbs *Petrophyton caespitosum* and *Phlox* spp.

Globally

This montane shrubland association is dominated by *Cercocarpus intricatus* with more than 10% cover. Other shrubs with lesser cover commonly associated include *Amelanchier utahensis, Cercocarpus montanus, Ephedra viridis, Eriogonum corymbosum*, and *Symphoricarpos oreophilus*. The herbaceous layer is diverse but sparse in

cover and may include the graminoids *Leymus salinus, Poa fendleriana, Pseudoroegneria spicata, Poa fendleriana, Achnatherum hymenoides, Koeleria macrantha,* and the cushion forbs *Arenaria fendleri, Petrophyton caespitosum,* and *Phlox* spp. Scattered individuals of *Pinus edulis* or *Juniperus osteosperma* may occur in stunted, shrublike form rarely exceeding 2 m in height and not exceeding 5% cover.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	Species
Short shrub/sapling	*Cercocarpus intricatus*
Herb (field)	*Carex rossii*

Globally

Stratum	Species
Short shrub/sapling	*Cercocarpus intricatus*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Bromus tectorum

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (7-Apr-2005).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
This type represents *Cercocarpus intricatus* shrublands at a much higher density than usually occurs on slickrock. The only difference between this association and *Cercocarpus intricatus* Slickrock Sparse Vegetation (CEGL002977) is the density of *Cercocarpus intricatus* (>10%). Otherwise the setting is similar and the associated species are very similar.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This type represents *Cercocarpus intricatus* shrublands at a much higher density than usually occurs on slickrock.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (2 plots: DINO.0816, DINO.0909, and 1 observation point: DINO.9912).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

Artemisia arbuscula ssp. *longiloba* / *Elymus lanceolatus* Shrubland
Alkali Sagebrush / Streamside Wild Rye Herbaceous Vegetation

CODE	CEGL002585
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 ARBUSCULA* SSP. *LONGILOBA* SHRUBLAND ALLIANCE (A.2549) Alkali 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 in northwestern Colorado and adjacent Utah, as well as southwestern Wyoming. Elevations range between 1600 and 2450 m (5250 -8040 feet), and sites are on gentle to moderately steep slopes oriented to any aspect. Soils are typically shallow and rocky with a clay loam texture, as they are derived from underlying Mancos, Morrison, Wasatch or Green River shale. Ground cover is mostly bare soil with organic litter concentrated under the shrubs. Surface gullying in many sites indicates that precipitation tends to run off rather than be absorbed by the soil. The vegetation is characterized by 10 to 30% cover of the dwarf-shrub *Artemisia arbuscula* ssp. *longiloba*. Other low-statured shrubs that may be present with low cover include *Atriplex confertifolia* and *Krascheninnikovia lanata*. The herbaceous layer is dominated by *Elymus lanceolatus* with 5 to 10% cover. Other common grasses include *Achnatherum hymenoides* and *Poa secunda*. Forb species are variable, but *Phlox hoodii* appears throughout the range. Total vegetation cover rarely exceeds 30%.

DISTRIBUTION

Dinosaur National Monument

This association is known from Rainbow Park and Lily Park, where extensive exposures of shale are common.

Globally

This association is known from high plateaus in northwestern Colorado and adjacent Utah, as well as southwestern Wyoming.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs on gentle to moderately sloping Mancos or Morrison shale hills at the edges of major valleys within the monument, at elevations below 1800 m. Soils are typically shallow and rocky and clayey in texture. Ground cover is mostly bare soil with organic litter concentrated under the shrubs.

Globally

This association occurs in northwestern Colorado and adjacent Utah, as well as southwestern Wyoming. Elevations range between 1600 and 2450 m (5250 -8040 feet), and sites are on gentle to moderately steep slopes oriented to any aspect. Soils are typically shallow and rocky and have a clay loam texture, as they are derived from underlying Mancos, Morrison, Wasatch or Green River shale. Ground cover is mostly bare soil with organic litter concentrated under the shrubs. Bare ground, gravel and litter cover most of the unvegetated ground surface, and surface gullying in many sites indicates that precipitation tends to run off rather than be absorbed by the soil.

VEGETATION DESCRIPTION

Dinosaur National Monument

This dwarf-shrub association is characterized by 20 to 30% cover of the dwarf-shrub *Artemisia arbuscula* ssp. *longiloba*. Other low-statured shrubs that may be present with low cover include *Opuntia fragilis, Opuntia polyacantha, Gutierrezia sarothrae, Atriplex confertifolia*, and *Krascheninnikovia lanata*. The herbaceous layer is dominated by *Elymus lanceolatus* with 5 to 10% cover. Other common grasses include *Achnatherum hymenoides* and *Hesperostipa comata*.

Globally

The vegetation is characterized by 10 to 30% cover of the dwarf-shrub *Artemisia arbuscula* ssp. *longiloba*. Other low-statured shrubs that may be present with low cover include *Atriplex confertifolia* and *Krascheninnikovia lanata*. The herbaceous layer is dominated by *Elymus lanceolatus* with 5 to 10% cover. Other common grasses include *Achnatherum hymenoides* and *Poa secunda*. Forb species are variable, but *Phlox hoodii* appears throughout the range. Total vegetation cover rarely exceeds 30%.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Short shrub/sapling	*Artemisia arbuscula* ssp. *longiloba*
Herb (field)	*Elymus lanceolatus*

Globally

Stratum	**Species**
Short shrub/sapling	*Artemisia arbuscula* ssp. *longiloba*
Herb (field)	*Elymus lanceolatus*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (6-Apr-2005).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Elymus lanceolatus can be difficult to distinguish from *Pseudoroegneria spicata* and also from their hybrid, *Elymus albicans*. All three entities occur within the range of this association. It may be worth considering combining this association with *Artemisia arbuscula* ssp. *longiloba* / *Pseudoroegneria spicata* Shrub Herbaceous Vegetation (CEGL001416) and include stands with *Elymus albicans* as well.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Artemisia arbuscula ssp. *longiloba* can be mistaken for *Artemisia nova* or a short-statured *Artemisia tridentata* ssp. *wyomingensis*. Their ranges of distribution overlap, and environmental characteristics associated with each of these species are similar. The stands of this association occur in situations (barren gray shales) where one might otherwise expect to find *Atriplex confertifolia* or *Atriplex corrugata* shrublands.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (2 plots: DINO.0130, DINO.0595).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

Artemisia nova / Pseudoroegneria spicata Shrubland
Black Sagebrush / Bluebunch Wheatgrass Shrubland

CODE	CEGL001424
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Evergreen shrubland (III.A.)
PHYSIOGNOMIC GROUP	Microphyllous evergreen shrubland (III.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural microphyllous evergreen shrubland (III.A.4.N.)
FORMATION	Lowland microphyllous evergreen shrubland (III.A.4.N.a.)
ALLIANCE	*ARTEMISIA NOVA* SHRUBLAND ALLIANCE (A.1105) Black Sagebrush Shrubland Alliance
ECOLOGICAL SYSTEM(S):	Great Basin Xeric Mixed Sagebrush Shrubland (CES304.774) Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762) Wyoming Basins Dwarf Sagebrush Shrubland and Steppe (CES304.794) Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785)
USFWS WETLAND SYSTEM:	Not applicable

CONCEPT SUMMARY
Globally

This common black sagebrush association occurs from northern Nevada to Colorado and north to Idaho and Montana. Sites are located on gently to moderately sloping, dry, often windswept hills and ridges that may be oriented to any aspect. Elevation ranges from 1400 to 2610 m (4600-8560 feet). Soils are shallow, gravelly and are often high in calcium carbonate. Rock and gravel cover much of the unvegetated ground surface. The vegetation is characterized by a low-shrub canopy dominated by Artemisia nova with 5 to 30% cover. Other shrubs are generally present, although with very low cover, including *Artemisia tridentata, Chrysothamnus viscidiflorus, Grayia spinosa, Symphoricarpos longiflorus*, and *Gutierrezia sarothrae*. Graminoids usually dominate the diverse herbaceous layer, with Pseudoroegneria spicata being the most conspicuous of as many as 10 species, including *Poa secunda, Achnatherum hymenoides, Pascopyrum smithii, Koeleria macrantha, Carex filifolia, Elymus trachycaulus, Pleuraphis jamesii*, and *Hesperostipa comata*. Sparse forbs are usually present and may include *Phlox hoodii, Crepis acuminata, Astragalus miser, Stenotus acaulis, Phlox diffusa, Artemisia frigida,* and *Calochortus* spp. Some sites have scattered *Juniperus osteosperma* trees.

DISTRIBUTION

Dinosaur National Monument

This association occurs on the high-elevation plateaus and mountains of the monument, specifically Douglas Mountain, Wild Mountain, Split Mountain and Round Top Mountain. It is restricted to limestone or substrates derived from limestone.

Globally

This common and widespread association is known from northern Nevada to Colorado and north to Idaho and Montana, including the Owl Creek, Absaroka and Laramie ranges and the Wind River Basin in Wyoming and the Uinta Basin of northwestern Colorado.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occupies a variety of aspects of level to moderately sloping windswept ridges and knobs at elevations ranging from 2010 to 2610 m. The geology of these high mountain ridges is commonly Madison, Morgan, or Park City formations consisting of limestone, limy sandstones and calcareous shale. Soils are uniformly thin, with textures ranging from gravelly, silt or clay loam. Much of the ground is covered by small and large rock with lesser cover of bare ground and litter.

Globally

This association occurs from northern Nevada to Colorado and north to Idaho and Montana. Sites are located on gently to moderately sloping, dry, windswept hills and ridges that may be oriented to any aspect. Elevation ranges from 1400 to 2610 m (4600-8560 feet). Soils are shallow, gravelly and are often high in calcium carbonate. Rock and gravel cover much of the unvegetated ground surface.

VEGETATION DESCRIPTION

Dinosaur National Monument

This dwarf-shrubland association is a diverse community that is strongly dominated by *Artemisia nova* with 5 to 20% cover. Other shrubs commonly present with minimal cover include *Eriogonum microthecum, Gutierrezia sarothrae*, and *Artemisia frigida*. *Pseudoroegneria spicata* is always present in the herbaceous layer and is generally dominant. The grass layer is generally well-developed and typically includes at least a trace of *Koeleria macrantha, Poa fendleriana*, and/or *Poa secunda*. The forb species are highly diverse and many are cushion plants adapted to the harsh windy environment. The most consistently occurring species include *Astragalus spatulatus, Stenotus acaulis, Leptodactylon pungens, Phlox* spp., *Cryptantha* spp., and *Petradoria pumila*.

Globally

The vegetation is characterized by a low-shrub canopy dominated by *Artemisia nova* with 5 to 30% cover. Other shrubs are generally present, although with very low cover, including *Artemisia tridentata, Chrysothamnus viscidiflorus, Grayia spinosa, Symphoricarpos longiflorus*, and *Gutierrezia sarothrae*. Graminoids usually dominate the diverse herbaceous layer, with *Pseudoroegneria spicata* being the most conspicuous of as many as 10 species, including *Poa secunda, Achnatherum hymenoides, Pascopyrum smithii, Koeleria macrantha, Carex filifolia, Elymus trachycaulus, Pleuraphis jamesii*, and *Hesperostipa comata*. Sparse forbs are usually present and may include *Phlox hoodii, Crepis acuminata, Astragalus miser, Stenotus acaulis, Phlox diffusa, Artemisia frigida,* and *Calochortus* spp. Some sites have scattered *Juniperus osteosperma* trees.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	Species
Short shrub/sapling	*Artemisia nova, Eriogonum microthecum*
Herb (field)	*Stenotus acaulis*
Herb (field)	*Koeleria macrantha, Poa secunda, Pseudoroegneria spicata*

Globally

Stratum	Species
Short shrub/sapling	*Artemisia nova*
Herb (field)	*Pseudoroegneria spicata*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G4G5 (1-Feb-1996). This is a common and widespread shrubland type occurring in the Great Basin, Wyoming Basins and Uinta Basin. However, this is generally a small- to moderate-patch community, limited by habitat requirements that are more specific than surrounding matrix communities.

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is easily recognized in the field and supported by several field plots and observations. It often occurs adjacent to, or at least in the vicinity of, *Pseudoroegneria spicata* Herbaceous Vegetation (CEGL001660). The species lists of these two communities is roughly similar; they are differentiated by the presence or absence of *Artemisia nova*.
Dinosaur National Monument Data Sources: The description is based on 2002 and 2003 field data (21 plots: DINO.0186, DINO.0210, DINO.0219,DINO.0 248, DINO.0259, DINO.0268, DINO.0346, DINO.0373, DINO.0521, DINO.0557, DINO.0563, DINO.0570, DINO.0579, DINO.0581, DINO.0681, DINO.0685, DINO.0701, DINO.0702, DINO.0721, DINO.0808, DINO.0809).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Baker 1983c, Baker and Kennedy 1985, Blackburn et al. 1968c, Blackburn et al. 1971, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Fisser 1962, Fisser 1970, Hughes 1977, Jones 1992b, Jones and Ogle 2000, Kagan et al. 2000, Lucky McMine Application n.d., MTNHP 2002b, NVNHP 2003, Soil Conservation Service 1978, Tweit and Houston 1980, Zamora and Tueller 1973

Artemisia nova Shrubland
Black Sagebrush Shrubland

CODE	CEGL001417
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Evergreen shrubland (III.A.)
PHYSIOGNOMIC GROUP	Microphyllous evergreen shrubland (III.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural microphyllous evergreen shrubland (III.A.4.N.)

FORMATION	Lowland microphyllous evergreen shrubland (III.A.4.N.a.)
ALLIANCE	*ARTEMISIA NOVA* SHRUBLAND ALLIANCE (A.1105) Black Sagebrush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Great Basin Xeric Mixed Sagebrush Shrubland (CES304.774)
Colorado Plateau Mixed Low Sagebrush Shrubland (CES304.762)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This broadly defined association is reported from eastern Wyoming and western Colorado to eastern California but may be found elsewhere in the interior western U.S. Stands occur at middle to upper elevations of 1400 to 2730 m (4590-8960 feet) on mountain and hillslopes, ridges, mesatops, alluvial fans and river bluffs. Sites are nearly level to steeply sloping; aspects are variable. Soils are shallow (often <30 cm deep), well-drained, and coarse-textured with high cover of gravel and cobble (desert pavement). Soil texture ranges from gravelly loam to sandy clay loam. The vegetation is characterized by an open to moderately dense (12-40% cover) dwarf-shrub layer (<0.5 m tall) that is dominated by *Artemisia nova*. Other woody species present include *Picrothamnus desertorum, Atriplex confertifolia, Artemisia tridentata, Chrysothamnus viscidiflorus, Ericameria nauseosa, Ephedra* spp., *Grayia spinosa, Krascheninnikovia lanata,* and *Opuntia erinacea*. Diagnostic of this community is a sparse herbaceous understory with only scattered grasses and forbs. Common grasses may include *Achnatherum hymenoides, Aristida purpurea, Hesperostipa comata, Pleuraphis jamesii, Pseudoroegneria spicata,* and *Poa secunda*. Forbs such as *Erysimum capitatum, Erigeron aphanactis, Stenotus acaulis,* and *Phlox* spp. may also be present. Scattered trees may be present, such as *Juniperus osteosperma, Pinus edulis, Pinus monophylla,* or *Yucca brevifolia,* depending on location. Introduced species are important in some stands and may include *Bromus tectorum, Salsola kali,* and *Halogeton glomeratus*.

DISTRIBUTION

Dinosaur National Monument

This association is known from South Cub Creek and the Sounds of Silence trail in the western part of the monument and from Bill White Hogback on the eastern border.

Globally

This association occurs from eastern Wyoming south to west-central Colorado and west to eastern California.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occupies steep, gravelly slopes at elevations of 1600 to 1750 m. Soils are shallow, sandy clays with ground cover consisting of mostly small rock and litter. Cryptogamic crust is common but variable in percent cover.

Globally

Stands occur at middle to upper elevations (1400-2730 m) on mountain and hillslopes, ridges, mesatops, alluvial fans and river bluffs. Sites are nearly level to steeply sloping; aspects are variable, but stands are reported from northwestern slopes. Soils are often shallow (<30 cm deep), well-drained, calcareous and coarse-textured with high cover (35-70% cover) of gravel and cobble (desert pavement). Soil texture ranges from gravelly loam to sandy clay loam. Adjacent vegetation includes *Juniperus osteosperma*-dominated woodlands. At Dinosaur National Monument, stands of *Artemisia nova* indicate limestone; at Mesa Verde National Park, stands occur in deep soils at the heads of drainages, as islands in a tall, mixed *Quercus - Amelanchier* shrubland.

VEGETATION DESCRIPTION

Dinosaur National Monument

This dwarf-shrubland is dominated by *Artemisia nova* with 10 to 30% cover. Other shrubs that may occur are *Gutierrezia sarothrae, Eriogonum microthecum, Atriplex confertifolia, Grayia spinosa,* and *Ericameria nauseosa*. Herbaceous species are variable in composition. Grasses that are most commonly present include *Bromus tectorum, Poa fendleriana, Pleuraphis jamesii, Elymus elymoides, Bouteloua gracilis, Hesperostipa comata,* and *Achnatherum hymenoides*. Scattered *Pinus edulis* and *Juniperus osteosperma* trees may occur throughout the community.

Globally

This association has an open to moderately dense (10-40% cover) dwarf-shrub layer (<0.5 m tall) that is dominated by *Artemisia nova*. Other woody species present include *Picrothamnus desertorum, Artemisia tridentata, Atriplex*

confertifolia, Chrysothamnus viscidiflorus, Ericameria nauseosa, Ephedra nevadensis, Ephedra torreyana, Ephedra viridis, Grayia spinosa, Krascheninnikovia lanata, and *Opuntia erinacea*. Diagnostic of this community is a sparse herbaceous understory with only scattered grasses and forbs. Common grasses may include *Achnatherum hymenoides, Aristida purpurea, Hesperostipa comata, Pleuraphis jamesii*, and *Poa secunda*. Forbs such as *Erysimum capitatum, Erigeron aphanactis*, and *Phlox viridis* may be present. Scattered *Juniperus osteosperma, Pinus monophylla*, and *Yucca brevifolia* may be present in eastern Mojave stands such as Cottonwood Mountains in Death Valley National Park in California. *Juniperus osteosperma* and *Pinus edulis* have been noted in Colorado Plateau stands. Introduced species are important in some stands and may include *Bromus tectorum, Salsola kali*, and *Halogeton glomeratus*.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	Species
Short shrub/sapling	*Artemisia nova*
Herb (field)	*Bromus tectorum*

Global ly

Stratum	Species
Short shrub/sapling	*Artemisia nova*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G3G5 (23-Feb-1994).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
This wide-ranging and broadly defined association is distinguished from other *Artemisia nova* dwarf-shrublands by the lack of a significant graminoid layer and therefore is quite variable in species composition. Blackburn et al. (1968c) described an *Artemisia nova / Bromus tectorum* association that may be included here until a new *Artemisia nova / Bromus tectorum* Shrubland association is created in the USNVC.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association includes *Artemisia nova* stands that lack a developed understory or associated diagnostic species. Care should be taken not to confuse *Artemisia nova* with dwarfed individuals of *Artemisia tridentata* ssp. *wyomingensis*.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (3 plots: DINO.0009, DINO.0156, DINO.0172, and 2 observation points: DINO.9012, DINO.9042).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: K.A. Schulz, mod. J. Drake and J. Coles

REFERENCES: Beatley 1976, Blackburn et al. 1968c, Bourgeron and Engelking 1994, Driscoll et al. 1984, Heinze et al. 1962, Leary and Peterson 1984, Milton and Purdy 1983, NVNHP 2003, Peterson 1984, Sawyer and Keeler-Wolf 1995, Western Ecology Working Group n.d.

Artemisia tridentata ssp. *tridentata* / *Hesperostipa comata* Shrubland
Basin Big Sagebrush / Needle-and-Thread Shrubland

CODE CEGL002966

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. *TRIDENTATA*, SSP. *XERICENSIS*) SHRUBLAND ALLIANCE (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 shrubland association occurs in small to large patches on point bars, stream terraces, valley floors and alluvial fans in the interior western U.S. and possibly British Columbia, Canada. Slopes are generally gentle but can range up to 20% in steeper tributary drainages. Elevations range from 1220 to 2000 m at any aspect. Soils are sandy loams or loamy sands derived from alluvium. Although associated with drainages and floodplains, this community occurs in sites that rarely flood. Total vegetation cover tends to be somewhat sparse, as many examples have had their herbaceous cover reduced by grazing; undisturbed examples have total vegetation cover up to 90%. The dominant shrub is *Artemisia tridentata* ssp. *tridentata*. Others occurring as scattered individuals include *Ericameria nauseosa, Chrysothamnus viscidiflorus, Ephedra viridis, Krascheninnikovia lanata, Opuntia polyacantha*, and *Atriplex canescens*. The understory is dominated or codominated by the native bunchgrass *Hesperostipa comata*. Common herbaceous associates include *Achnatherum hymenoides, Bouteloua gracilis, Poa secunda, Sporobolus cryptandrus*, and *Sphaeralcea coccinea*. Moss and cryptogamic crusts may have significant cover in sites that have not experienced recent grazing.

DISTRIBUTION

Dinosaur National Monument

This association is known from the Green and Yampa river corridors.

Globally

This shrubland association occurs in the interior western U.S. from Washington to Montana south to Utah and Nevada. It may also occur in Oregon, California, and British Columbia, Canada.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occupies level to gently sloping stream terraces, alluvial flats, and valley floors at elevations ranging from 1400 to 1800 m. Soils can be sandy alluvium deposits or silty loams often covered with biotic crusts.

Globally

This shrubland association occurs in small to large patches on point bars, stream terraces, valley floors and alluvial fans in the interior western U.S. and British Columbia, Canada. Slopes are generally gentle but can range up to 20% in steeper tributary drainages. Elevations range from 1220 to 2000 m (4000-6580 feet), and stands may be oriented to any aspect. Soils are sandy loams or loamy sands derived from alluvium. Although associated with drainages and floodplains, this community occurs in sites that rarely flood.

VEGETATION DESCRIPTION

Dinosaur National Monument

This association is dominated by 1- to 3-m tall shrub *Artemisia tridentata* ssp. *tridentata*. Cover ranges from 20 to 30%. Shrubs commonly present with minimal cover are *Chrysothamnus viscidiflorus* and dwarf-shrub *Opuntia polyacantha*. Graminoid *Hesperostipa comata* dominates the herbaceous understory with 10% cover. Annual grass *Bromus tectorum* is likely to be present. Other forbs and grasses are inconsistent among sites and contribute minimal cover. Moss and cryptogamic crusts may have significant cover.

Globally

Total vegetation cover tends to be somewhat sparse in this association (10-40%), as many examples have had their herbaceous cover reduced by grazing; undisturbed examples have up to 90% cover. Cover of the dominant shrub *Artemisia tridentata* ssp. *tridentata* ranges from 5 to 55% in this association. *Ericameria nauseosa, Chrysothamnus*

viscidiflorus, Ephedra viridis, Krascheninnikovia lanata, Opuntia polyacantha, and *Atriplex canescens* also frequently occur as scattered individuals in the shrub layer. The understory cover totals between 5 and 40% and is dominated or codominated by the native bunchgrass *Hesperostipa comata*. Common herbaceous associates include *Achnatherum hymenoides, Bouteloua gracilis, Poa secunda, Sporobolus cryptandrus,* and *Sphaeralcea coccinea*. Moss and cryptogamic crusts may have significant cover in sites that have not experienced recent grazing.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Artemisia tridentata* ssp. *tridentata*
Herb (field)	*Bromus tectorum, Hesperostipa comata*

Globally

Stratum	**Species**
Tall shrub/sapling	*Artemisia tridentata* ssp. *tridentata*
Herb (field)	*Achnatherum hymenoides, Hesperostipa comata*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Bromus tectorum

Globally
Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: G4? (4-Dec-2001).

CLASSIFICATION COMMENTS

Dinosaur National Monument
Data are not available.

Globally
Of the references for this association, Daubenmire (1970), Hironaka et al. (1983), and Caicco and Wellner (1983f, 1983k) clearly reference *Artemisia tridentata* ssp. *tridentata / Stipa comata* vegetation type. All the others (Poulton 1955, Tueller et al. 1966, Blackburn 1967, Blackburn et al. 1968c, 1971, McLean 1970, Tueller and Blackburn 1974, DeVelice and Lesica 1993) do not provide information as to the subspecies of *Artemisia tridentata*. However, it is likely, based on habitat data, photos, and descriptions, that these studies were working with *Artemisia tridentata* ssp. *tridentata / Stipa comata* vegetation types.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Dinosaur National Monument Inventory Notes: Artemisia tridentata ssp. *wyomingensis* also occurs with *Hesperostipa comata* in very similar environmental conditions such as low-elevation alluvial flats. See DINO observation points 9005, 9007, 9412, 9413, 9692, 9809, 9811, 9821.
Dinosaur National Monument Data Sources: The description is based on 2002 and 2004 field data (2 plots: DINO.0638, DINO.1408).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Blackburn 1967, Blackburn et al. 1968c, Blackburn et al. 1971, CONHP unpubl. data 2003, Caicco and Wellner 1983f, Caicco and Wellner 1983k, Daubenmire 1970, DeVelice and Lesica 1993, Hironaka et al. 1983, Kagan et al. 2004, MTNHP 2002b, McLean 1970, NVNHP 2003, Poulton 1955, Tueller and Blackburn 1974, Tueller et al. 1966, Western Ecology Working Group n.d.

Artemisia tridentata ssp. *tridentata* / *Leymus cinereus* Shrubland
Basin Big Sagebrush / Great Basin Lyme Grass Shrubland

CODE	CEGL001016
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. *TRIDENTATA*, SSP. *XERICENSIS*) SHRUBLAND ALLIANCE (A.830) (Basin Big Sagebrush, Foothill Big Sagebrush) Shrubland Alliance
ECOLOGICAL SYSTEM(S):	Inter-Mountain Basins Big Sagebrush Steppe (CES304.778) Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)
USFWS WETLAND SYSTEM:	Palustrine

CONCEPT SUMMARY

Globally

This widely distributed plant association is a transitional community found on floodplains, terraces of perennial streams and along the edges of seasonally flooded washes and gullies of the high desert steppe of the western United States. Elevations range from 1600 to 1900 m (5250-6235 feet). Slopes are level to gentle, and the substrate is alluvium or loess. Soils generally have silty or clay loam textures and are moderately well-drained. Stands of this association are characterized by a shrub layer dominated by Artemisia tridentata ssp. tridentata standing 1-3 m tall and an herbaceous layer dominated by *Leymus cinereus* 0.5 to 1.5 m tall. Some stands may take the form of a *Leymus cinereus* grassland with *Artemisia tridentata* ssp. *tridentata* on the margins, but more often the stands are shrublands with grass growing in openings between shrub canopies. Total vegetation cover ranges from 20 to 90%. Sarcobatus vermiculatus and *Ericameria nauseosa* may also be present in the shrub stratum. *Leymus cinereus* dominates the understory with 15 to 90% cover. Various other grasses are likely to be present, including *Bromus tectorum, Distichlis spicata,* and other grasses associated with more mesic or riparian environments. Forbs species vary among sites.

DISTRIBUTION

Dinosaur National Monument

This association is known from the eastern end of the monument in the Yampa River corridor.

Globally

This was formerly a widespread association in the western United States. Today it is known from California to Washington and east to Montana and Colorado.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs in small stands located on the banks of small seasonally flooded washes or permanent stream terraces. Elevation ranges from 1600 to 1900 m. Soil texture is silt or clay loam, moderately well-drained, and generously covered with organic litter.

Globally

This widely distributed plant association is a transitional community found on floodplain terraces of perennial streams and along the edges of seasonally flooded washes and gullies of the high desert steppe. Elevations range from 1600 to 1900 m (5250-6235 feet). Slopes are level to gentle, and the substrate is alluvium or loess. Soils generally have silty or clay loam textures and are moderately well-drained.

VEGETATION DESCRIPTION

Dinosaur National Monument

This shrubland association is dominated by *Artemisia tridentata* ssp. *tridentata*, standing 1-3 m tall. Cover ranges from 20 to 40%. *Sarcobatus vermiculatus* and *Ericameria nauseosa* may also be present in the shrub stratum with lesser cover. Graminoid *Leymus cinereus* dominates the understory with 20 to 50% cover. Various other grasses are likely to be present, including *Bromus tectorum, Distichlis spicata,* and grasses associated with more mesic or riparian environments. Forbs species vary among sites.

Globally

Stands of this association are characterized by a shrub layer dominated by *Artemisia tridentata* ssp. *tridentata* standing 1-3 m tall, and an herbaceous layer dominated by *Leymus cinereus* 0.5 to 1.5 m tall. Some stands may take

the form of a *Leymus cinereus* grassland with *Artemisia tridentata* ssp. *tridentata* on the margins, but more often the stands are shrublands with grass growing in openings between shrub canopies. Total vegetation cover ranges from 20 to 90%. *Sarcobatus vermiculatus* and *Ericameria nauseosa* may also be present in the shrub stratum. *Leymus cinereus* dominates the understory with 15 to 90% cover. Various other grasses are likely to be present, including *Bromus tectorum, Distichlis spicata*, and other grasses associated with more mesic or riparian environments. Forbs species vary among sites.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Short shrub/sapling	*Artemisia tridentata* ssp. *tridentata*
Herb (field)	*Leymus cinereus*

Globally

Stratum	Species
Tall shrub/sapling	*Artemisia tridentata* ssp. *tridentata*
Herb (field)	*Leymus cinereus*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Bromus inermis, Bromus tectorum, Poa pratensis

Globally
Bromus inermis, Bromus tectorum, Poa pratensis

CONSERVATION STATUS RANK

Global Rank & Reasons: G2 (7-Apr-1998). This plant association was formerly widespread in the western United States but is now rare due to habitat loss and degradation of stands. The association is believed to be extirpated in Washington. In other western states, high-quality examples are of rare occurrence, and most stands are small and fragmented. Livestock use has reduced the quality of stands and continues to threaten remaining occurrences. Agricultural conversion has also eliminated habitat previously occupied by the association. Exotic species, including *Poa pratensis* or *Bromus tectorum*, may become locally dominant, nearly replacing the diagnostic graminoid. Incision of smaller streams and intermittent drainages throughout the West also has affected this association by dropping the water table and causing stands to dry out to the point that they will no longer support *Leymus cinereus*.

CLASSIFICATION COMMENTS

Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Dinosaur National Monument Inventory Notes: This association occurs in small stands and is uncommon in the monument.
Dinosaur National Monument Data Sources: The description is based on 2002 and 2004 field data (2 plots: DINO.0611, DINO.1409).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: M. Jankovsky-Jones, mod. J. Coles

REFERENCES: Baker 1982b, Baker 1983b, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Hess 1981, IDCDC 2005, Jones and Fertig 1996, Jones and Ogle 2000, Kagan et al. 2000, Kittel et al. 1994, Kittel et al. 1999a, MTNHP 2002b, NVNHP 2003, Walford 1996, Western Ecology Working Group n.d.

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	*ARTEMISIA TRIDENTATA* (SSP. *TRIDENTATA*, SSP. *XERICENSIS*) SHRUBLAND ALLIANCE (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 feet), 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

Dinosaur National Monument

This association is known from Bobby Island on the Green River.

Globally

This association is known from western Colorado. It is to be expected throughout the Colorado Plateau.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

The single sample of this association occurs at 1512 m elevation on a level alluvial floodplain terrace. The soil texture is silty clay.

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 feet), and sites are level to gently sloping. The substrate is alluvium, and soils tend to be fine-textured silty clays.

VEGETATION DESCRIPTION

Dinosaur National Monument

This shrubland association is dominated by shrub *Artemisia tridentata* ssp. *tridentata* with 30% cover. *Sporobolus airoides* dominates the herbaceous understory with 30% cover. *Bromus tectorum* is present with low 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 cryptobiological crusts.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Short shrub/sapling	*Artemisia tridentata* ssp. *tridentata*
Herb (field)	*Sporobolus airoides*

Globally

Stratum	**Species**
Tall shrub/sapling	*Artemisia tridentata* ssp. *tridentata*
Herb (field)	*Sporobolus airoides*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Bromus tectorum

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (6-Jan-2005).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This is a rare association in the monument.
Dinosaur National Monument Data Sources: This description is based on 2002 field data (1 plot: DINO.0132).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

Artemisia tridentata (ssp. *vaseyana*, ssp. *wyomingensis*) -*Amelanchier utahensis* Shrubland (Mountain Big Sagebrush, Wyoming Big Sagebrush) - Utah Serviceberry Shrubland

CODE	CEGL002820
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* SHRUBLAND ALLIANCE (A.829) Basin Big Sagebrush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This association has been described from Dinosaur National Monument, the Roan Plateau and the Piceance Basin in northwestern Colorado and adjacent Utah. It is likely also to occur in southwestern Wyoming. Sites are on level to moderately sloping hills, valleys and benches. Elevation ranges from 2165 to 2600 m, and stands may be oriented to any aspect. The deep, well-drained soils are derived from sandstone, shale, loess or limestone and range in texture from clay loam and silt loam to loamy sand. Organic litter is typically a significant component of the ground surface cover. The vegetation is characterized by the presence in the canopy of both *Artemisia tridentata* (ssp. *vaseyana* or ssp. *wyomingensis*, or sometimes a hybrid of the two) and *Amelanchier utahensis* with 15 to 55% total cover. It often takes the appearance of a tall shrubland type in which clumps of serviceberry grow in a matrix of sagebrush. Although serviceberry and sagebrush are visually dominant, in some stands *Symphoricarpos oreophilus* may have

the highest cover of the three shrub species. *Chrysothamnus viscidiflorus, Mahonia repens,* and *Purshia tridentata* may be minor components of the shrub canopy. *Quercus gambelii*, if present, has less than 1% cover. Graminoids tend to dominate the well-developed herbaceous layer; typical species are *Pascopyrum smithii, Melica spectabilis, Carex geyeri, Koeleria macrantha, Poa fendleriana, Achnatherum nelsonii* ssp. *dorei, Hesperostipa comata*, and *Achnatherum lettermanii*. The forb component of the understory is usually diverse and may contribute significant cover, especially in stands that have been grazed. *Achillea millefolium, Balsamorhiza sagittata, Comandra umbellata, Crepis acuminata, Eriogonum umbellatum, Lathyrus lanszwertii* var. *leucanthus, Lupinus argenteus, Penstemon caespitosus, Sphaeralcea coccinea*, and *Viola nuttallii* are common species. *Poa pratensis* may be the dominant grass in areas that have a history of grazing.

DISTRIBUTION

Dinosaur National Monument

This association is known from the Yampa Bench, Blue Mountain, and Douglas Mountain.

Globally

This association is currently known only from the highlands of Dinosaur National Monument as well as the Roan Plateau and Piceance Basin in northwestern Colorado and northeastern Utah. It is likely also to occur in southwestern Wyoming.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs on level to moderately sloping hills, valleys and benches of the high plateau and mountain country of the monument. Elevation ranges from 2300 to 2600 m, and stands may be oriented to any aspect. The well-drained soils are derived from sandstone or limestone and range in texture from clay loam and silt loam to loamy sand. Organic litter is typically a significant component of the ground surface cover.

Globally

This association occurs on level to moderately sloping hills, plateaus, valleys, ridgetops and benches in northwestern Colorado. Elevation ranges from 2165 to 2600 m (7100-8530 feet), and stands may be oriented to any aspect. The deep, well-drained soils are derived from sandstone, shale, loess or limestone and range in texture from clay loam and silt loam to loamy sand. Organic litter is typically a significant component of the ground surface cover.

VEGETATION DESCRIPTION

Dinosaur National Monument

This mountain shrubland association is characterized by the presence in the canopy of both *Artemisia tridentata* ssp. *vaseyana* or *Artemisia tridentata* ssp. *wyomingensis* and *Amelanchier utahensis* with 15 to 55% total cover. Sagebrush generally has higher cover, but the serviceberry may form an open tall-shrub canopy with sagebrush between serviceberry clumps. *Symphoricarpos oreophilus* is consistently present with cover ranging from 1 to 20%, and *Mahonia repens* generally has around 1% cover. Herbaceous species are highly diverse but contribute minimal total cover. Species most likely to occur include *Poa fendleriana, Koeleria macrantha, Eriogonum umbellatum, Achillea millefolium, and Balsamorhiza sagittata*.

Globally

This mountain shrubland association is characterized by the presence in the canopy of both *Artemisia tridentata* ssp. *vaseyana* or *Artemisia tridentata* ssp. *wyomingensis* and *Amelanchier utahensis* with 15 to 55% total cover. It often takes the appearance of a tall shrubland type in which clumps of serviceberry grow in a matrix of sagebrush. Although serviceberry and sagebrush are visually dominant, in some stands *Symphoricarpos oreophilus* may have the highest cover of the three shrub species. *Chrysothamnus viscidiflorus, Mahonia repens,* and *Purshia tridentata* may be minor components of the shrub canopy. *Quercus gambelii*, if present, has less than 1% cover. Graminoids tend to dominate the well-developed herbaceous layer; typical species are *Pascopyrum smithii, Melica spectabilis, Carex geyeri, Koeleria macrantha, Poa fendleriana, Achnatherum nelsonii* ssp. *dorei, Hesperostipa comata*, and *Achnatherum lettermanii*. The forb component of the understory is usually diverse and may contribute significant cover, especially in stands that have been grazed. *Achillea millefolium, Balsamorhiza sagittata, Comandra umbellata, Crepis acuminata, Eriogonum umbellatum, Lathyrus lanszwertii* var. *leucanthus, Lupinus argenteus, Penstemon caespitosus, Sphaeralcea coccinea*, and *Viola nuttallii* are common species. *Poa pratensis* may be the dominant grass in areas that have a history of grazing.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Tall shrub/sapling	*Amelanchier utahensis*
Short shrub/sapling	*Symphoricarpos oreophilus*
Short shrub/sapling	*Artemisia tridentata* ssp. *vaseyana, Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Hesperostipa comata, Nassella viridula*

Globally

Stratum	Species
Tall shrub/sapling	*Amelanchier utahensis*
Short shrub/sapling	*Symphoricarpos oreophilus*
Short shrub/sapling	*Artemisia tridentata* ssp. *vaseyana, Artemisia tridentata* ssp. *wyomingensis*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (12-Jul-2005).

CLASSIFICATION COMMENTS

Dinosaur National Monument
Data are not available.

Globally
There is some overlap between this community and the various sagebrush - snowberry associations in the IVC, but the presence of *Amelanchier utahensis* distinguishes it from them. This association is not ecotonal between sagebrush shrublands and mixed mountain shrublands; instead, it appears to occupy its own habitat and can cover extensive areas.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Dinosaur National Monument Inventory Notes: Keammerer and Peterson (1981) describe a very similar community from the Naval Oil Shale Reserve on the Roan Plateau, south of the monument.
Dinosaur National Monument Data Sources: This description is based on 2002 and 2003 field data (11 plots: DINO.0147, DINO.0149, DINO.0628,DINO.0660 DINO.0661, DINO.0663, DINO.064, DINO.0709, DINO.0904, DINO.0910, DINO.0914).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Keammerer and Peterson 1981, Keammerer and Stoecker 1975

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	*ARTEMISIA TRIDENTATA* 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 feet) 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

Dinosaur National Monument

This association is known from the floodplains of Sage Creek, Pool Creek, Deerlodge Park, Starvation Valley, Bull Canyon, and other drainages associated with the Yampa and Green rivers.

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

Dinosaur National Monument

This association occupies level or gentle sloping alluvial terraces, fans, and plains below 2000 m elevation. Soils are mostly sandy and rapidly drained. Leaf litter and wood cover most of the soil surface.

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 feet) 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

Dinosaur National Monument

This shrubland association is dominated by *Artemisia tridentata* ssp. *tridentata* with 10 to 70% cover. Other associated shrubs include *Chrysothamnus viscidiflorus* and *Sarcobatus vermiculatus*. *Ericameria nauseosa* may also occur. The exotic annual grass *Bromus tectorum* occurs in the understory with sparse to dense cover. Other common grasses with low cover include *Achnatherum hymenoides, Leymus cinereus, Poa fendleriana,* and *Poa secunda*. Forb species are minor and inconsistent among sites.

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 up 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
Dinosaur National Monument

Stratum	Species
Short shrub/sapling	*Artemisia tridentata* ssp. *tridentata*
Herb (field)	*Bromus tectorum*

Globally

Stratum	Species
Tall shrub/sapling	*Artemisia tridentata* ssp. *tridentata*
Herb (field)	*Bromus tectorum*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Carduus nutans ssp. *macrolepis, Lactuca serriola, Salsola tragus, Sisymbrium altissimum*

CONSERVATION STATUS RANK
Global Rank & Reasons: GNA (ruderal) (14-Aug-2001).

CLASSIFICATION COMMENTS
Dinosaur National Monument
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
Dinosaur National Monument Inventory Notes: This association is common in the park, occurring in most lowland terrace sites.
Dinosaur National Monument Data Sources: This description is based on 2002 and 2003 field data (10 plots: DINO.0022, DINO.0316, DINO.0429, DINO.0443, DINO.0459, DINO.0602, DINO.0609, DINO.0704, DINO.0712, DINO.1022).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles, mod. K.A. Schulz

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

Artemisia tridentata ssp. *vaseyana / Achnatherum lettermanii* Shrubland
Wyoming Big Sagebrush / Letterman's Needlegrass Shrubland

CODE	CEGL002811
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Evergreen shrubland (III.A.)
PHYSIOGNOMIC GROUP	Microphyllous evergreen shrubland (III.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural microphyllous evergreen shrubland (III.A.4.N.)
FORMATION	Lowland microphyllous evergreen shrubland (III.A.4.N.a.)
ALLIANCE	*ARTEMISIA TRIDENTATA* SSP. *VASEYANA* SHRUBLAND ALLIANCE (A.831) 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 shrubland association occurs in the upper elevations of the sagebrush zone in plateau areas of western Colorado.

Stands are located on gently to moderately sloping hills, ridgetops and benches. Elevations range from 2268 to 2609 m, and aspect is not a factor. Soils are deep, well-developed and often derived from eolian loess, although the underlying substrate may be sandstone, limestone or shale. Soil texture is a silt loam or a fine sandy loam. Litter covers most of the unvegetated ground surface. The vegetation of this association is characterized by a moderately closed shrub canopy dominated by *Artemisia tridentata* ssp. *vaseyana* with a well-developed and diverse herbaceous understory dominated by *Achnatherum lettermanii*. Total shrub cover generally ranges between 20 and 50%, and the shrub layer often also includes *Symphoricarpos oreophilus* and *Chrysothamnus viscidiflorus*. The herbaceous layer is dominated by graminoids and usually contains a number of species, including *Poa fendleriana, Poa secunda, Achnatherum pinetorum,* and *Carex rossii* or *Carex geyeri*. Forbs vary among sites, but *Eriogonum umbellatum* is often present.

DISTRIBUTION

Dinosaur National Monument

Most plots of this association were sampled on the Yampa Plateau, with one sample on the Zenobia Peak massif.

Globally

This association has been documented from western Colorado. It is likely to occur elsewhere in the western U.S. at higher elevations of the sagebrush zone.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This shrubland association occurs in the upper reaches of the sagebrush zone within the monument. Stands are located on gently to moderately sloping hills and benches on the high plateaus of the monument. Elevations range from 2268 to 2609 m. Soils are deep, well-developed and often derived from eolian loess, although the underlying substrate may be sandstone, limestone or shale. Litter covers most of the unvegetated ground surface.

Globally

This shrubland association occurs in the upper elevations of the sagebrush zone in plateau areas of western Colorado. Stands are located on gently to moderately sloping hills, ridgetops and benches. Elevations range from 2268 to 2609 m, and aspect is not a factor. Soils are deep, well-developed and often derived from eolian loess, although the underlying substrate may be sandstone, limestone or shale. Soil texture is a silt loam or a fine sandy loam. Litter covers most of the unvegetated ground surface.

VEGETATION DESCRIPTION

Dinosaur National Monument

This sagebrush shrubland association has a mixed shrub canopy dominated by *Artemisia tridentata* ssp. *vaseyana* with between 15 and 45% cover. The shrub layer also contains up to 20% cover by *Symphoricarpos oreophilus*, as well as scattered individuals of *Chrysothamnus viscidiflorus*. The herbaceous layer is diverse and well-developed and is dominated by *Achnatherum hymenoides* with between 5 and 25% cover. Other grasses present include *Poa fendleriana, Poa secunda, Pseudoroegneria spicata, Hesperostipa comata,* and *Carex geyeri*. The forb component is variable and has significantly less cover than the graminoid element. Common species include *Achillea millefolium, Eriogonum umbellatum, Antennaria* spp., *Linum lewisii*, and *Phlox austromontana*.

Globally

The vegetation of this association is characterized by a moderately closed shrub canopy dominated by *Artemisia tridentata* ssp. *vaseyana* with a well-developed and diverse herbaceous understory dominated by *Achnatherum lettermanii*. Total shrub cover generally ranges between 20 and 50%, and the shrub layer often also includes *Symphoricarpos oreophilus* and *Chrysothamnus viscidiflorus*. The herbaceous layer is dominated by graminoids and usually contains a number of species, including *Poa fendleriana, Poa secunda, Achnatherum pinetorum,* and *Carex rossii* or *Carex geyeri*. Forbs vary among sites, but *Eriogonum umbellatum* is often present.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Symphoricarpos oreophilus*
Short shrub/sapling	*Artemisia tridentata* ssp. *vaseyana*
Herb (field)	*Eriogonum umbellatum, Phlox austromontana*
Herb (field)	*Achnatherum lettermanii, Nassella viridula, Poa fendleriana, Poa secunda*

Globally

Stratum	**Species**
Short shrub/sapling	*Symphoricarpos oreophilus*
Short shrub/sapling	*Artemisia tridentata* ssp. *vaseyana*
Herb (field)	*Achnatherum lettermanii*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Astragalus anisus, Poa pratensis

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (28-Jun-2005).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Most plots note recent grazing. One plot noted evidence of fire.
Dinosaur National Monument Data Sources: This description is based on 2002 and 2003 field data (5 plots: DINO.0271, DINO.0623. DINO.0662, DINO.0805, DINO.0812).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

Artemisia tridentata ssp. *vaseyana / Balsamorhiza sagittata* Shrubland Mountain Big Sagebrush / Arrowleaf Balsamroot Shrubland

CODE	CEGL001020
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Evergreen shrubland (III.A.)
PHYSIOGNOMIC GROUP	Microphyllous evergreen shrubland (III.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural microphyllous evergreen shrubland (III.A.4.N.)
FORMATION	Lowland microphyllous evergreen shrubland (III.A.4.N.a.)
ALLIANCE	*ARTEMISIA TRIDENTATA* SSP. *VASEYANA* SHRUBLAND ALLIANCE (A.831) 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 shrubland association occurs on ridges, benches and mesas in the northern Colorado Plateau and western slope of the southern Rocky Mountains. Stands occur in somewhat isolated upland patches in western Colorado. Slopes range from level to moderate and between 2300 and 2675 m (7545-8776 feet) elevation. Soils are derived from a wide variety of substrates; textures vary accordingly from clay loams and silty loams to sandy loams. Cryptobiotic crusts may be present but rarely have significant cover. Total vegetation cover ranges from 25% to nearly 100%. The vegetation is characterized by a shrub canopy of *Artemisia tridentata* ssp. *vaseyana* (15-75%), often associated with *Amelanchier utahensis, Symphoricarpos oreophilus,* and *Purshia tridentata*. The herbaceous understory is

dominated by *Balsamorhiza sagittata* and other forbs, including *Phlox* spp., *Eriogonum umbellatum, Castilleja linariifolia, Senecio integerrimus, Arenaria congesta*, and *Crepis acuminata*. Total herbaceous cover ranges from 10 to 30%. Grasses vary among sites and may include *Poa fendleriana, Poa secunda, Hesperostipa comata, Pseudoroegneria spicata, Achnatherum pinetorum, Achnatherum lettermanii,* and *Pascopyrum smithii*. Scattered *Juniperus osteosperma* may be present, but pinyon or juniper trees appear not to threaten stands on high slopes and ridgetops because of their relatively thin soils. Fire tends to convert these sites to grasslands dominated by the herbaceous species present before the burn.

DISTRIBUTION

Dinosaur National Monument

This association is known from Burnt Gulch near Zenobia Basin and Harper's Corner.

Globally

This association is known from western Colorado.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs on ridges and slopes of the monument's mountains and plateaus. Elevations range from 2300 to 2400 m, and slopes range from level to moderate. Bare soil and litter cover nearly all the unvegetated ground surface. The substrate is limestone or derived from limestone, and soils are silty or sandy loams.

Globally

This shrubland association occurs on ridges, benches and mesas in the northern Colorado Plateau. Slopes range from level to moderate, and known sites occur between 2300 and 2675 m (7545-8776 feet) elevation. Soils are derived from a wide variety of substrates, including shales, volcanic tuff and limestone; textures vary accordingly from clay loams and silty loams to sandy loams. The unvegetated surface has high exposure of bare soil and low to moderate cover of small rocks and litter. Cryptobiotic crusts may be present but rarely have significant cover.

VEGETATION DESCRIPTION

Dinosaur National Monument

This sparse shrubland has a shrub canopy 1 m or less tall with an *Artemisia tridentata* ssp. *vaseyana* canopy cover of between 15 and 35%. *Purshia tridentata* is typically associated with this community but with less than 5% cover. Scattered individuals of *Juniperus osteosperma* may be present with less than 10% cover. The herbaceous layer is well-developed and is dominated by *Balsamorhiza sagittata*, usually associated with *Phlox* spp. and *Eriogonum umbellatum*. Grasses have at least 5% cover but are variable. *Poa fendleriana, Poa secunda, Elymus lanceolatus, Pseudoroegneria spicata, Hesperostipa comata*, and *Pascopyrum smithii* may occur with sparse to moderate cover. Total herbaceous cover typically ranges from 10 to 30%.

Globally

This shrubland association is characterized by a sparse to dense cover of *Artemisia tridentata* ssp. *vaseyana* (15-75%), with an herbaceous understory in which *Balsamorhiza sagittata* is the most conspicuous species. Total vegetation cover ranges from 25 to nearly 100%. Other shrubs are usually present as minor canopy elements, including *Purshia tridentata, Symphoricarpos oreophilus,* and *Amelanchier utahensis*. Total herbaceous cover ranges from 10 to 30%. Grasses often have 5 to 10% cover in the forb-dominated understory, but vary among sites, and include *Poa fendleriana, Poa secunda, Hesperostipa comata, Pseudoroegneria spicata, Achnatherum pinetorum, Achnatherum lettermanii*, and *Pascopyrum smithii*. Common forbs in addition to *Balsamorhiza include Phlox* spp., *Eriogonum umbellatum, Castilleja linariifolia, Senecio integerrimus, Arenaria congesta*, and *Crepis acuminata*. Scattered individuals of *Juniperus osteosperma* may be present with less than 10% cover.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Artemisia tridentata* ssp. *vaseyana*
Herb (field)	*Balsamorhiza sagittata*
Herb (field)	*Hesperostipa comata, Poa secunda*

Globally

Stratum	**Species**

Tall shrub/sapling	*Artemisia tridentata* ssp. *vaseyana*
Herb (field)	*Balsamorhiza sagittata*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Data are not available.
Dinosaur National Monument Data Sources: This description is based on 2002 field data (2 plots: DINO.0247, DINO.0630).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Hess and Wasser 1982, Johnston 2001, Komarkova 1986, Terwilliger and Tiedemann 1978

Artemisia tridentata ssp. *vaseyana / Hesperostipa comata* Shrubland
Mountain Big Sagebrush / Needle-and-Thread Shrubland

CODE	CEGL002931
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Evergreen shrubland (III.A.)
PHYSIOGNOMIC GROUP	Microphyllous evergreen shrubland (III.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural microphyllous evergreen shrubland (III.A.4.N.)
FORMATION	Lowland microphyllous evergreen shrubland (III.A.4.N.a.)
ALLIANCE	*ARTEMISIA TRIDENTATA* SSP. *VASEYANA* SHRUBLAND ALLIANCE (A.831) 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 association is known from southern Utah to southern Idaho and western Wyoming and is likely to occur in northern Nevada. It occurs on moderate slopes between 1372 to 2850 m (4500-9350 feet) elevation. Soils are deep and range from clay loam to sandy loams. *Artemisia tridentata* ssp. *vaseyana* is the dominant shrub. *Purshia tridentata, Symphoricarpos oreophilus, Ericameria* sp., *Artemisia tripartita,* and *Amelanchier alnifolia* may be present at upper elevations, and at lower altitudes *Chrysothamnus viscidiflorus* and *Tetradymia canescens* can be common. *Hesperostipa comata* is the principal understory species. *Festuca idahoensis, Pseudoroegneria spicata,* and *Koeleria macrantha* may be present in small amounts. Other herbaceous species that may be present include *Carex rossii, Achnatherum lettermanii, Achnatherum nelsonii, Pseudoroegneria spicata, Poa pratensis, Antennaria microphylla,* and *Eriogonum umbellatum.*

DISTRIBUTION

Dinosaur National Monument
This association is known from Zenobia Basin, Douglas Mountain and the Yampa Plateau.

Globally
This association is known from southern Utah to southern Idaho and western Wyoming. It is likely to occur in northern Nevada.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument
This association occurs on the slopes of ridges and plateaus in the monument. Elevation ranges from 2250 to 2450 m, slopes from level to moderate, and sites may be oriented to any aspect. Soils are typically deep sandy loams derived from eolian sands and loess and generally covered with organic litter.

Globally
This association occurs on gentle to moderate slopes, ridges, depressions and plateaus between 1370 and 2850 m (4500-9350 feet) elevation. The lower elevations tend to occur at the northern end of the association's range. Soils are derived from alluvium, eolian sands or loess, are deep and range in texture from clay loam to sandy loams.

VEGETATION DESCRIPTION

Dinosaur National Monument
This association is characterized by large stands of *Artemisia tridentata* ssp. *vaseyana* with 20 to 40% cover. Contributing another 5 to 10% cover to the shrub layer are *Amelanchier utahensis, Purshia tridentata, Symphoricarpos oreophilus,* and *Chrysothamnus viscidiflorus*. The herbaceous understory typically exceeds 10% cover. *Hesperostipa comata* dominates or codominates the herbaceous layer with *Poa fendleriana, Elymus elymoides,* and *Achnatherum hymenoides.* Forb species frequently occurring include *Heterotheca villosa, Eriogonum umbellatum, Phlox* spp., and *Balsamorhiza sagittata*. Many other grasses and forbs also occur in this lush shrubland association, albeit with less than 5% cover. Total vegetation cover usually exceeds 60%.

Globally
Total vegetation cover usually exceeds 60% in these moderately to densely vegetated communities. *Artemisia tridentata* ssp. *vaseyana* is the dominant shrub, with between 1 and 40% cover. *Purshia tridentata, Symphoricarpos oreophilus, Ericameria* sp., *Artemisia tripartita*, and *Amelanchier alnifolia* may be present at upper elevations, and at lower altitudes *Chrysothamnus viscidiflorus, Cercocarpus montanus,* and *Tetradymia canescens* can be common. *Hesperostipa comata* is the principal understory species. *Festuca idahoensis, Pseudoroegneria spicata*, and *Koeleria macrantha* may be present in small amounts. Other herbaceous species that may be present include *Bouteloua gracilis, Poa fendleriana, Muhlenbergia* spp., *Carex rossii, Achnatherum lettermanii, Achnatherum nelsonii, Pseudoroegneria spicata, Poa pratensis, Antennaria microphylla,* and *Eriogonum umbellatum*.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Short shrub/sapling	*Amelanchier utahensis*
Short shrub/sapling	*Artemisia tridentata* ssp. *vaseyana*
Herb (field)	*Heterotheca villosa*
Herb (field)	*Elymus lanceolatus, Hesperostipa comata*

Globally

Stratum	Species
Short shrub/sapling	*Purshia tridentata*
Short shrub/sapling	*Artemisia tridentata* ssp. *vaseyana*
Tall shrub/sapling	*Artemisia tridentata* ssp. *tridentata*
Herb (field)	*Antennaria microphylla, Eriogonum umbellatum*
Herb (field)	*Hesperostipa comata*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Bromus tectorum

Globally
Data are not available.

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
The global description is based on Hironaka et al. (1983) and Grand Teton National Park and Zion National Park local descriptions. Of all the references for this association, only Hironaka et al. (1983) clearly reference an *Artemisia tridentata* ssp. *vaseyana / Stipa comata* vegetation type. All the others (Poulton 1955, Tueller et al. 1966, Blackburn 1967, Blackburn et al. 1968c, 1971, McLean 1970, Tueller and Blackburn 1974, DeVelice and Lesica 1993) do not provide information as to the subspecies of *Artemisia tridentata*. Further clarification of which published materials relate to this association is needed. Based on habitat information and photos available for the study areas in Nevada, these could reference *Artemisia tridentata* ssp. *tridentata / Stipa comata* vegetation types.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This is a relatively common type at middle to high elevations of the monument. The abundance of *Hesperostipa comata* may vary considerably from year to year depending on the timing and amount of precipitation.
Dinosaur National Monument Data Sources: This description is based on 2002 field data (8 plots: DINO.0256, DINO.0573, DINO.0582, DINO.0592, DINO.0622, DINO.0624, DINO.0625, DINO.0815).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: G. Kittel, mod. J. Coles

REFERENCES: Blackburn 1967, Blackburn et al. 1968c, Blackburn et al. 1971, Bramble-Brodahl 1978, CONHP unpubl. data 2003, Cogan et al. 2004, DeVelice and Lesica 1993, Hironaka et al. 1983, McLean 1970, NVNHP 2003, Poulton 1955, Tueller and Blackburn 1974, Tueller et al. 1966, Western Ecology Working Group n.d.

Artemisia tridentata ssp. *vaseyana / Leymus cinereus* Shrubland
Mountain Big Sagebrush / Great Basin Lyme Grass Shrubland

CODE	CEGL001027
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Evergreen shrubland (III.A.)
PHYSIOGNOMIC GROUP	Microphyllous evergreen shrubland (III.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural microphyllous evergreen shrubland (III.A.4.N.)
FORMATION	Lowland microphyllous evergreen shrubland (III.A.4.N.a.)
ALLIANCE	*ARTEMISIA TRIDENTATA* SSP. *VASEYANA* SHRUBLAND ALLIANCE (A.831) 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 widely distributed association occupies shallow upland drainages associated with springs or seepage areas as well as riparian terraces. Stands are small and isolated but occur throughout the sagebrush zone in the Great Basin, Wyoming Basins and Uinta Basin. Sites are located on gentle to moderate lee slopes (3-30%) that collect windblown snow and may be oriented to any aspect. Elevations range between 2100 and 2560 m (6890-8400 feet). Soils are deep, well-developed, moderately well-drained and variable in texture. The underlying substrate is either sandstone, marlstone or shale. Shrub cover is lower in this association than in most mountain sagebrush types. *Artemisia*

tridentata ssp. *vaseyana* dominates the shrub layer with at least 10% cover. Other shrubs present are *Symphoricarpos oreophilus, Tetradymia canescens, Chrysothamnus viscidiflorus, Rosa woodsii*, and *Ericameria nauseosa*. *Leymus cinereus* is the dominant grass, usually with at least 10% cover, although cover may be lower in stands that have been heavily grazed. Associated grasses include *Elymus lanceolatus, Bromus carinatus, Festuca idahoensis, Poa pratensis, Poa fendleriana*, and *Poa secunda*. Forb species contribute sparse cover and vary among sites. Common species include *Achillea millefolium, Balsamorhiza sagittata*, and *Phlox* spp.

DISTRIBUTION

Dinosaur National Monument

This association is known from near Brown's Cabin in Zenobia Basin.

Globally

This association is widely distributed from small, isolated stands in northwestern Colorado (Dinosaur National Monument) and southwestern Wyoming (Fossil Butte National Monument). It has been reported from northern and central Nevada, northeastern Utah, southwestern Montana, southern Idaho and possibly from northeastern California.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs at elevations above 2200 m in shallow drainages associated with springs or seepage areas. Soils are somewhat rapidly drained, sandy, and densely covered with organic litter.

Globally

This widely distributed association occupies shallow upland drainages associated with springs or seepage areas as well as riparian terraces. Stands are small and isolated but occur throughout the sagebrush zone in the Great Basin, Wyoming Basins and Uinta Basin. Sites are located on gentle to moderate lee slopes (3-30%) that collect windblown snow and may be oriented to any aspect. Elevations range between 2100 and 2560 m (6890-8400 feet). Soils are deep, well-developed, moderately well-drained and variable in texture. The underlying substrate is either sandstone, marlstone or shale. Bare soil, gravel or litter cover most of the unvegetated ground surface.

VEGETATION DESCRIPTION

Dinosaur National Monument

Artemisia tridentata ssp. *vaseyana* dominates the shrub layer in this association with at least 10% cover. Other shrubs present are *Rosa woodsii*, *Ericameria nauseosa*, and *Chrysothamnus viscidiflorus. Leymus cinereus* is the dominant grass with at least 10% cover. Associated grasses include *Thinopyrum intermedium*, *Poa pratensis*, and *Poa secunda*. Forb species contribute sparse cover and are diverse in composition with no strong dominant.

Globally

This association is relatively common within its range but tends to occur in small, isolated stands. Shrub cover is lower in this association than in most mountain sagebrush types. *Artemisia tridentata* ssp. *vaseyana* dominates the shrub layer with at least 10% cover. Other shrubs present are *Symphoricarpos oreophilus, Tetradymia canescens, Chrysothamnus viscidiflorus, Rosa woodsii*, and *Ericameria nauseosa. Leymus cinereus* is the dominant grass, usually with at least 10% cover, although cover may be lower in stands that have been heavily grazed. Associated grasses include *Elymus lanceolatus, Bromus carinatus, Festuca idahoensis, Poa pratensis, Poa fendleriana*, and *Poa secunda*. Forb species contribute sparse cover and vary among sites. Common species include *Achillea millefolium, Balsamorhiza sagittata*, and *Phlox* spp.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Rosa woodsii*
Short shrub/sapling	*Artemisia tridentata* ssp. *vaseyana*
Herb (field)	*Leymus cinereus, Thinopyrum intermedium*

Globally

Stratum	**Species**
Short shrub/sapling	*Artemisia tridentata* ssp. *vaseyana*
Herb (field)	*Leymus cinereus*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum, Poa pratensis

Globally
Bromus tectorum, Poa pratensis

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This type should be more common in the high-elevation sagebrush shrublands of the monument. It is likely that grazing has largely eliminated *Leymus cinereus* from most of its former range.
Dinosaur National Monument Data Sources: This description is based on 2002 field data (1 plot: DINO.0553).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Cooper et al. 1999, Driscoll et al. 1984, Hironaka et al. 1983, IDCDC 2005, Jensen et al. 1988a, MTNHP 2002b, Mooney 1985, NVNHP 2003

Artemisia tridentata ssp. *vaseyana / Pascopyrum smithii* Shrubland
Mountain Big Sagebrush / Western Wheatgrass Shrubland

CODE	CEGL001028
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Evergreen shrubland (III.A.)
PHYSIOGNOMIC GROUP	Microphyllous evergreen shrubland (III.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural microphyllous evergreen shrubland (III.A.4.N.)
FORMATION	Lowland microphyllous evergreen shrubland (III.A.4.N.a.)
ALLIANCE	*ARTEMISIA TRIDENTATA* SSP. *VASEYANA* SHRUBLAND ALLIANCE (A.831) Mountain Big Sagebrush Shrubland Alliance
ECOLOGICAL SYSTEM(S):	Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785) Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)
USFWS WETLAND SYSTEM:	Not applicable

CONCEPT SUMMARY
Globally
This mesic sagebrush association occurs in upland areas where snow accumulates, including swales and valley bottoms. Documented stands are known from Wyoming, Montana and northern and western Colorado. Elevations range from 2200 to 2500 m (7200-8200 feet). Sites are level to gently sloping and may be oriented to any aspect. Soils may be derived from eolian sediments, sandstone or shale, and often have a silty loam or clay loam texture. The amount of litter on the ground surface is inversely proportional to the intensity of grazing. Total vegetation cover ranges from a low of around 20% to approximately 75%. *Artemisia tridentata* ssp. *vaseyana* dominates the shrub layer with 10 to 50% cover, and *Pascopyrum smithii* dominates a diverse herbaceous layer. Other shrubs comprise a minority of the shrub canopy, including *Symphoricarpos oreophilus, Amelanchier utahensis, Purshia tridentata, Ericameria nauseosa, Tetradymia canescens, Krascheninnikovia lanata*, and *Chrysothamnus viscidiflorus*. The grass component of the understory is often diverse and may include a combination of *Poa fendleriana, Achnatherum pinetorum, Achnatherum hymenoides, Bouteloua gracilis, Elymus lanceolatus, Leymus*

cinereus, Hesperostipa comata, Elymus elymoides, and *Poa secunda*. Forbs such as *Artemisia frigida, Achillea millefolium*, and *Phlox hoodii* ssp. muscoides generally contribute little cover.

DISTRIBUTION

Dinosaur National Monument
This association is known from Little Joe Draw on Douglas Mountain.

Globally
This association is known from Montana, northern and western Colorado, and Wyoming.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument
This association occurs in gently sloping swales and valley bottoms at elevations ranging from 2200 to 2500 m. Soils are silt loams, and the ground surface is nearly completely covered with organic litter.

Globally
This mesic sagebrush association occurs in uplands in areas where snow accumulates, including swales and valley bottoms. Documented stands are in Wyoming and in northern and western Colorado, but this association is likely to be widespread. Elevations range from 2200 to 2500 m (7200-8200 feet). Sites are level to gently sloping and may occur on any aspect. Soils may be derived from eolian deposits, sandstone or shale, and often have a silty loam or clay loam texture. The amount of litter on the ground surface is inversely proportional to the intensity of grazing.

VEGETATION DESCRIPTION

Dinosaur National Monument
Artemisia tridentata ssp. *vaseyana* dominates this shrubland association with at least 10% cover. Associated shrubs include *Rosa woodsii, Ericameria nauseosa*, and *Symphoricarpos oreophilus*. The herbaceous understory has a moderately dense cover of graminoids dominated by *Pascopyrum smithii. Achillea millefolium* is the most common associated herbaceous species. If *Leymus cinereus* is present, it is with no more than 1% cover.

Globally
Total vegetation cover in these sagebrush shrublands ranges from 20% to approximately 75%. *Artemisia tridentata* ssp. *vaseyana* dominates the shrub layer with 10-50% cover, and *Pascopyrum smithii* dominates the diverse herbaceous layer. Other shrubs may comprise a minor component of the shrub canopy, including *Symphoricarpos oreophilus, Amelanchier utahensis, Purshia tridentata, Ericameria nauseosa, Tetradymia canescens, Krascheninnikovia lanata*, and *Chrysothamnus viscidiflorus*. The grass component of the understory is often diverse and may include a combination of *Poa fendleriana, Achnatherum pinetorum, Achnatherum hymenoides, Bouteloua gracilis, Elymus lanceolatus, Leymus cinereus, Hesperostipa comata, Elymus elymoides*, and *Poa secunda*. Forbs such as *Artemisia frigida, Achillea millefolium*, and *Phlox hoodii* ssp. *muscoides* generally contribute little cover.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Ericameria nauseosa*
Short shrub/sapling	*Artemisia tridentata* ssp. *vaseyana*
Herb (field)	*Achillea millefolium*
Herb (field)	*Pascopyrum smithii, Poa fendleriana*

Globally

Stratum	**Species**
Short shrub/sapling	*Artemisia tridentata* ssp. *vaseyana*
Herb (field)	*Pascopyrum smithii*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Data are not available.

Globally
Poa pratensis

CONSERVATION STATUS RANK
Global Rank & Reasons: G3? (1-Feb-1996).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association requires mesic conditions and protection from fire. Most plots with significant cover of *Pascopyrum smithii* are associated with other mesic shrubs, especially *Sarcobatus vermiculatus* and *Prunus virginiana*.
Dinosaur National Monument Data Sources: This description is based on 2002 field data (1 plot: DINO.0274).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Baker 1984a, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Jones 1992b, MTNHP 2002b, Rzedowski 1981, Skull Point Mine Application n.d., Skull Point Mine Permit Renewal n.d., Smith 1966, Terwilliger and Smith 1978, Western Ecology Working Group n.d.

Artemisia tridentata ssp. *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	*ARTEMISIA TRIDENTATA* SSP. *VASEYANA* 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 feet). 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 up 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

Dinosaur National Monument

This association is known from widely scattered sites within the monument: Zenobia Basin, McKee Bench and Thanksgiving Gorge.

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

Dinosaur National Monument

Stands of this association occupy gently sloping hills throughout the middle and upper elevations of the monument. Elevation ranges from 2100 to 2400 m. The deep, well-developed soils range from silt loam to clay loam to loamy sand. The substrate is covered with organic litter.

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 feet). 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

Dinosaur National Monument

This association occurs in openings of pinyon-juniper woodland and is dominated by the shrub *Artemisia tridentata* ssp. *vaseyana* with 20 to 30% cover. The most commonly associated species in the shrub layer are *Symphoricarpos oreophilus, Purshia tridentata,* and *Chrysothamnus viscidiflorus*. In the herbaceous layer, graminoids contribute at least 10% cover, dominated by *Poa fendleriana. Koeleria macrantha, Poa secunda, Elymus lanceolatus, Pseudoroegneria spicata,* and *Hesperostipa comata* are common associated species. Forbs are present but with low cover, and there are no consistent species.

Globally

This Wyoming big sagebrush association occurs in a mosaic with other sagebrush communities that in aggregate may cover entire landscapes. Total vegetation cover ranges from approximately 35% to nearly 100%. The shrub layer is dominated by *Artemisia tridentata* ssp. *vaseyana* shrubs up 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

Dinosaur National Monument

Stratum	Species
Short shrub/sapling	*Symphoricarpos oreophilus*
Short shrub/sapling	*Artemisia tridentata* ssp. *vaseyana, Purshia tridentata*
Herb (field)	*Poa fendleriana*

Globally

Stratum	Species
Short shrub/sapling	*Artemisia tridentata* ssp. *vaseyana*
Herb (field)	*Poa fendleriana*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (28-Jun-2005).

CLASSIFICATION COMMENTS
Dinosaur National Monument
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
Dinosaur National Monument Inventory Notes: Data are not available.
Dinosaur National Monument Data Sources: This description is based on 2002 field data (4 plots: DINO.0330, DINO.0341, DINO.0561, DINO.0587).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

Artemisia tridentata ssp. *vaseyana / Poa secunda* Shrubland
Mountain Big Sagebrush / Curly Bluegrass Shrubland

CODE	CEGL001029
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Evergreen shrubland (III.A.)
PHYSIOGNOMIC GROUP	Microphyllous evergreen shrubland (III.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural microphyllous evergreen shrubland (III.A.4.N.)
FORMATION	Lowland microphyllous evergreen shrubland (III.A.4.N.a.)
ALLIANCE	*ARTEMISIA TRIDENTATA* SSP. *VASEYANA* SHRUBLAND ALLIANCE (A.831) Mountain Big Sagebrush Shrubland Alliance
ECOLOGICAL SYSTEM(S):	Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785) Inter-Mountain Basins Volcanic Rock and Cinder Land (CES304.791)
USFWS WETLAND SYSTEM:	Not applicable

CONCEPT SUMMARY
Globally
Stands of this plant association are known from Craters of the Moon National Monument in Idaho and scattered locations in south-central and southeastern Oregon and northwestern Colorado. It is noted in northern and central Nevada, but these may be early-seral stands of other *Artemisia tridentata* ssp. *vaseyana* plant associations. At Craters of the Moon, the plant association is the most widespread vegetation type and is found on xeric sites with shallow soil, usually on (but not limited to) lava flows and cinder buttes. In the Uinta Basin, stands occur on gentle to moderate slopes on high plateaus above 2200 m (7200 feet) elevation. Soils in these sites are deep and well-developed and include silt loams and sandy loams. *Artemisia tridentata* ssp. *vaseyana* dominates stands, though other shrubs, such as *Ericameria* spp. (= *Chrysothamnus* spp.), *Eriogonum microthecum, Leptodactylon pungens, Purshia tridentata, Amelanchier utahensis*, and *Symphoricarpos oreophilus*, are also common. *Poa secunda* dominates the relatively sparse herbaceous understory. Other perennial grasses, such as *Achnatherum thurberianum, Poa fendleriana, Hesperostipa comata*, and *Pseudoroegneria spicata*, are occasionally found on pockets of better

soil. Common forbs include *Eriogonum heracleoides, Eriogonum ovalifolium, Trifolium gymnocarpon*, and *Eriogonum umbellatum*.

DISTRIBUTION

Dinosaur National Monument

This association is known from Zenobia Basin and Douglas Mountain.

Globally

This plant association is known from Craters of the Moon National Monument in Idaho, south-central and southeastern Oregon, Dinosaur National Monument in northwestern Colorado and possibly north and central Nevada (Day and Wright 1985, Tueller and Eckert 1987, ORNHP 2001). The distribution of this association is discontinuous, partly due to the restriction of *Artemisia tridentata* ssp. *vaseyana* to cooler and moister higher elevations. However, within the range of *Artemisia tridentata* ssp. *vaseyana*, the discontinuous distribution also probably reflects the lack of sites unsuitable for the growth of perennial grasses other than *Poa secunda*.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occupies gently sloping hills and ridges of the middle and high elevations within the monument. Sites occur above 2200 m. The deep, well-developed soils include silt loam and sandy loam. The ground surface is covered by organic litter.

Globally

Stands of this association are known from Craters of the Moon National Monument in Idaho and scattered locations in south-central and southeastern Oregon and northwestern Colorado. It is noted in northern and central Nevada, but these may be early-seral stands of other *Artemisia tridentata* ssp. *vaseyana* plant associations. At Craters of the Moon, the plant association is found on xeric sites with shallow soil, usually on (but not limited to) lava flows and cinder buttes. In the Uinta Basin, stands occur on gentle to moderate slopes on high plateaus above 2200 m (7200 feet) elevation. Soils in these sites are deep and well-developed and include silt loams and sandy loams.

VEGETATION DESCRIPTION

Dinosaur National Monument

This association is dominated by *Artemisia tridentata* ssp. *vaseyana* with 30 to 40% cover. Other commonly associated shrubs include *Purshia tridentata, Amelanchier utahensis*, and *Symphoricarpos oreophilus*. The dominant in the herbaceous vegetation layer is *Poa secunda* with 5 to 20% cover. *Poa fendleriana, Hesperostipa comata*, and *Elymus elymoides* are also likely to occur with less than 5% cover. Forbs are diverse and low in cover.

Globally

Artemisia tridentata ssp. *vaseyana* dominates stands, though other shrubs, such as *Ericameria* spp. (= *Chrysothamnus* spp.), *Eriogonum microthecum, Leptodactylon pungens, Purshia tridentata, Amelanchier utahensis*, and *Symphoricarpos oreophilus*, are also common. *Poa secunda* dominates the relatively sparse herbaceous understory. Other perennial grasses, such as *Achnatherum thurberianum, Poa fendleriana, Hesperostipa comata,* and *Pseudoroegneria spicata*, are occasionally found on pockets of better soil. Common forbs include *Eriogonum heracleoides, Eriogonum ovalifolium, Trifolium gymnocarpon*, and *Eriogonum umbellatum*.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Artemisia tridentata* ssp. *vaseyana, Purshia tridentata*
Herb (field)	*Poa secunda*

Globally

Stratum	**Species**
Short shrub/sapling	*Artemisia tridentata* ssp. *vaseyana*
Herb (field)	*Poa secunda*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G3 (19-Jan-2001). This plant association is widely scattered in eastern Oregon, locally common in Idaho and northwestern Colorado, and probably present in Nevada. Rangewide, however, it is not abundant and it is discontinuously distributed. There are less than 100 element occurrences of this type known, though some occurrences cover large areas. The association is probably limited to the least productive soils within the range of *Artemisia tridentata* ssp. *vaseyana*. At lower elevations, these poorly developed and exposed soils are susceptible to surface disturbance and subsequent *Bromus tectorum* invasion. Once *Bromus tectorum* has invaded the *Artemisia tridentata* ssp. *vaseyana* understory, recovery of the original association after prescribed burns or wildfire becomes very difficult.

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
In contrast to stands with noticeable *Achnatherum thurberianum, Festuca idahoensis, Hesperostipa comata,* or *Pseudoroegneria spicata, Poa secunda* is the only perennial grass of significance in late-seral *Artemisia tridentata* ssp. *vaseyana / Poa secunda* stands (Day and Wright 1985). Similar plant associations documented in northern and central Nevada, such as *Artemisia tridentata* ssp. *vaseyana - Chrysothamnus viscidiflorus / Poa secunda - Wyethia mollis, Artemisia tridentata* ssp. *vaseyana / Poa secunda - Balsamorhiza sagittata,* and *Artemisia tridentata* ssp. *vaseyana - Symphoricarpos oreophilus / Poa secunda,* are described as "low seral" communities (Tueller and Eckert 1987). They are probably seral to other *Artemisia tridentata* ssp. *vaseyana - Symphoricarpos oreophilus* plant associations. For example, the indicator grass species *Poa secunda* had the highest constancy and cover in late-seral *Artemisia tridentata* ssp. *vaseyana - Symphoricarpos oreophilus / Elymus trachycaulus* and *Artemisia tridentata* ssp. *vaseyana - Symphoricarpos oreophilus / Festuca idahoensis* plant associations (Tueller and Eckert 1987).
In the Uinta Basin of northwestern Colorado (Dinosaur National Monument), stands of this association may be representative of *Artemisia tridentata* ssp. *vaseyana / Poa fendleriana* Shrubland (CEGL002812) or *Artemisia tridentata* ssp. *vaseyana / Pseudoroegneria spicata* Shrubland (CEGL001030) that have been degraded by grazing so that *Poa secunda* is dominant.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is very similar to *Artemisia tridentata* ssp. *vaseyana / Poa fendleriana* Shrubland (CEGL002812), only with difference in the cover of each species of *Poa*. *Poa secunda* is more tolerant of drought and of grazing than *Poa fendleriana*.
Dinosaur National Monument Data Sources: This description is based on 2002 field data (3 plots: DINO.0525, DINO.0527, DINO.0548).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: C. Murphy, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, Day and Wright 1985, Driscoll et al. 1984, Kagan et al. 2000, NVNHP 2003, ORNHP unpubl. data, Tueller and Eckert 1987, Western Ecology Working Group n.d.

Artemisia tridentata ssp. *vaseyana / Pseudoroegneria spicata* Shrubland Mountain Big Sagebrush / Bluebunch Wheatgrass Shrubland

CODE	CEGL001030
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Evergreen shrubland (III.A.)
PHYSIOGNOMIC GROUP	Microphyllous evergreen shrubland (III.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural microphyllous evergreen shrubland (III.A.4.N.)

FORMATION	Lowland microphyllous evergreen shrubland (III.A.4.N.a.)
ALLIANCE	*ARTEMISIA TRIDENTATA* SSP. *VASEYANA* SHRUBLAND ALLIANCE (A.831) 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 is a common, abundant and widespread sagebrush community in the western U.S. It occurs from 1829 to 3048 m (6000-10,000 feet) elevation, on 10-59% slopes, usually on the upper part of the slope, or on ridgetops, with northeast-to south-facing aspects. Soils are generally deep Mollisols (average depth from one study was 104 cm). This association is dominated by *Artemisia tridentata* ssp. *vaseyana*, with a conspicuous herbaceous undergrowth often dominated by *Pseudoroegneria spicata*. Other shrubs are usually present, but no one species consistently so, all generally with low cover (<10%). Shrub species include *Chrysothamnus* spp., *Tetradymia canescens, Purshia tridentata*, and *Amelanchier alnifolia*. Note that stands usually lack *Symphoricarpos oreophilus*. The herbaceous undergrowth is dominated by grasses, *Pseudoroegneria spicata* usually having the highest cover. In disturbed stands, *Bromus tectorum* can be more abundant. Other grass species include *Poa fendleriana, Poa secunda, Bouteloua gracilis, Elymus lanceolatus, Koeleria macrantha, Hesperostipa comata*, and *Elymus elymoides. Festuca idahoensis* is usually not present, but if so, then in very low amounts. Common forbs include *Eriogonum umbellatum, Lupinus sericeus, Comandra umbellata, Balsamorhiza sagittata, Lithospermum ruderale*, and *Achillea millefolium. Bromus tectorum* may be present to dominant in stands that have been severely disturbed.

DISTRIBUTION

Dinosaur National Monument

This association is known from the slopes of Round Top Mountain, the Douglas Mountain area, Thanksgiving Gorge, and Warm Springs Draw.

Globally

This common association is known from Nevada, Oregon, Idaho, Montana, Wyoming, Colorado and possibly Utah.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs on gentle to somewhat steep slopes and ridges at higher elevations within the monument. Elevation ranges from 2100 to 2450 m, and stands occur on any aspect except south or southwest. The substrate is often limestone or derived from limestone. Soils are generally fine-textured, including clay loams and silt loams. The substrate may be somewhat compact and windblown, exposing a pebbly rock pavement.

Globally

This is a common, abundant and widespread sagebrush community in the western U.S. It occurs from 1829 to 3048 m (6000-10,000 feet) elevation, on 10-59% slopes, usually on the upper part of the slope, and on ridgetops, with northeast-to south-facing aspects. Soils are generally deep Mollisols (average depth from one study was 104 cm). Soil textures range from loams to gravely clays.

VEGETATION DESCRIPTION

Dinosaur National Monument

Artemisia tridentata ssp. *vaseyana* is the dominant species in this shrubland association with 10 to 40% cover. Other commonly associated shrubs include *Purshia tridentata, Tetradymia canescens, Chrysothamnus viscidiflorus*, and *Eriogonum microthecum*. The herbaceous layer is a diverse mix of grasses and forbs. The dominant or codominant grass is *Pseudoroegneria spicata*, usually associated with *Poa fendleriana* and *Hesperostipa comata*. Forbs are diverse and vary among sites. Frequently occurring species include *Stenotus acaulis, Eriogonum umbellatum, Phlox hoodii*, and *Sphaeralcea coccinea*.

Globally

This association is dominated by *Artemisia tridentata* ssp. *vaseyana*, with a well-developed herbaceous undergrowth dominated by *Pseudoroegneria spicata*. Other shrubs are usually present, but no one species consistently so, and all generally with low cover (<10%). Shrub species include *Chrysothamnus* spp., *Tetradymia canescens, Purshia tridentata*, and *Amelanchier alnifolia*. Note that stands usually lack *Symphoricarpos oreophilus*. The herbaceous

undergrowth is dominated by grasses, *Pseudoroegneria spicata* usually having the highest cover. In disturbed stands, *Bromus tectorum* can be more abundant. Other grass species include *Poa fendleriana, Poa secunda, Bouteloua gracilis, Elymus lanceolatus, Koeleria macrantha, Hesperostipa comata,* and *Elymus elymoides. Festuca idahoensis* is usually not present, but if so, then in very low amounts. Common forbs include *Eriogonum umbellatum, Lupinus sericeus, Lupinus caudatus, Comandra umbellata, Balsamorhiza sagittata, Lithospermum ruderale, Phlox hoodii, Sphaeralcea coccinea, Stenotus acaulis,* and *Achillea millefolium*.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Short shrub/sapling	*Artemisia tridentata* ssp. *vaseyana, Purshia tridentata*
Herb (field)	*Eriogonum microthecum*
Herb (field)	*Astragalus spatulatus, Stenotus acaulis*
Herb (field)	*Festuca idahoensis, Poa fendleriana, Pseudoroegneria spicata*

Globally

Stratum	Species
Short shrub/sapling	*Artemisia tridentata* ssp. *vaseyana*
Herb (field)	*Pseudoroegneria spicata*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (1-Feb-1996).

CLASSIFICATION COMMENTS

Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Dinosaur National Monument Inventory Notes: This association is a healthy, vigorous mix of shrubs and grasses.
Dinosaur National Monument Data Sources: This description is based on 2002 field data (7 plots: DINO.0340, DINO.0345, DINO.0347, DINO.0550, DINO.0558, DINO.0566, DINO.0806).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: G. Kittel, mod. J. Coles

REFERENCES: Baker and Kennedy 1985, Bourgeron and Engelking 1994, Bramble-Brodahl 1978, CONHP unpubl. data 2003, Cooper et al. 1999, Current 1984, Driscoll et al. 1984, Eddleman and Jaindl 1994, Hironaka et al. 1983, Jensen et al. 1988a, Jensen et al. 1988b, Jones and Ogle 2000, Kagan et al. 2000, Lewis 1971, Lewis 1975a, MTNHP 2002b, Mooney 1985, NVNHP 2003, Smith 1966, Terwilliger and Smith 1978

Artemisia tridentata ssp. *wyomingensis - Atriplex confertifolia* Shrubland
Wyoming Big Sagebrush - Shadscale Shrubland

CODE	CEGL001040
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 Mixed Salt Desert Scrub (CES304.784)
Great Basin Xeric Mixed Sagebrush Shrubland (CES304.774)
Columbia Plateau Ash and Tuff Badland (CES304.081)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This type is found irregularly in xeric, alkaline sites in the Colorado Plateau, Great Basin and northwestern Great Plains of the United States. Slopes tend to be gentle to moderate, and the relatively deep, alkaline soils may be modified by a thin layer of alluvial or colluvial deposits. Stands are dominated by *Artemisia tridentata* ssp. *wyomingensis*, with *Atriplex confertifolia* as an associate. The understory tends to be sparse and inconsistent in its composition.

DISTRIBUTION

Dinosaur National Monument

This association is limited to shale substrates modified by a veneer of old alluvium or eolian deposits. It was sampled at Stone Bridge, Horse Trail Draw, Graham Gulch, Calico Draw, Quarry Entrance, Gates of Lodore and Conway Draw. It is likely to occur on Pleistocene terraces in all of the broader valleys or on the Yampa Bench.

Globally

This type is found irregularly in the Columbia Plateau, Colorado Plateau, Great Basin and northwestern Great Plains of the United States, ranging from western North Dakota to Montana and southwest to Utah and California.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This sparse desert shrubland association occupies gentle to moderate slopes (up to 15 degrees) oriented to any aspect on shale surfaces that are modified by the presence of a thin veneer of gravel or cobble between 1500 and 1800 m. Gravel and bare soil cover most of the unvegetated surface, with lesser cover by litter and larger rocks. Soils are generally fine-textured (silty or clayey) and are derived from Mancos or Morrison shales, Browns Park Formation, or the Frontier Formation, modified by the presence of either a thin residual or alluvial gravel layer.

Globally

This short shrubland association occurs on slopes, ridgetops and benches in dry habitats of the Colorado Plateau and Great Basin, extending into the northwestern Great Plains. It is found in lowlands and on terraces and alluvial fans in the outwash plains near Bighorn and Prior mountains (Knight et al. 1987, DeVelice and Lesica 1993) in north-central Wyoming, northwestern Colorado and south-central Montana. Elevations range between 1120 and 1800 m (3680-5900 feet), slopes range from level to gently sloping, and sites may be oriented to any aspect. Soil textures are variable, including silty loam, clay loam, sandy loam and sandy clay, and generally are derived from alluvium, sandstone, siltstone or shale. Soils of this association are more alkaline than those of adjacent sagebrush steppe associations (Knight et al. 1987) and similar in alkalinity to soils supporting saltbush associations. Biological soil crusts may cover up to 50% of the unvegetated ground surface in undisturbed stands.

VEGETATION DESCRIPTION

Dinosaur National Monument

This mixed desert shrubland is characterized by an open (5 to 25% cover) shrub canopy dominated by *Artemisia tridentata* ssp. *wyomingensis* with slightly less cover by Atriplex confertifolia. Few other shrubs are consistently present, except *Tetradymia spinosa* and *Opuntia polyacantha*. About half the sampled stands have scattered individual *Juniperus osteosperma* trees present, but there is no evidence that these stands are being taken over by trees. The herbaceous layer shows the effects of many years of domestic livestock grazing; it is depauperate and perennial species have relatively sparse cover (rarely exceeding 5%). Common species include *Hesperostipa comata, Achnatherum hymenoides*, and *Pleuraphis jamesii*, and the exotic grass *Bromus tectorum* is present to codominant in most stands. Forbs are a minor and variable component of this association; the only reported species are *Antennaria* sp., *Eriogonum ovalifolium, Leptodactylon pungens, Machaeranthera grindelioides*, and *Phlox hoodii*; none with more than trace cover.

Globally
Stands of this somewhat sparsely vegetated association are dominated by *Artemisia tridentata* ssp. *wyomingensis*, with between 1 and 28% cover. *Atriplex confertifolia* is present and may be codominant. Other shrub species that may be present include *Atriplex gardneri, Ericameria nauseosa, Krascheninnikovia lanata, Grayia spinosa, Gutierrezia sarothrae, Opuntia polyacantha, Picrothamnus desertorum, Tetradymia spinosa,* and *Sarcobatus vermiculatus*. The understory in most stands is relatively sparse, rarely exceeding 10% total cover. Herbaceous species may include small amounts of *Achnatherum hymenoides, Aristida purpurea, Elymus elymoides, Hesperostipa comata, Lepidium montanum, Oenothera pallida, Phlox hoodii, Pleuraphis jamesii, Leptodactylon pungens, Sphaeralcea coccinea,* and *Sporobolus airoides*. Stands degraded by grazing may have an understory dominated or codominated by *Bromus tectorum*.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Atriplex confertifolia, Sarcobatus vermiculatus*
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Lappula occidentalis*
Herb (field)	*Hesperostipa comata, Leymus salinus, Poa fendleriana*

Globally

Stratum	**Species**
Short shrub/sapling	*Atriplex confertifolia*
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Bromus tectorum

CONSERVATION STATUS RANK
Global Rank & Reasons: G3G5 (23-Feb-1994).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
This type needs further characterization. In the Great Plains, the type is largely synonymous with *Artemisia tridentata - Atriplex confertifolia* Shrubland (CEGL000993). DeVelice and Lesica (1993) described stands of *Artemisia tridentata - Atriplex confertifolia* Community Type that likely were dominated by *Artemisia tridentata* ssp. *wyomingensis*, but sagebrush was not keyed to subspecies. These stands were included in the concept of this association but are also referenced in *Artemisia tridentata - Atriplex confertifolia* Shrubland (CEGL000993) because of the possibility that some of the stands were dominated by *Artemisia tridentata* ssp. *tridentata*. More information is needed as to how much *Atriplex confertifolia* cover is needed to classify a stand as this association. A number of the existing *Artemisia tridentata* ssp. *wyomingensis* associations list *Atriplex confertifolia* as an associate. DeVelice and Lesica (1993) sampled four stands that averaged 28% cover *Artemisia tridentata*, 4% cover *Atriplex confertifolia*, 2% cover *Picrothamnus desertorum*, and 2% cover *Atriplex gardneri*. Knight et al. (1987) indicate that in their stands *Artemisia tridentata* ssp. *wyomingensis* averaged 7% cover, *Picrothamnus desertorum* averaged 1% cover, and *Atriplex confertifolia* averaged <1%. This closely resembles plots at Dinosaur National Monument that were assigned to other *Artemisia tridentata* ssp. *wyomingensis* associations.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association reflects the moderating influence of a thin layer of gravel or sand has on an otherwise alkaline substrate; both the alkaline-tolerant *Atriplex confertifolia* and the

relatively intolerant *Artemisia tridentata* ssp. *wyomingensis* can persist. Shrubs are often stunted to 0.5 m or less in height. Most examples have been grazed extensively and have lost much of their original native grass cover to *Bromus tectorum.*
Dinosaur National Monument Data Sources: This association is described from 2002 field data (3 plots: DINO.0116, DINO.0126, DINO.0370) and accuracy assessment data collected in 2005 (4 plots: DINO_AA.A0565, DINO_AA.A0771, DINO_AA.A0569, DINO_AA.A1290).
Local Description Authors: J. Coles
Global Description Authors: D. Faber-Langendoen, mod. J. Coles and K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, Brown 1971, DeVelice and Lesica 1993, Driscoll et al. 1984, Kagan et al. 2000, Knight et al. 1987, MTNHP 2002b, NDNHI n.d., Western Ecology Working Group n.d.

Artemisia tridentata ssp. *wyomingensis / Balsamorhiza sagittata* Shrubland
Wyoming Big Sagebrush / Arrowleaf Balsamroot Shrubland

CODE	CEGL000994
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)
Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This association occurs on plateaus, benches and canyons in northwestern Colorado, adjacent eastern Utah and northeastern Nevada. Elevations range from 2275 to 2325 m (7465-7625 feet) in Colorado and 2195 m (7200 feet) in Nevada. Soils are typically well-drained sandy loams. Bare ground and litter cover nearly all the unvegetated surface, except in rare cases where the substrate is quite rocky. *Artemisia tridentata* ssp. *wyomingensis* is the dominant species in this sparsely vegetated shrub association, with between 5 and 30% cover. Associated shrubs vary among sites, although *Purshia tridentata* is present in about half of them. *Mahonia repens* and *Ericameria nauseosa* may also be present. The broad-leafy forb *Balsamorhiza sagittata* dominates the diverse herbaceous understory, typically contributing at least 10% cover. Other commonly associated forbs that contribute less cover include *Phlox* spp., *Comandra umbellata, Achillea millefolium, Mertensia oblongifolia, Penstemon speciosus, Lupinus argenteus,* and *Petradoria pumila*. Grass cover is usually comparatively sparse, less species-rich, and most commonly includes *Poa fendleriana, Leymus cinereus, Achnatherum lettermanii,* and *Pseudoroegneria spicata*.

DISTRIBUTION
Dinosaur National Monument
This association is known from Jones Hole Overlook, Island Park Overlook, and Snow Ranch on the Yampa Plateau.

Globally
This association has been reported from northwestern Colorado, adjacent eastern Utah and northeastern Nevada. It may be expected to occur at moderate elevations within the sagebrush zone throughout the western U.S.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association occurs on gentle to moderate north to northeast slopes at elevations ranging from 2275 to 2325 m. Soils are typically well-drained sandy loams, and in one case, the substrate is quite rocky.

Globally
This association occurs on plateaus, benches and canyons in northwestern Colorado, adjacent eastern Utah and northeastern Nevada. There is little environmental information available for Nevada sites. Elevations range from

2275 to 2325 m (7465-7625 feet) in Colorado and 2195 m (7200 feet) in Nevada. Soils are typically well-drained sandy loams. Bare ground and litter cover nearly all the unvegetated surface, except in rare cases where the substrate is rocky.

VEGETATION DESCRIPTION

Dinosaur National Monument

Artemisia tridentata ssp. *wyomingensis* is the dominant species in this sparsely vegetated shrub association, with between 5 and 30% cover. Associated shrubs vary among sites, although *Purshia tridentata* is present in about half of them. The broad leafy forb *Balsamorhiza sagittata* dominates the diverse herbaceous understory, typically contributing at least 10% cover. Other commonly associated forbs that contribute less cover include *Phlox* spp., *Comandra umbellata, Achillea millefolium*, and *Petradoria pumila*. Grass cover is usually comparatively sparse, less species-rich, and most commonly includes *Poa fendleriana* and *Pseudoroegneria spicata*.

Globally

Artemisia tridentata ssp. *wyomingensis* is the dominant species in this sparsely vegetated shrub association, with between 5 and 30% cover. Associated shrubs vary among sites, although *Purshia tridentata* is present in about half of them. *Mahonia repens* and *Ericameria nauseosa* may also be present. The broad-leafy forb *Balsamorhiza sagittata* dominates the diverse herbaceous understory, typically contributing at least 10% cover. Other commonly associated forbs that contribute less cover include *Phlox* spp., *Comandra umbellata, Achillea millefolium, Mertensia oblongifolia, Penstemon speciosus, Lupinus argenteus*, and *Petradoria pumila*. Grass cover is usually comparatively sparse, less species-rich, and most commonly includes *Poa fendleriana*, *Leymus cinereus, Achnatherum lettermanii*, and *Pseudoroegneria spicata*.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Balsamorhiza sagittata*

Globally

Stratum	**Species**
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Balsamorhiza sagittata*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Bromus tectorum

Globally
Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Dinosaur National Monument
Data are not available.

Globally

A number of the Nevada "Sagebrush-Herb Community" plots described by Loope (1969) mention only *Artemisia tridentata*, without identifying the subspecies. The sites are at 8800-9000 feet, which is higher in elevation than most of the range of *Artemisia tridentata* ssp. *wyomingensis*; it is likely that these plots belong in *Artemisia tridentata* ssp. *vaseyana / Balsamorhiza sagittata* Shrubland (CEGL001020). The site at 7200 feet may contain either *Artemisia tridentata* ssp. *wyomingensis* or *Artemisia tridentata* ssp. *vaseyana*.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Dinosaur National Monument Inventory Notes: Data are not available.
Dinosaur National Monument Data Sources: This description is based on 2002 field data (4 plots: DINO.0102,

DINO.0104, DINO.0408, DINO.0453).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Loope 1969, NVNHP 2003

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 occurs 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 feet) 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*. and *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
Dinosaur National Monument
This association is known from throughout the monument, particularly south of the Yampa and Green rivers from South Cub Creek on the west to Happy Hollow on the east. It is the common type on the valley floor in the vicinity of the Dinosaur Quarry.

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
Dinosaur National Monument
This association typically occupies valley floors and toeslopes. It also occasionally occurs on steep colluvial slopes. Elevations range from 1450 to 1800 m with a few plots up to 2200 m elevation. Soils are usually deep alluvium and well-drained. Cryptogamic crust and moss may be significant components of the ground cover.

Globally
This association has been found on a variety of landscape features, including mesatops, midslopes and low slopes of canyons, hills, and valleys, and on terraces. Sites can be flat to moderately steep (0-15 degrees) and have any aspect. Sampled sites have had elevations between 1455 and 2372 m (4770-7777 feet). 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

Dinosaur National Monument

This shrubland association is characterized by moderate to dense cover of *Artemisia tridentata* ssp. *wyomingensis*, with an understory dominated by the annual exotic grass *Bromus tectorum*. Associated shrubs occurring with low cover include *Atriplex confertifolia, Atriplex canescens*, and *Ericameria nauseosa*. The dwarf-shrub succulents *Opuntia fragilis* and *Opuntia polyacantha* are commonly present, with cover not generally exceeding 5%. The herbaceous understory is predominantly *Bromus tectorum*, which in dry years may be sparse, but in wet years may have up to 80% cover. Relict native bunch grasses are scattered throughout the stands, including *Achnatherum hymenoides, Elymus elymoides, Poa fendleriana, Poa secunda*, and *Hesperostipa comata*. Forb species are highly variable among sites and contribute low 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*. and *Juniperus scopulorum* trees may provide up to 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

Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Alyssum desertorum, Descurainia pinnata, Salsola tragus*
Herb (field)	*Bromus tectorum*

Globally

Stratum	**Species**
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Bromus tectorum

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (invasive) (14-Dec-2004).

CLASSIFICATION COMMENTS

Dinosaur National Monument

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

Dinosaur National Monument Inventory Notes: This type is the result of land-use history as much as it is floristic or environmental influences. It is therefore difficult to predict where in the monument it will occur.
Dinosaur National Monument Data Sources: This description is based on 2002 and 2003 field data (13 plots: DINO.0017, DINO.0145, DINO.0162, DINO.0265, DINO.0419, DINO.0422, DINO.0426, DINO.0483, DINO.0643, DINO.0644, DINO.0655, DINO.0659, DINO.1000).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Drake, mod. J. Coles and K.A. Schulz

REFERENCES: Western Ecology Working Group n.d.

Artemisia tridentata ssp. *wyomingensis / Elymus elymoides* Shrubland
Wyoming Big Sagebrush / Bottlebrush Shrubland

CODE	CEGL001043
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)
Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
Little environmental information is available for this association. Some authorities believe that this association is either ecotonal or the result of grazing or burning other types of sagebrush shrublands. Documented sites occur between 1689 and 2134 m (5540-7000 feet) elevation on gentle to moderate slopes in northwestern Colorado, northeastern Nevada, southern Idaho and possibly in eastern Idaho and southeastern Oregon. Aspect is not important in determining the distribution of this association. Soils are deep and well-developed and may have a loam or clay loam texture. The unvegetated surface is dominated by bare soil, with little litter present in grazed stands. The vegetation of this sagebrush shrubland is characterized by an open layer of *Artemisia tridentata* ssp. *wyomingensis* with between 20 and 35% cover, and a mixed grass understory dominated or codominated by *Elymus elymoides* with between 5 and 15% cover. *Chrysothamnus viscidiflorus, Purshia tridentata, Sarcobatus vermiculatus, Symphoricarpos oreophilus, Atriplex confertifolia*, and *Krascheninnikovia lanata* may also be present in the shrub layer, although cover of these species is generally very low. Other important graminoids include *Pascopyrum smithii, Festuca idahoensis, Poa secunda, Achnatherum hymenoides, Hesperostipa comata, Leymus cinereus,* and *Poa fendleriana*. *Bromus tectorum* may be important in disturbed stands. Forbs are generally sparse and vary greatly from site to site. Some common species include *Achillea millefolium, Eriogonum ovalifolium, Lupinus argenteus, Packera multilobata, Cryptantha* spp., *Sphaeralcea coccinea*, and *Phlox hoodii*.

DISTRIBUTION
Dinosaur National Monument
This association is known from the Yampa Bench.

Globally
This association has been documented from isolated sites in northwestern Colorado, southern Idaho (Hironaka et al. 1983), southeastern Oregon, and northeastern Nevada (Jensen et al. 1988a, 1988b). It may also occur in eastern Idaho (Winward 1970) and Wyoming.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This shrub association, sampled once in the monument, occurs at 1689 m elevation on a northeast-facing, moderately angled slope. Soil texture is clay loam derived from the Moenkopi Formation. Much of the soil surface

is barren, devoid of rocks and has small amounts of organic litter on the surface.

Globally
Little environmental information is available for this association. Documented sites occur between 1689 and 2134 m (5540-7000 feet) elevation on gentle to moderate slopes in northwestern Colorado, northeastern Nevada, southern Idaho and possibly in eastern Idaho and southeastern Oregon. Aspect is not important in determining the distribution of this association. Soils are deep and well-developed and may have a loam or clay loam texture. The unvegetated surface is dominated by bare soil, with little litter present in grazed stands.

VEGETATION DESCRIPTION
Dinosaur National Monument
This shrubland association has approximately 20% cover of *Artemisia tridentata* ssp. *wyomingensis*. Other shrubs present, each with less than 5% cover, include *Sarcobatus vermiculatus, Chrysothamnus viscidiflorus, Atriplex confertifolia*, and *Krascheninnikovia lanata*. The herbaceous understory totals almost 20% and is dominated by Elymus elymoides with up to 15% cover. Associated grasses include *Poa secunda, Bromus tectorum, Achnatherum hymenoides,* and *Hesperostipa comata*. Forb species are absent to sparse in cover.

Globally
The vegetation of this sagebrush shrubland is characterized by an open layer of *Artemisia tridentata* ssp. *wyomingensis* with between 20 and 35% cover, and a mixed grass understory dominated or codominated by *Elymus elymoides* with between 5 and 15% cover. *Chrysothamnus viscidiflorus, Purshia tridentata, Sarcobatus vermiculatus, Symphoricarpos oreophilus, Atriplex confertifolia,* and *Krascheninnikovia* lanata may also be present in the shrub layer, although cover of these species is generally very low. Other important graminoids include *Pascopyrum smithii, Festuca idahoensis, Poa secunda, Achnatherum hymenoides, Hesperostipa comata, Leymus cinereus,* and *Poa fendleriana. Bromus tectorum* may be important in disturbed stands. Forbs are generally sparse and vary greatly from site to site. Some common species include *Achillea millefolium, Eriogonum ovalifolium, Lupinus argenteus, Packera multilobata, Cryptantha* spp., *Sphaeralcea coccinea,* and *Phlox hoodii*.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Elymus elymoides*

Globally

Stratum	**Species**
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Elymus elymoides*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Data are not available.

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
The grass layer in this association is generally mixed. It may sometimes be difficult in the field to distinguish this association from closely related sagebrush / grass communities.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Data are not available.
Dinosaur National Monument Data Sources: This description is based on 2002 field data (1 plot: DINO.0484).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Hironaka et al. 1983, Jensen et al. 1988a, Jensen et al. 1988b, NVNHP 2003, Winward 1970

Artemisia tridentata ssp. *wyomingensis / Hesperostipa comata* Colorado Plateau Shrubland
Wyoming Big Sagebrush / Needle-and-Thread Colorado Plateau Shrubland

CODE	CEGL002761
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 occurs on deep soils on the slopes and summits of plateaus, ridges, hills and mesas throughout the Colorado Plateau in eastern Utah and western Colorado. The type is likely to occur in southwestern Wyoming as well. Elevations range from 1450 to 2419 m (4750-7940 feet). Slopes are level to moderately steep (0-50%). Substrates include eolian sands, loess and landslide deposits; most often soils are not residual but develop from these secondary sources. Total vegetation cover ranges from 25 to 75%, dominated by *Artemisia tridentata* ssp. *wyomingensis*. Other shrubs provide little additional cover but may include *Chrysothamnus viscidiflorus, Gutierrezia sarothrae, Leptodactylon pungens, Opuntia polyacantha*, and *Yucca harrimaniae*. *Hesperostipa comata* dominates the sparse to moderately dense herbaceous layer. Other grass species present depend on the soil texture, with *Achnatherum hymenoides, Elymus elymoides*, and *Koeleria macrantha* more common on sandy soils, whereas *Pleuraphis jamesii, Bouteloua gracilis*, and *Poa fendleriana* are more common on silty soils. Forbs provide little total cover but may include *Arenaria fendleri, Calochortus gunnisonii, Lepidium montanum, Linum lewisii, Phlox hoodii, Penstemon teucrioides*, and *Sphaeralcea coccinea*. *Bromus tectorum* may be codominant in heavily disturbed sites. Scattered young *Juniperus osteosperma* and *Pinus edulis* trees are often present. Cryptobiotic soil crusts are common in this type, but development is uneven and tends to be sparse in sites that have been grazed by domestic livestock.

DISTRIBUTION
Dinosaur National Monument
This association is known from many sites of the monument, specifically, listed west to east, Island Park, McKee Bench, Red Wash, The Billiard Table, Cactus Flat, Twelvemile Gulch, Deerlodge Park, as well as other sites north and south of these areas.

Globally
This shrubland association occurs on deep soils on the slopes and summits of plateaus, ridges, hills and mesas throughout the Colorado Plateau in eastern Utah and western Colorado, and may extend into Wyoming.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This common shrub association occurs in extensive stands throughout the monument. Elevations range from 1450 to 2375 m, slopes are gentle to moderate, and stands may appear on slopes with any aspect. Soils range from clay loams to sandy loams derived primarily from eolian deposits of sand or silt.

Globally

This widespread shrubland association occurs on deep soils on the slopes and summits of plateaus, ridges, hills and mesas throughout the Colorado Plateau in eastern Utah and western Colorado. The type is likely to occur in southwestern Wyoming as well. Elevations range from 1450 to 2419 m (4750-7940 feet). Slopes are level to moderately steep (0-50%). Substrates include eolian sands, loess and landslide deposits; most often soils are not residual but develop from these secondary sources. In sparsely vegetated stands, there is usually an abundance of exposed soil on the ground surface, whereas in denser stands litter covers most of the ground.

VEGETATION DESCRIPTION

Dinosaur National Monument

This shrubland association is characterized by 5 to 65% cover of *Artemisia tridentata* ssp. *wyomingensis* and 5 to 35% cover of *Hesperostipa comata*. Few other shrubs are consistently associated with this community except *Opuntia* spp. and *Gutierrezia sarothrae*. *Hesperostipa comata* clearly dominates the understory. Common associated grasses include *Bromus tectorum, Achnatherum hymenoides, Poa fendleriana*, and *Poa secunda*, each with minimal cover. The most consistent forbs are *Sphaeralcea coccinea* and *Phlox hoodii*.

Globally

This sagebrush association is widespread throughout the northern Colorado Plateau and is abundant in northwestern Colorado. Total vegetation cover ranges from 14 to 75% and is dominated by *Artemisia tridentata* ssp. *wyomingensis* with between 5 and 65% cover. Other shrubs provide little additional cover but may include *Chrysothamnus viscidiflorus, Gutierrezia sarothrae, Leptodactylon pungens, Opuntia polyacantha*, and *Yucca harrimaniae*. Scattered *Pinus edulis* and *Juniperus osteosperma* trees and seedlings may be present but do not form a layer. *Hesperostipa comata* dominates the sparse to moderately dense herbaceous layer. Other grass species present depend on the soil texture, with *Achnatherum hymenoides, Elymus elymoides*, and *Koeleria macrantha* more common on sandy soils, whereas *Pleuraphis jamesii, Bouteloua gracilis*, and *Poa fendleriana* are more common on silty soils. Forbs provide little total cover but may include *Arenaria fendleri, Calochortus gunnisonii, Eriogonum cernuum, Lepidium montanum, Linum lewisii, Machaeranthera canescens, Oenothera albicaulis, Phlox hoodii, Penstemon teucrioides*, and *Sphaeralcea coccinea. Bromus tectorum* may be codominant in heavily disturbed sites. Scattered young *Juniperus osteosperma* and *Pinus edulis* trees are often present. Cryptobiotic soil crusts are common in this type, but developmenttends to be sparse in sites that have been grazed by domestic livestock.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Opuntia fragilis*
Herb (field)	*Artemisia dracunculus*
Herb (field)	*Hesperostipa comata*

Globally

Stratum	**Species**
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Hesperostipa comata*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Bromus tectorum

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (12-Apr-2005).

CLASSIFICATION COMMENTS

Dinosaur National Monument

Data are not available.

Globally

A similar association, *Artemisia tridentata* ssp. *wyomingensis / Hesperostipa comata* Shrubland (CEGL001051), describes a shrubland type of the Columbia River Basin of Oregon and Washington and the Snake River Plain of Idaho that is restricted to dry calcareous hardpan sites. However, little is known of the specifics of this association and its possible relationship to the Colorado Plateau shrubland. Baker's (1984a) concept of *Artemisia tridentata* ssp. *wyomingensis / Stipa comata* Association includes both the Colorado and Columbia Basin/Snake River Plain communities. As more data become available, and especially as the range of the Colorado Plateau shrubland type is better known, these two associations should be revisited and compared to justify their separation.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is common and well-documented.
Dinosaur National Monument Data Sources: This description is based on 2002 and 2003 field data (31 plots: DINO.0005,DINO.0006, DINO.0008, DINO.0129, DINO.0152, DINO.0184, DINO.0288, DINO.0343, DINO.0360, DINO.0369, DINO.0461, DINO.0471, DINO.0473, DINO.0482, DINO.0489, DINO.0509 DINO.0597, DINO.0599, DINO.0618, DINO.0639, DINO.0648, DINO.0680, DINO.0697, DINO.0706, DINO.0719, DINO.0824, DINO.0842, DINO.1419, DINO.1421, DINO.1422, DINO.1423).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Baker 1984a, Western Ecology Working Group n.d.

Artemisia tridentata ssp. *wyomingensis / Leymus salinus* Shrubland
Wyoming Big Sagebrush / Salinas Lyme Grass Shrubland

CODE	CEGL002813
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Evergreen shrubland (III.A.)
PHYSIOGNOMIC GROUP	Microphyllous evergreen shrubland (III.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural microphyllous evergreen shrubland (III.A.4.N.)
FORMATION	Lowland microphyllous evergreen shrubland (III.A.4.N.a.)
ALLIANCE	*ARTEMISIA TRIDENTATA* SSP. *WYOMINGENSIS* SHRUBLAND ALLIANCE (A.832) Wyoming Big Sagebrush Shrubland Alliance
ECOLOGICAL SYSTEM(S):	Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788) Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)
USFWS WETLAND SYSTEM:	Not applicable

CONCEPT SUMMARY
Globally
This association has been described only from Dinosaur National Monument in northwestern Colorado but may be expected on marine shale substrates in southern Wyoming and northeastern Utah as well. This summary refers only to stands in the monument. The association occupies badland hills of Mancos shale at around 1700 m elevation. The barren, rocky substrate has clayey, well-drained soils. The vegetation is dominated by Artemisia tridentata ssp. wyomingensis, averaging 10% cover. *Atriplex confertifolia* and *Gutierrezia sarothrae* are often present with sparse cover. *Leymus salinus* dominates the herbaceous understory with 1 to 10% cover and is typically associated with *Achnatherum hymenoides*. Forb species typically include *Phlox hoodii* and *Stenotus acaulis*.

DISTRIBUTION
Dinosaur National Monument
This association is known from Lily Park and Calico Draw on the eastern end of the monument.

Globally
This association is known from exposures of Mancos shale adjacent to the east end of Dinosaur National Monument in northwestern Colorado but may be expected on marine shale substrates in southern Wyoming and northeastern Utah as well.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument
This association occupies badland hills in the Mancos shale at around 1700 m elevation. The barren, rocky substrate has clayey, well-drained soils.

Globally
This association has been documented only from Dinosaur National Monument. Without additional data, there is no global information.

VEGETATION DESCRIPTION
Dinosaur National Monument
This shrubland association is dominated by *Artemisia tridentata* ssp. *wyomingensis*, averaging 10% cover. *Atriplex confertifolia* and *Gutierrezia sarothrae* are often present with sparse cover. *Leymus salinus* dominates the herbaceous understory with 1 to 10% cover and is typically associated with *Achnatherum hymenoides*. Forb species typically include *Phlox hoodii* and *Stenotus acaulis*.

Globally
This association has been documented only from Dinosaur National Monument. Without additional data, there is no global information.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Leymus salinus*

Globally
Data are not available.

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (5-Jul-2005).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
The floristics are similar to the *Artemisia tridentata* ssp. *wyomingensis-Atriplex confertifolia/Elymus salina* Association described by (Baker 1982b), but it is not codominated by both shrub species.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Although known only from the eastern end of the monument, this association could also occur on exposures of Mancos shale in the vicinity of the Dinosaur Quarry or on the north side of Split Mountain.
Dinosaur National Monument Data Sources: This description is based on 2002 field data (3 plots: DINO.0307, DINO.0371, DINO.0372).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Baker 1982b, Western Ecology Working Group n.d.

Artemisia tridentata ssp. *wyomingensis / Pleuraphis jamesii* Shrubland
Wyoming Big Sagebrush / James' Galleta Shrubland

CODE	CEGL002084
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 occurs on alluvial flats and terraces, as well as on upland slopes and mesas in the Colorado Plateau. Sites tend to have gentle to moderately steep slopes, and elevations range from 1400 to 1939 m (4600-6360 feet). Known sites have an east or southeast aspect. Soils are derived from a wide variety of substrates; however, soil texture tends to be a sandy loam. Cryptobiotic crust cover is usually present. The vegetation is characterized by a moderately dense canopy of *Artemisia tridentata* ssp. *wyomingensis* with a sparse herbaceous understory dominated by *Pleuraphis jamesii*. Other shrubs present may include scattered individuals of *Atriplex confertifolia, Sarcobatus vermiculatus, Ericameria nauseosa, Gutierrezia sarothrae,* and *Opuntia* spp. *Achnatherum hymenoides, Hesperostipa comata, Pseudoroegneria spicata, Poa secunda,* and *Leymus salinus* may be present in addition to *Pleuraphis jamesii*. Forbs tend to be sparse and inconsistent among stands but may include *Calochortus* spp., *Astragalus nuttallianus, Oenothera pallida,* and *Sphaeralcea coccinea*.

DISTRIBUTION

Dinosaur National Monument

This association is known from the western to eastern ends of the monument, specifically the Sounds of Silence Trail, Stone Bridge Draw, Red Rock Canyon, Yampa Bench, and Deerlodge Park.

Globally

This association is known from the northern Colorado Plateau of southeastern Utah and western Colorado.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occupies broad alluvial flats and terraces of the Green and Yampa rivers and gently sloping foothills, hogbacks, and benches of the middle elevations of the monument. Site elevations range from 1400 to 1800 m. Soils vary in texture from site to site but are typically deep and derived from marine shales or adjacent sandstones. In this association, cryptobiotic crusts are commonly present and sometimes contribute significant ground cover.

Globally

This shrubland association occurs on alluvial flats and terraces, as well as on ridges, slopes, benches and mesas throughout the Colorado Plateau. Sites tend to have gentle slopes, but some sites range up to 55% slope. Elevations range from 1400 to 1939 m (4600-6360 feet), and sites may be oriented to any aspect, although most of the sampled stands have either an east or southeast aspect. Soils are derived from a wide variety of substrates, from alluvium, sandstone and eolian sands to limestone, metamorphic rocks and shales; however, soil texture tends to be a sandy loam. Cryptobiotic crust cover is usually present and ranges from sparse to nearly 30% cover.

VEGETATION DESCRIPTION

Dinosaur National Monument

This shrubland association is characterized by moderate to moderately dense cover of short shrub *Artemisia tridentata* ssp. *wyomingensis* with an herbaceous understory dominated by *Pleuraphis jamesii*. The shrub mix typically includes *Sarcobatus vermiculatus, Atriplex confertifolia, Opuntia* spp., and *Gutierrezia sarothrae. Pleuraphis jamesii* contributes 5 to 30% cover in the herbaceous stratum. Associated grasses of equal or lesser cover

include the annual exotic *Bromus tectorum* and native bunch grasses *Poa secunda, Achnatherum hymenoides, Pseudoroegneria spicata, Elymus elymoides*, and *Hesperostipa comata*. Forb species are sparsely distributed and inconsistent among sites.

Globally
This shrubland association is characterized by a moderately dense canopy of *Artemisia tridentata* ssp. *wyomingensis*, with low cover of herbaceous species in the understory dominated by *Pleuraphis jamesii* (1-10% cover). Total shrub cover ranges from 20 to 40% and may include scattered individuals of *Atriplex confertifolia, Sarcobatus vermiculatus*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, and *Opuntia* spp. The herbaceous layer tends to be dominated in most years by perennial bunch grasses, with *Achnatherum hymenoides, Hesperostipa comata, Pseudoroegneria spicata, Poa secunda*, and *Leymus salinus* evident in addition to *Pleuraphis jamesii*. Forbs tend to be sparse and inconsistent among stands but may include *Calochortus* spp., *Astragalus nuttallianus, Oenothera pallida*, and *Sphaeralcea coccinea*.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	Species
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Pleuraphis jamesii*

Globally

Stratum	Species
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Opuntia polyacantha*
Herb (field)	*Pleuraphis jamesii*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Bromus tectorum

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (14-Dec-2004).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE:

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association may be distinguished from other sagebrush / grass associations by its relatively low elevation (in most cases), the shale-derived substrates, and the cover of Pleuraphis jamesii, which is usually dominant and at least codominant with other grasses in the understory.
Dinosaur National Monument Data Sources: This association is based on 2002 field data (6 plots: DINO.0182, DINO.0416, DINO.0434, DINO.0600, DINO.0835, DINO.0846).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Naumann pers. comm., Western Ecology Working Group n.d.

Artemisia tridentata ssp. *wyomingensis / Poa fendleriana* Shrubland
Wyoming Big Sagebrush / Muttongrass Shrubland

CODE CEGL002775

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 sagebrush shrubland association is widespread throughout the northern Colorado Plateau, occurring on ridges, mesas and hills between 1600 and 2400 m (5250-7875 feet) elevation. Stands may cover entire plateaus or less than an acre in small openings in pinyon-juniper woodlands. Slopes range from 3% to more than 50% and are oriented to all aspects. Soils are deep and often derived from eolian loess or sand, although some stands are on residual soils derived from the underlying sandstone or shale. Total vegetation cover ranges widely, from 10 to 80%. The shrub layer is sparse in hot, dry sites (around 10% cover) but may cover more than 50% in sheltered areas. Other shrubs are usually present and may include *Purshia tridentata, Atriplex confertifolia, Symphoricarpos oreophilus, Amelanchier utahensis*, and *Chrysothamnus viscidiflorus*. The herbaceous understory is generally well-developed and is dominated by *Poa fendleriana* with around 3% cover in sparse shrublands and up to 35% cover in denser shrublands. Associated herbaceous species vary but generally include a number of grass species, especially *Achnatherum hymenoides, Hesperostipa comata, Koeleria macrantha, Pseudoroegneria spicata, Bouteloua gracilis*, and *Achnatherum pinetorum*. Forbs are inconsistent and usually contribute 1% cover or less. Some stands will have scattered *Pinus edulis* and *Juniperus osteosperma* trees.

DISTRIBUTION

Dinosaur National Monument

This association is known from the Yampa Bench, Yampa Plateau, Split Mountain, Wild Mountain, and Douglas Mountain.

Globally

This association is widespread within the sagebrush shrublands of the Colorado Plateau. It has been documented from western Colorado and eastern Utah.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs in extensive stands on gently to moderately sloping hills and ridges at lower and middle elevations within the monument. Elevations range from 1600 to 2400 m. It occurs on all aspects except south. The substrate includes sandstones, shales and limestones, and soil textures range from sandy loam to silty clay.

Globally

This sagebrush shrubland is widespread throughout the northern Colorado Plateau, occurring on ridges, mesas and hills between 1600 and 2400 m (5250-7875 feet) elevation. Stands may cover hundreds of acres or less than an acre in small openings in pinyon-juniper woodlands. Slopes range from 3% to more than 50% and are oriented to all aspects. Soils are deep and often derived from eolian loess or sand, although some stands are on residual soils derived from the underlying sandstone or shale.

VEGETATION DESCRIPTION

Dinosaur National Monument

Artemisia tridentata ssp. *wyomingensis* strongly dominates this shrubland association with 5 to 65% cover. Associated shrubs contributing significant cover include *Purshia tridentata, Atriplex confertifolia*, and *Symphoricarpos oreophilus*. The herbaceous stratum is dominated by the bunchgrass *Poa fendleriana* with between 5 and 35% cover. Other grasses present include *Hesperostipa comata, Elymus elymoides, Koeleria macrantha, Pseudoroegneria spicata*, and *Bromus tectorum*. Forb species are highly diverse with no strong dominant.

Globally

This type of Wyoming big sagebrush shrubland is common in the northern Colorado Plateau. The total vegetation cover ranges widely from 10 to 80%. The shrub layer ranges from sparse in hot, dry sites (around 10% cover) to more than 50% in sheltered sites. Other shrubs are usually present and may include *Purshia tridentata, Atriplex confertifolia, Symphoricarpos oreophilus, Amelanchier utahensis,* and *Chrysothamnus viscidiflorus*. The herbaceous understory is generally well-developed and is dominated by *Poa fendleriana* with around 3% cover in sparse shrublands and up to 35% cover in denser shrublands. Associated herbaceous species vary but generally include a number of grass species, especially *Achnatherum hymenoides, Hesperostipa comata, Koeleria macrantha, Pseudoroegneria spicata, Bouteloua gracilis,* and *Achnatherum pinetorum*. Forbs are inconsistent and usually contribute 1% cover or less. Some stands will have scattered trees of *Pinus edulis* and *Juniperus osteosperma*.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	Species
Short shrub/sapling	*Atriplex confertifolia*
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis, Purshia tridentata*
Herb (field)	*Leptodactylon pungens*
Herb (field)	*Poa fendleriana*

Globally

Stratum	Species
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Poa fendleriana*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Bromus tectorum

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (13-Apr-2005).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Data are not available.
Dinosaur National Monument Data Sources: This description is based on 2002 and 2003 field data (17 plots: DINO.0002, DINO.0107, DINO.0111, DINO.0118, DINO.0150, DINO.0197, DINO.0218, DINO.0311, DINO.0412, DINO.0414, DINO.0454, DINO.0465, DINO.0499, DINO.0501, DINO.0541, DINO.0723, DINO.0845).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

Artemisia tridentata ssp. *wyomingensis / Poa secunda* Shrubland
Wyoming Big Sagebrush / Curly Bluegrass Shrubland

CODE	CEGL001049
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) Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777) Wyoming Basins Dwarf Sagebrush Shrubland and Steppe (CES304.794)
USFWS WETLAND SYSTEM:	Not applicable

CONCEPT SUMMARY

Globally

This sparse shrubland association occurs in patches within a matrix of other shrubland or shrub-steppe types in the Columbia and Uinta basins of Washington, Oregon, Idaho, Nevada and Colorado. Stands are on level to moderate slopes of derived substrates such as loess deposits or alluvial fans and terraces, often modified by a veneer of alluvial cobble or gravel. Elevations range from 1675 to 2300 m (5500-7550 feet). Soils are generally calcareous, excessively well-drained, fine-textured silts or fine sands, often deep to bedrock but sometimes with a shallow duripan that limits water infiltration.

DISTRIBUTION

Dinosaur National Monument

This association is rare in the park and was sampled only north of the Yampa Bench and near the Chew Ranch.

Globally

This association has been documented from northwestern Colorado, northeastern Nevada (Jensen et al. 1988a, b), southern Idaho (Hironaka et al. 1983), the Columbia Basin of eastern Washington (Franklin and Dyrness 1969) and Oregon (Kagan et al. 2000). It is likely to occur in Wyoming and possibly also in northeastern California and southern Montana.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This sparse desert shrubland association occupies gentle to moderate slopes (up to 12 degrees) oriented to any aspect between 1675 and 2300 m. Gravel and bare soil cover most of the unvegetated surface, with lesser cover by litter and biological soil crusts. Soils are generally fine-textured (silty or clayey) and are derived from Moenkopi shales, sometimes modified by the presence of lag gravels of the Bishop conglomerate.

Globally

This sparse shrubland association occurs as patches in a matrix of other shrubland or shrub-steppe types in the Columbia Basin of Washington, Oregon and Idaho, extending south into northern Nevada and with outliers in northwestern Colorado. Slopes range from level to moderate, and many stands are on derived substrates such as loess deposits or alluvial fans and terraces, often modified by a veneer of alluvial cobble or gravel. Annual precipitation in the main part of the range is around 18 cm (7 inches), and the climate is characterized by hot, dry summers and cold, dry winters. Elevations range from 1675 to 2300 m (5500-7550 feet). Soils are generally calcareous, excessively well-drained, fine-textured silts, clays or fine sands, often deep to bedrock but sometimes with a shallow duripan that limits water infiltration.

VEGETATION DESCRIPTION

Dinosaur National Monument

This mixed desert shrubland is characterized by a moderate (15 to 25% cover) shrub canopy dominated by *Artemisia tridentata* ssp. *wyomingensis*, usually accompanied by *Atriplex confertifolia*. Few other shrubs are consistently present except *Purshia tridentata* and *Ericameria nauseosa*. The herbaceous layer is relatively dense and is dominated by the native bunchgrass *Poa secunda* with between 5 and 10% cover. Other grasses are usually present, but not with more than a few percent cover, including *Hesperostipa comata, Elymus elymoides, Koeleria macrantha,* and *Bromus tectorum*. Forbs are a minor and variable component of this association; the only reported species are *Petradoria pumila, Sphaeralcea coccinea,* and *Phlox hoodii,* although these species often have at least 1% cover.

Globally

This sparse shrubland association often occupies the lowest, driest sites within the shrub-steppe mosaic in which it occurs. The named species may often be the only species of note present. *Artemisia tridentata* ssp. *wyomingensis* dominates the open shrub canopy that generally does not exceed 1 m in height and 25% cover. *Grayia spinosa, Ericameria nauseosa*, or *Atriplex confertifolia* may be scattered through the shrub canopy. Besides *Poa secunda, Phlox* spp. are the only herbaceous taxa that are common throughout the range. Other herbaceous species reported include *Petradoria pumila, Sphaeralcea coccinea,* and *Descurainia pinnata*.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Short shrub/sapling	*Atriplex confertifolia*
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Petradoria pumila*
Herb (field)	*Koeleria macrantha, Poa secunda*

Globally

Stratum	Species
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Poa secunda*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Bromus tectorum

Globally
Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G4 (1-Feb-1996). This association is widely distributed. It tends to occur as small to medium patches within a mosaic of many different types of sagebrush and related shrublands.

CLASSIFICATION COMMENTS

Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Dinosaur National Monument Inventory Notes: This association is closely related to *Artemisia tridentata* ssp. *wyomingensis - Atriplex confertifolia* Shrubland (CEGL001040). It is distinguished from it by the higher grass cover in the understory that is dominated by *Poa secunda*. It often occurs adjacent to stands dominated by *Atriplex confertifolia* or *Sarcobatus vermiculatus*.
Dinosaur National Monument Data Sources: This association is described from accuracy assessment data collected in 2005 (3 plots: DINO_AA.A0519, DINO_AA.A0794, DINO_AA.A1003).
Local Description Authors: J. Coles
Global Description Authors: J. Coles

REFERENCES: Bourgeron and Engelking 1994, Caicco and Wellner 1983l, Driscoll et al. 1984, Franklin and Dyrness 1969, Hironaka et al. 1983, Jensen et al. 1988a, Jensen et al. 1988b, Kagan et al. 2000, MTNHP 2002b, NVNHP 2003, WNHP unpubl. data, Western Ecology Working Group n.d.

Artemisia tridentata ssp. *wyomingensis / Pseudoroegneria spicata* Shrubland
Wyoming Big Sagebrush / Bluebunch Wheatgrass Shrubland

CODE CEGL001009

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)
Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association is common and widespread throughout the sagebrush zone of the western Great Plains through southern British Columbia, south into the Great Basin and northern Colorado Plateau. Slopes may be gentle to steep, and aspect is not important in determining the distribution of this association. Stands occupy moderately deep to deep loamy soils (often with coarse fragments), sometimes with a cemented clay layer limiting water and root penetration. Parent materials are variable. Throughout the geographic range of this type, *Artemisia tridentata* ssp. *wyomingensis* dominates a shrub layer that has at least 10% canopy cover. Total vegetation cover ranges between 20% and more than 100%, roughly evenly divided between the shrub and herbaceous strata. The shrubs *Chrysothamnus* spp., *Atriplex confertifolia, Purshia tridentata, Symphoricarpos longiflorus*, and *Amelanchier utahensis* are often present as well. The herbaceous understory is generally a diverse mix of grasses and forbs. *Pseudoroegneria spicata* contributes more cover to the diverse herbaceous layer than does any other native species, and *Achnatherum thurberianum, Festuca idahoensis, Hesperostipa comata, Poa secunda, Koeleria macrantha*, and *Poa fendleriana* are often present. Forbs are variable across the range of this type, but common species include *Eriogonum umbellatum, Sphaeralcea coccinea*, and *Balsamorhiza sagittata*. Stands in the eastern part of the geographic range often include *Gutierrezia sarothrae, Artemisia frigida*, and *Bouteloua gracilis*. The height of the sagebrush ranges from about 35 cm tall in the eastern part of the range to about 1 m tall in the western part.

DISTRIBUTION

Dinosaur National Monument

This association is known from Wild Mountain, Cross Mountain, Yampa Plateau, Yampa Bench, Douglas Mountain, and Island Park.

Globally

This is a widespread Wyoming big sagebrush shrub type, extending from the western side of the Great Plains on the east to British Columbia on the west, and south as far as northern Nevada, southern Wyoming and northwestern Colorado.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This common association occurs on deep, often rocky soils on gentle to steep slopes of all aspects between 1620 to 2300 m elevation. Sites occur on all soil types, although most are on sandy loams. There is some correlation with shale and limestone geologic formations, although a few plots are also on sandstone, talus, or landslide deposits.

Globally

This association is common and widespread throughout the sagebrush zone of the western Great Plains through southern British Columbia, south into the Great Basin and northern Colorado Plateau. Slopes may be gentle to steep, and aspect is not important in determining the distribution of this association. Stands occupy moderately deep to deep loamy soils (often with coarse fragments), sometimes with a cemented clay layer limiting water and root penetration. Parent materials are variable.

VEGETATION DESCRIPTION

Dinosaur National Monument

This shrubland association is strongly dominated by *Artemisia tridentata* ssp. *wyomingensis*. Total vegetation cover ranges between 20% and more than 100%, with an average of 69%, roughly evenly divided between the shrub and herbaceous strata. Total shrub cover ranges between 5 and 55%, and herbaceous cover between 5 and 40%. Shrubs

commonly associated with this association include *Purshia tridentata, Amelanchier utahensis*, and *Gutierrezia sarothrae*. The herbaceous understory is often a diverse mix of grasses and forbs. The bunchgrass *Pseudoroegneria spicata* dominates or codominates with *Koeleria macrantha* and *Poa fendleriana*. The forbs most likely to occur in this association include *Eriogonum umbellatum* and *Balsamorhiza sagittata*.

Globally
Throughout the geographic range of this type, *Artemisia tridentata* ssp. *wyomingensis* dominates a shrub layer that has at least 10% canopy cover. Total vegetation cover ranges between 20% and more than 100%, roughly evenly divided between the shrub and herbaceous strata. The shrubs *Chrysothamnus* spp., *Atriplex confertifolia, Purshia tridentata, Symphoricarpos longiflorus*, and *Amelanchier utahensis* are often present as well. The herbaceous understory is generally a diverse mix of grasses and forbs. *Pseudoroegneria spicata* contributes more cover to the diverse herbaceous layer than does any other native species, and *Achnatherum thurberianum, Festuca idahoensis, Hesperostipa comata, Poa secunda, Koeleria macrantha*, and *Poa fendleriana* are often present. Forbs are variable across the range of this type, but common species include *Eriogonum umbellatum, Sphaeralcea coccinea*, and *Balsamorhiza sagittata*. Stands in the eastern part of the geographic range often include *Gutierrezia sarothrae, Artemisia frigida*, and *Bouteloua gracilis*. The height of the sagebrush ranges from about 35 cm tall in the eastern part of the range to about 1 m tall in the western part (Hironaka et al. 1983).

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	Species
Short shrub/sapling	*Philadelphus microphyllus*
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis, Purshia tridentata*
Herb (field)	*Petradoria pumila*
Herb (field)	*Koeleria macrantha, Poa fendleriana, Pseudoroegneria spicata*

Globally

Stratum	Species
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Pseudoroegneria spicata*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Bromus tectorum

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Many stands of this association may be derived by grazing of *Artemisia tridentata* ssp. *wyomingensis / Pseudoroegneria spicata* Shrub Herbaceous Vegetation (CEGL001535). It may be preferable to first combine these two types, and then split them geographically. The occurrences from the Great Plains west as far as northwestern Colorado, western Wyoming, and western Montana might belong to one type characterized by the presence of *Bouteloua* spp., *Carex filifolia, Koeleria macrantha, Gutierrezia sarothrae, Artemisia frigida*, and *Opuntia polyacantha*, and by the absence of *Achnatherum thurberianum*. The occurrences from southern Idaho, northern Nevada, eastern Oregon, eastern Washington, and British Columbia could belong to a different type characterized by the presence of *Achnatherum thurberianum*, and by the absence of the other species listed above. The separation between these two types probably would occur in Idaho. Additional research will be required to clarify this issue.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is common at middle elevations within the monument, throughout the entire range of *Artemisia tridentata* ssp. *wyomingensis*.
Dinosaur National Monument Data Sources: This description is based on 2002 and 2003 field data (16 plots: DINO.0004, DINO.0112, DINO.0134, DINO.0220, DINO.0306, DINO.0411, DINO.0487, DINO.0498, DINO.0513, DINO.0905, DINO.0906, DINO.1002, DINO.1003, DINO.1004, DINO.1008, DINO.1404).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: B. Johnston, mod. D. Faber-Langendoen and J. Coles

REFERENCES: Blackburn 1967, Blackburn et al. 1968a, Blackburn et al. 1968b, Blackburn et al. 1969a, Blackburn et al. 1969c, Blackburn et al. 1971, Bourgeron and Engelking 1994, Brotherson and Brotherson 1981, CONHP Ecology Team 2001, Cooper et al. 1995, Daubenmire 1970, DeVelice et al. 1991, Driscoll et al. 1984, Fisser 1964, Fisser 1970, Hall 1973, Heinze et al. 1962, Hironaka et al. 1983, Jensen et al. 1992, Johnston 1987, Jones 1992b, Knight et al. 1987, Lewis 1975a, MTNHP 2002b, McLean 1970, Moretti 1979, Moretti and Brotherson 1982, Mueggler and Stewart 1980, NDNHI n.d., NVNHP 2003, Poulton 1955, Seminoe I Mine Application n.d., Thilenius et al. 1995, Tisdale 1947, Tweit and Houston 1980, Western Ecology Working Group n.d.

Artemisia tridentata ssp. wyomingensis / Sparse Understory Shrubland
Wyoming Big Sagebrush / Sparse Understory Shrubland

CODE	CEGL002768
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 is intended to represent sagebrush shrublands where the sparse understory is the result of edaphic conditions, not grazing or other disturbance. It occurs in scattered patches throughout the sagebrush zone of the Colorado Plateau and western Rocky Mountains of Colorado and Utah. Elevations range from 1590 to 2390 m (5215-7840 feet), and sites occur on level to moderately steep slopes. There is a slight tendency toward hot western and southern exposures. Soils may be thin over bedrock, or loose, unstable sands, or tight clays, or extremely well-drained gravels; all of these situations tend to discourage herbaceous growth. Total vegetation cover is somewhat sparse in these sagebrush communities, rarely exceeding 40% and usually closer to 25%. The shrub layer consists of dwarfed *Artemisia tridentata* ssp. *wyomingensis* shrubs, sometimes accompanied by *Purshia tridentata, Atriplex confertifolia, Ephedra viridis*, or *Ericameria nauseosa*. The understory of dwarf-shrubs and herbaceous species has less than 5% cover, and usually much less. Common species include *Gutierrezia sarothrae, Achnatherum hymenoides, Pleuraphis jamesii*, and *Bouteloua gracilis*. Cryptobiotic crusts may be well-developed in sandy sites.

DISTRIBUTION
Dinosaur National Monument
This association is known from McKee Bench, Red Wash and Graveyard Ridge on the western edge of the monument.

Globally
This association is scattered widely over the Colorado Plateau of Utah and Colorado and extends west into the southern Rocky Mountains.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association occurs at a wide range of elevations, from 1600 to 2300 m, on flat to steep slopes and all aspects.

Soils vary from loamy sand to clay loam. Cryptogamic crusts may contribute significant cover.

Globally
This association occurs in scattered patches throughout the sagebrush zone of the Colorado Plateau and western Rocky Mountains. Elevations range from 1590 to 2390 m (5215-7840 feet), and sites occur on level to moderately steep slopes. There is a slight tendency toward hot western and southern exposures. Soils may be thin over bedrock, or loose, unstable sands, or tight clays, or extremely well-drained gravels; all of these situations tend to discourage herbaceous growth.

VEGETATION DESCRIPTION
Dinosaur National Monument
This shrubland association is characterized by its nearly monospecific composition. Some stands are extremely sparse in total cover. *Artemisia tridentata* ssp. *wyomingensis* has 1 to 30% cover. *Gutierrezia sarothrae* and *Opuntia* spp. are likely to be associated but with minimal cover. The depauperate herbaceous understory has less than 3% total cover, but weedy species such as *Bromus tectorum, Descurainia pinnata* or *Halogeton glomeratus* are absent or have only trace cover.

Globally
Total vegetation cover is relatively low in these sagebrush communities, rarely exceeding 40% and usually closer to 25%. The shrub layer consists of dwarfed *Artemisia tridentata* ssp. *wyomingensis* shrubs, sometimes accompanied by *Purshia tridentata, Atriplex confertifolia, Ephedra viridis*, or *Ericameria nauseosa*. The understory of dwarf-shrubs and herbaceous species has less than 5% cover, and usually much less. Common species include *Gutierrezia sarothrae, Achnatherum hymenoides, Pleuraphis jamesii*, and *Bouteloua gracilis*. Cryptobiotic crusts may be well-developed in sandy sites.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Philadelphus microphyllus*

Globally

Stratum	**Species**
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (13-Apr-2005).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
This association is intended to represent sagebrush shrublands in which the substrate is such that few herbaceous species can grow. Situations in which the understory has been removed by grazing or other disturbance should be assigned to *Artemisia tridentata* ssp. *wyomingensis* / Disturbed Understory Semi-natural Shrubland (CEGL002083).

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association describes sites that offer poor growing conditions and thus support only a sparse cover of hardy species, not degraded sites that support a weedy understory [see *Artemisia tridentata* ssp. *wyomingensis* / Disturbed Understory Semi-natural Shrubland (CEGL002083)].

Dinosaur National Monument Data Sources: This description is based on 2002 field data (5 plots: DINO.0001, DINO.0153, DINO.0415, DINO.0420, DINO.0442).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

Cercocarpus ledifolius / Prunus virginiana Shrubland
Curl-leaf Mountain-mahogany / Choke Cherry Shrubland

CODE	CEGL000966
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	*CERCOCARPUS LEDIFOLIUS* SHRUBLAND ALLIANCE (A.828) Curl-leaf Mountain-mahogany Shrubland 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 occupies slopes and ridgelines of high plateaus between 2450 and 2650 m (8040-8700 feet) elevation in northwestern Colorado and has been reported from eastern Oregon, as well as from the Ruby and Jarbidge mountains of Nevada. Stands occur on level to moderate slopes that generally face north to east, with a few stands on southeast exposures. Soils are deep sandy loams, but most stands also include outcrops or boulders of the underlying sandstone or limestone bedrock. The vegetation is characterized by an arborescent canopy of *Cercocarpus ledifolius* shrubs with at least 25% cover and up to 5 m tall. In some stands, scattered individual *Pseudotsuga menziesii*, *Pinus ponderosa*, or *Populus tremuloides* will emerge from the *Cercocarpus* canopy. The shrub layer is diverse, relatively dense, and is characterized by the presence (and often dominance) of *Prunus virginiana*. Other common shrubs include *Amelanchier alnifolia, Symphoricarpos oreophilus, Artemisia tridentata, Rosa woodsii, Mahonia repens*, and *Paxistima myrsinites*. A variety of grasses and forbs are present in a diverse ground layer and may include *Stenotus acaulis, Arenaria* spp., *Comandra umbellata*, or *Hackelia patens. Pseudoroegneria spicata* is sparse to absent in these stands.

DISTRIBUTION
Dinosaur National Monument
This community is limited to areas of deep soils over Precambrian sandstone bedrock and is known to occur only in the vicinity of Zenobia Peak.

Globally
This association has been reported from scattered locations in the Great Basin, Columbia Basin, and Uinta Basin of Colorado, Nevada and possibly Oregon and California.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association occupies mountain slopes and ridgelines between 2450 and 2650 m elevation. Stands occur on level to moderate slopes with east to southeast exposures. Soils are deep sandy loams, but most stands also include outcrops or boulders of hard Precambrian Uinta Mountain Group sandstone.

Globally
This association occupies slopes and ridgelines of high plateaus between 2450 and 2650 m (8040-8700 feet) elevation in northwestern Colorado and has been reported from eastern Oregon, as well as from the Ruby and Jarbidge mountains of Nevada. Stands occur on level to moderate slopes that generally face north to east, with a few stands on southeast exposures. Soils are deep sandy loams, but most stands also include outcrops or boulders of the

underlying sandstone or limestone bedrock.

VEGETATION DESCRIPTION

Dinosaur National Monument

This tall shrubland association is characterized by an arborescent canopy of Cercocarpus ledifolius (25-55% cover) between 2-5 m tall. In some stands, scattered individual *Pseudotsuga menziesii, Pinus ponderosa,* or *Populus tremuloides* will emerge from the canopy. The shrub layer is diverse, relatively dense (between 5-30% cover), and is characterized by the presence (and often dominance) of *Prunus virginiana*. Other common shrubs include *Amelanchier alnifolia, Symphoricarpos oreophilus, Artemisia tridentata, Rosa woodsii,* and *Paxistima myrsinites.* A variety of grasses and forbs are present in a diverse ground layer, but *Pseudoroegneria spicata* is sparse to absent.

Globally

This tall shrubland association is characterized by an arborescent canopy of *Cercocarpus ledifolius* with at least 25% cover up to 5 m tall. In some stands, scattered individual *Pseudotsuga menziesii, Pinus ponderosa,* or *Populus tremuloides* will emerge from the canopy. The shrub layer is diverse, relatively dense, and is characterized by the presence (and often dominance) of *Prunus virginiana*. Other common shrubs include *Amelanchier alnifolia, Symphoricarpos oreophilus, Artemisia tridentata, Rosa woodsii, Mahonia repens,* and *Paxistima myrsinites*. A variety of grasses and forbs are present in a diverse ground layer and may include *Stenotus acaulis, Arenaria* spp., *Comandra umbellata*, or *Hackelia patens. Pseudoroegneria* spicata is sparse to absent in these stands.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Tall shrub/sapling	*Amelanchier alnifolia, Prunus virginiana var. melanocarpa*
Tall shrub/sapling	*Cercocarpus ledifolius*
Short shrub/sapling	*Juniperus communis*
Short shrub/sapling	*Symphoricarpos oreophilus*

Globally

Stratum	**Species**
Tall shrub/sapling	*Amelanchier alnifolia, Prunus virginiana var. melanocarpa*
Tall shrub/sapling	*Cercocarpus ledifolius*
Short shrub/sapling	*Symphoricarpos oreophilus*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Poa pratensis

Globally
Poa pratensis

CONSERVATION STATUS RANK

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

CLASSIFICATION COMMENTS

Dinosaur National Monument
Data are not available.

Globally
This association is distinguished from other *Cercocarpus ledifolius* woodlands by its relatively dense, well-developed tall-shrub understory.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Dinosaur National Monument Inventory Notes: Mature stands have arborescent *Cercocarpus ledifolius* shrubs. Stands of any age have a dense shrub understory and a rich diversity of woody and herbaceous species.
Dinosaur National Monument Data Sources: This association is described from 2002 field data (3 plots: DINO.0529, DINO.0533, DINO.0535).

Local Description Authors: J. Coles
Global Description Authors: J. Coles

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Kagan et al. 2000, Lewis 1975a, NVNHP 2003, Western Ecology Working Group n.d.

Cercocarpus ledifolius / Pseudoroegneria spicata Shrubland
Curl-leaf Mountain-mahogany / Bluebunch Wheatgrass Shrubland

CODE	CEGL000967
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	*CERCOCARPUS LEDIFOLIUS* SHRUBLAND ALLIANCE (A.828) Curl-leaf Mountain-mahogany Shrubland 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 small-patch association occurs in isolated stands throughout the interior western U.S. Sites are generally located in gentle to moderately steep, dry, rocky habitats, where soils are patchy and shallow and fracturing allows *Cercocarpus roots* to penetrate the underlying bedrock. Elevations range from 1400 m (4600 feet) in Montana to over 2600 m (8530 feet) in western Colorado. The substrate is often limestone, less often quartzite or sandstone. This tall shrubland is dominated by *Cercocarpus ledifolius*, often treelike in form. *Scattered Juniperus osteosperma, Juniperus scopulorum,* and *Pinus edulis* may also occur in the canopy. Total canopy cover is between 30 and 60%. There is usually no developed shrub layer, but *Amelanchier utahensis, Amelanchier alnifolia, Artemisia nova, Artemisia tridentata, Physocarpus monogynus, Symphoricarpos oreophilus*, and *Juniperus communis* may be present. *Prunus virginiana* is absent or has very low cover. Herbaceous species have relatively high cover (20-30%), dominated by *Pseudoroegneria spicata*. Other graminoid species with significant cover include *Achnatherum hymenoides* and *Hesperostipa comata,* and common forbs include *Artemisia frigida, Balsamorhiza sagittata, Hackelia patens, Mertensia oblongifolia, Phlox hoodii,* and *Petradoria pumila*.

DISTRIBUTION
Dinosaur National Monument
This association is known from sheltered areas at high elevations on Zenobia Peak and the Yampa Plateau, including areas near Iron Springs Overlook and Martha's Peak. It is likely to occur in the vicinity of Limestone Ridge in the northern park of the project area.

Globally
This widespread but uncommon association is known from isolated sites in the Jarbidge and Ruby mountains of northeastern Nevada, the Bighorn and Pryor mountains of north-central Wyoming, southern Montana, northwestern Colorado and adjacent Utah, southern Idaho and eastern Oregon and California.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association occurs in medium to large stands on moderately steep mountain slopes. Elevations range from 2300 to 2600 m. Soils at these sites are shallow, rocky and coarse-textured, overlying calcareous or quartzite bedrock.

Globally
This small-patch association occurs in isolated stands throughout the interior western U.S. Sites are generally located in gentle to moderately steep, dry, rocky habitats, where soils are patchy and shallow and fracturing allows *Cercocarpus* roots to penetrate the underlying bedrock. Elevations range from 1400 m (4600 feet) in Montana to

over 2600 m (8530 feet) in western Colorado. The substrate is often limestone, less often quartzite or sandstone.

VEGETATION DESCRIPTION

Dinosaur National Monument

This tall shrubland is dominated by *Cercocarpus ledifolius*, often treelike in form. These 2- to 5-m tall shrubs are commonly associated with *Juniperus osteosperma* and *Pinus edulis*. Total canopy cover is between 30 and 60%. There is usually no developed shrub layer, but *Amelanchier utahensis, Artemisia tridentata, Symphoricarpos oreophilus,* and *Juniperus communis* may be present. *Prunus virginiana* is absent. Herbaceous species have relatively high cover (20-30%), dominated by *Pseudoroegneria spicata*. Other herbaceous species with significant cover include *Petradoria pumila, Achnatherum hymenoides*, and *Hesperostipa comata*.

Globally

This tall shrubland is dominated by *Cercocarpus ledifolius*, often treelike in form. Scattered *Juniperus osteosperma, Juniperus scopulorum,* and *Pinus edulis* may also occur in the canopy. Total canopy cover is between 30 and 60%. There is usually no developed shrub layer, but *Amelanchier utahensis, Amelanchier alnifolia, Artemisia nova, Artemisia tridentata, Physocarpus monogynus, Symphoricarpos oreophilus*, and *Juniperus communis* may be present. *Prunus virginiana* is absent or has very low cover. Herbaceous species have relatively high cover (20-30%), dominated by *Pseudoroegneria spicata*. Other graminoid species with significant cover include *Achnatherum hymenoides* and *Hesperostipa comata,* and common forbs include *Artemisia frigida, Balsamorhiza sagittata, Hackelia patens, Mertensia oblongifolia, Phlox hoodii,* and *Petradoria pumila*.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Tall shrub/sapling	*Amelanchier utahensis*
Tall shrub/sapling	*Cercocarpus ledifolius*
Short shrub/sapling	*Symphoricarpos oreophilus*
Herb (field)	*Petradoria pumila*
Herb (field)	*Achnatherum hymenoides, Pseudoroegneria spicata*

Globally

Stratum	**Species**
Tall shrub/sapling	*Cercocarpus ledifolius*
Herb (field)	*Petradoria pumila*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G4Q (1-Feb-1996).

CLASSIFICATION COMMENTS

Dinosaur National Monument

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Dinosaur National Monument Inventory Notes: Although *Cercocarpus ledifolius* is not widespread in the monument, it is abundant where it occurs, on high ridges and slopes on quartzite, limestone or conglomerate substrates.

Dinosaur National Monument Data Sources: The description is based on 2002 field data (3 plots: DINO.0109, DINO.0338, DINO.0522).

Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Baker 1983c, Baker and Kennedy 1985, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Jones 1992b, Jones and Ogle 2000, Kagan et al. 2000, Knight et al. 1987, Lewis 1975a, MTNHP 2002b, Miller 1964, Mueggler and Stewart 1980, NVNHP 2003, Tisdale 1986

Chrysothamnus viscidiflorus / Hesperostipa comata Shrubland
Green Rabbitbrush / Needle-and-Thread Shrubland

CODE	CEGL002799
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Evergreen shrubland (III.A.)
PHYSIOGNOMIC GROUP	Microphyllous evergreen shrubland (III.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural microphyllous evergreen shrubland (III.A.4.N.)
FORMATION	Lowland microphyllous evergreen shrubland (III.A.4.N.a.)
ALLIANCE	*CHRYSOTHAMNUS VISCIDIFLORUS* SHRUBLAND ALLIANCE (A.2651) Green Rabbitbrush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This association occurs on disturbed ridges and valleys in the northern Colorado Plateau of Colorado and Utah and into the southern Rocky Mountains between 1800 and 2440 m (5900-8000 feet) elevation. Slopes range from gentle to moderately steep. Soils have textures ranging from silt loam to sandy loam to loamy sand, and bare soil covers most of the unvegetated ground surface. The total vegetation cover rarely exceeds 60% and is characterized by an open shrub canopy of *Chrysothamnus viscidiflorus* with between 5 and 35% cover. The native bunchgrass *Hesperostipa comata* contributes 10 to 20% cover. Other short shrubs providing sparse cover include *Symphoricarpos oreophilus* and *Tetradymia canescens*. The herbaceous layer is diverse in terms of species composition. Associated graminoids include *Achnatherum hymenoides, Bouteloua gracilis, Elymus elymoides, Pascopyrum smithii, Poa fendleriana*, and *Poa secunda*. Forbs are diverse but contribute very little cover, including *Chenopodium leptophyllum, Crepis acuminata, Cryptantha cinerea* var. *jamesii, Erigeron engelmannii, Eriogonum umbellatum, Lupinus caudatus, Packera tridenticulata, Sedum lanceolatum*, and *Schoenocrambe linifolia*. This community generally occurs in areas that have experienced significant disturbance (such as fire) or on-going natural disturbance such as season-long grazing.

DISTRIBUTION
Dinosaur National Monument
This association is known from Big Joe Draw on Douglas Mountain and in the Red Wash area near Island Park.

Globally
This association has been documented from western Colorado and adjacent Utah. It is likely to occur throughout the interior West in sandy, disturbed areas that normally support sagebrush shrublands.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association occurs on moderately sloping disturbed sites between 1800 and 2100 m elevation with a southeast aspect. Substrates include eolian sands and limestone, and the soil is likewise variable, with textures ranging from silt loam to sandy loam.

Globally
This association occurs on level to moderately sloping disturbed sites on ridges and in valleys between 1800 and 2440 m (5900-8000 feet) elevation. Substrates include eolian sands, metamorphic rocks, granite or limestone, and the soil is likewise variable, with textures ranging from silt loam to sandy loam to loamy sand. Bare soil covers most of the unvegetated ground surface.

VEGETATION DESCRIPTION

Dinosaur National Monument
Chrysothamnus viscidiflorus ssp. *lanceolatus* dominates this shrubland with between 5 and 35% cover. Other shrubs have less than 1% cover. The herbaceous understory may be sparse to moderately dense but includes *Hesperostipa comata* with a trace to 10% cover. Associated herbaceous species with lesser cover include *Poa secunda* and *Bromus tectorum.*

Globally
This disturbed shrub association is uncommon. The total vegetation cover rarely exceeds 60% and is characterized by an open shrub canopy of *Chrysothamnus viscidiflorus* with between 5 and 35% cover. The native bunchgrass *Hesperostipa comata* contributes 10 to 20% cover. Other short shrubs providing sparse cover include *Symphoricarpos oreophilus* and *Tetradymia canescens*. The herbaceous layer is diverse in terms of species composition. Associated graminoids include *Achnatherum hymenoides, Bouteloua gracilis, Elymus elymoides, Pascopyrum smithii*, *Poa fendleriana*, and *Poa secunda*. Forbs are diverse but contribute very little cover, including *Chenopodium leptophyllum, Crepis acuminata, Cryptantha cinerea* var. *jamesii, Erigeron engelmannii, Eriogonum umbellatum, Lupinus caudatus, Packera tridenticulata, Sedum lanceolatum,* and *Schoenocrambe linifolia*.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Chrysothamnus viscidiflorus* ssp. *lanceolatus*
Herb (field)	*Achnatherum hymenoides, Hesperostipa comata*

Globally

Stratum	**Species**
Short shrub/sapling	*Chrysothamnus viscidiflorus*
Herb (field)	*Achnatherum hymenoides, Hesperostipa comata*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Bromus tectorum

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This community ranges from sparse to moderate in cover but generally occurs in areas that have experienced significant disturbance or on-going natural disturbance.
Dinosaur National Monument Data Sources: This description is based on 2002 and 2003 field data (2 plots: DINO.0542, DINO.0727).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

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	*CHRYSOTHAMNUS VISCIDIFLORUS* SHRUBLAND ALLIANCE (A.2651) Green Rabbitbrush Shrubland 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 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 feet). 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

Dinosaur National Monument

This association is known from below Jenny Lind Rock and in Happy Hollow and is likely to occur as small stands in disturbed, sunny, low-elevation sites throughout the monument.

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

Dinosaur National Monument

This association occurs on moderate to steep slopes with southerly aspects at elevations between 1600 and 2300 m. The substrate varies from eroding shale to colluvial but is generally unstable. Loose rock comprises most of the nonvegetated ground cover and organic litter is minimal.

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 feet), 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

Dinosaur National Monument

Chrysothamnus viscidiflorus dominates a sparse shrub layer, with only between 5 and 15% cover. Other shrubs and dwarf-shrubs that may occur with less than 5% cover include *Artemisia tridentata* ssp. *wyomingensis, Atriplex confertifolia,* or *Eriogonum corymbosum*. The herbaceous layer is always sparse, rarely exceeding 5% total cover. The particular herbaceous species present tend to reflect the nature of the substrate rather than characterize the community. Typical species include *Stenotus acaulis, Leptodactylon pungens,* and *Poa secunda*.

Globally

Chrysothamnus viscidiflorus dominates this community, where chronic downslope 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
Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Chrysothamnus viscidiflorus*

Globally

Stratum	**Species**
Short shrub/sapling	*Chrysothamnus viscidiflorus*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Bromus tectorum

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (21-Mar-2005).

CLASSIFICATION COMMENTS
Dinosaur National Monument
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
Dinosaur National Monument Inventory Notes: This association occurs in widely scattered, small stands that are easily overlooked in the field. The diagnostic characteristics are the unstable substrates (talus) and a sparse shrub cover dominated by *Chrysothamnus viscidiflorus*.
Dinosaur National Monument Data Sources: This association is described from 2002 and 2004 field data (1 plot: DINO.1001, and 2 observation points: DINO.9048, DINO.9688).
Local Description Authors: J. Thompson, mod. J. Coles
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	*ERICAMERIA NAUSEOSA* 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 feet), 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

Dinosaur National Monument

This association is known from the vicinity of the Massey Cabin, Jack Springs, Jones Hole, and the Dugway, and is likely to occur throughout the monument in post-burn areas.

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

Dinosaur National Monument

This association occupies upland sites that have burned or experienced other significant disturbance. Although the geologic substrate varies, soils tend to be sandy and rapidly drained.

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 feet), 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

Dinosaur National Monument

This association is characterized by sparse to moderate cover of the shrub *Ericameria nauseosa* and a moderately dense to dense (>20%) cover of the annual grass *Bromus tectorum.* A variety of other shrubs may be present but always with low cover. Native herbaceous species that are commonly associated include scattered tufts of *Achnatherum hymenoides, Poa fendleriana*, and *Heterotheca villosa*. Where this association became established following fire, *Juniperus osteosperma* skeletons or a few remaining live trees may be present.

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
Dinosaur National Monument

Stratum	Species
Short shrub/sapling	*Ericameria nauseosa*
Herb (field)	*Bromus tectorum*

Globally

Stratum	Species
Short shrub/sapling	*Ericameria nauseosa*
Herb (field)	*Bromus tectorum*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

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
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This type is common, but many examples are small in size because they result from small lightning-ignited fires. One is a former corral. The most extensive examples are in the vicinity of the Gates of Lodore, where a major fire burned several decades before. Extensive exposures of Uinta Mountain Groups quartzites and a lack of seed sources have created an area of several thousand contiguous acres that are this association, occurring in a mosaic with *Artemisia tridentata* ssp. *wyomingensis* / Disturbed Understory Semi-natural Shrubland (CEGL002083).
Dinosaur National Monument Data Sources: The description is based on 1995 and 2002 field data (3 plots: DINO.0227, DINO.0646, GR008, and 3 observation points: DINO.9046, DINO.9123, DINO.9683).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Cogan et al. 2004, 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	*ERICAMERIA NAUSEOSA* 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 feet) 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 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

Dinosaur National Monument

This association is known from the toe of the Warm Springs Cedars landslide. It is likely to be found in other sites along the Yampa and Green river corridors, wherever temporary watercourses flow through sandy and gravelly substrates.

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

Dinosaur National Monument

This association occurs on the banks of low-gradient, intermittently flooded washes and on islands in the washes. The soils are deep, sandy alluviums, usually strewn with large rocks and cobbles.

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 feet) 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 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

Dinosaur National Monument

The vegetation of this association can vary from a simple community, comprised of only a few species, to exceptionally diverse. Ericameria nauseosa is the dominant shrub with 10 to 20% cover. Other shrub species present include *Chrysothamnus linifolius, Chrysothamnus viscidiflorus, Ephedra viridis*, and *Artemisia tridentata* ssp. *tridentata*. Occasional single trees, such as *Juniperus osteosperma* and *Acer negundo*, may occur in more stable areas. Herbaceous species will vary among sites and usually contribute minimal cover, with higher cover occurring in washes with less-frequent flooding. Grass species likely to be present include *Sporobolus airoides, Achnatherum hymenoides*, and *Elymus elymoides*.

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

Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Chrysothamnus linifolius, Chrysothamnus viscidiflorus, Ericameria nauseosa*
Herb (field)	*Brickellia microphylla*

Globally

Stratum	**Species**
Short shrub/sapling	*Ericameria nauseosa*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (10-Jan-2005).

CLASSIFICATION COMMENTS

Dinosaur National Monument
Data are not available.

Globally
In sparse or patchy stands, Ericameria nauseosa acts as an indicator species.

CLASSIFICATION CONFIDENCE:

ELEMENT SOURCES

Dinosaur National Monument Inventory Notes: This association probably occurs more commonly than what is shown by the number of plots sampled. The community is usually very small in size, only a few m in width, straddling an intermittent watercourse, so it doesn't often meet plot size criteria and as a result is under-sampled.
Dinosaur National Monument Data Sources: This description was derived from 1998 and 2003 field data (2 plots: DINO.1018, GR.115).
Local Description Authors: J. Thompson, mod. J. Coles
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	*ERICAMERIA NAUSEOSA* 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 sandsheets 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 feet). 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 sandsheets 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) that is 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

Dinosaur National Monument

This association is known from Iron Mine Basin, Buck Ridge, and the hogbacks ringing Split Mountain.

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

Dinosaur National Monument

This association occupies sand dunes, sandsheets and blowouts at elevations ranging from 1600 to 2300 m. The ground surface is flat to gently sloping and composed of a mix of sand, bare ground and litter, as well as moss and crusts.

Globally

This association occurs on sandsheets 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 feet). 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 sandsheets 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

Dinosaur National Monument

Cover of the dominant shrub in this association, *Ericameria nauseosa*, ranges from 10 to 30% but typically is less than 15%. *Artemisia tridentata* ssp. *wyomingensis* and *Grayia spinosa* may be present with less than 5% cover. Herbaceous species are diverse in composition and sparse in cover. Achnatherum *hymenoides, Hesperostipa comata*, and *Bromus tectorum* are the most common and abundant grasses. *Heterotheca villosa, Cryptantha* spp., and *Sphaeralcea coccinea* occur in many of the sites as well.

Globally

This association is characterized by a sparse short-shrub layer 5-20% cover (but may range up to 30% cover) that is 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, Heterotheca villosa, Sophora stenophylla, Penstemon palmeri, Phacelia heterophylla, Sphaeralcea coccinea,* and *Streptanthella longirostris*.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	Species
Short shrub/sapling	*Ericameria nauseosa*
Herb (field)	*Artemisia dracunculus*
Herb (field)	*Achnatherum hymenoides*

Globally

Stratum	Species
Short shrub/sapling	*Ericameria nauseosa*
Short shrub/sapling	*Atriplex canescens*
Herb (field)	*Gutierrezia sarothrae, Opuntia polyacantha*
Herb (field)	*Heterotheca villosa*
Herb (field)	*Achnatherum hymenoides, Aristida purpurea, Hesperostipa comata, Sporobolus cryptandrus*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Bromus tectorum, Yucca elata var. *utahensis*

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (22-Jan-2002).

CLASSIFICATION COMMENTS
Dinosaur National Monument
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
Dinosaur National Monument Inventory Notes: This association is similar in species composition to *Ericameria nauseosa* Desert Wash Shrubland (CEGL002261). It differs in that its substrate is derived from eolian sand deposits rather than alluvial sands and occurs in upland environments rather than alluvial systems.
Dinosaur National Monument Data Sources: This description is derived from 2002 field data (5 plots: DINO.0177, DINO.0278, DINO.0291, DINO.0294, DINO.0428).
Local Description Authors: J. Thompson, mod. J. Coles
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	*TAMARIX* 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)
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This broadly defined association is composed of shrublands which 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

Dinosaur National Monument

This association occurs in extensive linear patches along the Green and Yampa rivers. Most of the stands on the Yampa River are on the lower third.

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

Dinosaur National Monument

This association mostly occurs on and adjacent to the banks, sandbars, and overflow channels of the Yampa and Green rivers below 1600 m elevation. It may also occupy small streambanks, washes, springs and seeps. Soils are sandy or cobbly alluvium.

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

Dinosaur National Monument

The tall shrub *Tamarix ramosissima* dominates this association with 10 to 100% cover. Few other woody species can compete; those that may occur with sparse cover include Acer negundo, Salix exigua, and *Chrysothamnus linifolius*. Herbaceous species cover is inversely related to the cover of tamarisk. Shrub interspaces and margins may support a sparse cover of herbaceous species including *Iva axillaris, Heterotheca villosa, Sporobolus cryptandrus, Bromus tectorum, Distichlis spicata*, and *Poa pratensis*.

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
Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Tamarix ramosissima*
Herb (field)	*Heterotheca villosa, Iva axillaris*
Herb (field)	*Bromus tectorum, Distichlis spicata, Poa pratensis, Sporobolus cryptandrus*

Globally

Stratum	**Species**
Tall shrub/sapling	*Tamarix chinensis, Tamarix gallica, Tamarix parviflora, Tamarix ramosissima*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum, Lepidium latifolium, Poa pratensis, Tamarix ramosissima

Globally
Bromus tectorum, Lepidium latifolium, Poa pratensis

CONSERVATION STATUS RANK
Global Rank & Reasons: GNA (invasive) (24-Jul-2001).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
This is a broadly defined plant association that is 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
Dinosaur National Monument Inventory Notes: Tamarisk usually occurs in relatively pure stands. However, stands of mixed tamarisk / deciduous trees (*Acer negundo, Elaeagnus angustifolia*) are also included in this association.
Dinosaur National Monument Data Sources: This association is described from field data plots collected in the 1990s, 2002, and 2003 (13 plots: GR002, GR003, GR004, GR005, GR006, GR011, GR012, GR013, GR014, GR023, GR026, GR034, GR043, and 4 observation points: DINO.8005, DINO.8408, DINO.9017, DINO.9685).
Local Description Authors: J. Thompson, mod. J. Coles
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

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	*EPHEDRA VIRIDIS* 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) Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)
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 feet), 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

Dinosaur National Monument

This association is known from widely separated locations at Wild Mountain and Warm Spring.

Globally

This association has been reported from northwestern Colorado and southern Utah. It is likely to be widespread throughout the Colorado Plateau.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occupies moderate to steep slopes at elevations between 1450 and 1650 m. Soils are shallow, sandy and rapidly drained.

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 feet), and slopes range from gentle to steep. Soils are sandy and may be derived from eolian or alluvial deposits.

VEGETATION DESCRIPTION

Dinosaur National Monument

Ephedra viridis dominates this shrubland with 10 to 40% cover. Few other shrubs are present or contribute more than 1% cover. The exotic annual grass *Bromus tectorum* occurs with moderate to dense cover. Other grass species that may be present with lesser cover are *Hesperostipa comata, Poa fendleriana,* and *Poa secunda*.

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

Dinosaur National Monument

Stratum	**Species**

Short shrub/sapling	*Ephedra viridis*

Globally

Stratum	**Species**
Short shrub/sapling	*Ephedra viridis*
Herb (field)	*Bromus tectorum*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Erodium cicutarium

CONSERVATION STATUS RANK
Global Rank & Reasons: GNA (ruderal) (21-Mar-2005).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
There is little quantitative information for this semi-natural association.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Stands of this association may occur anywhere in the park where there has been a hot wildfire.
Dinosaur National Monument Data Sources: This description was derived from 2002 field data (2 plots: DINO.0023, DINO.0321).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

Atriplex canescens / Achnatherum hymenoides Shrubland
Fourwing Saltbush / Indian Ricegrass Shrubland

CODE	CEGL001289
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Evergreen shrubland (III.A.)
PHYSIOGNOMIC GROUP	Extremely xeromorphic evergreen shrubland (III.A.5.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural extremely xeromorphic evergreen shrubland (III.A.5.N.)
FORMATION	Facultatively deciduous extremely xeromorphic subdesert shrubland (III.A.5.N.b.)
ALLIANCE	*ATRIPLEX CANESCENS* SHRUBLAND ALLIANCE (A.869) Fourwing Saltbush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This shrubland is found on the western slope of the Colorado Rocky Mountains, adjacent northeastern Utah and the Great Salt Lake Desert. Elevation ranges from approximately 1300-2454 m (4260-8545 feet). Stands occur on level desert plains, toeslopes, alluvial terraces and steep slopes at the base of mesas. Soils are well-drained, somewhat alkaline and include sandy clay loam. The vegetation is characterized by an open (10 to 25% cover) short-shrub layer that is dominated by *Atriplex canescens*, with an herbaceous layer dominated by the bunchgrass *Achnatherum hymenoides*. Associated shrubby species provide sparse cover and may include *Rhus trilobata* and

Krascheninnikovia lanata. The herbaceous layer is low in species diversity and provides sparse to low cover, except in disturbed stands, where *Bromus tectorum* is present to codominant in the understory.

DISTRIBUTION

Dinosaur National Monument

This association is limited to the floor and high terraces of the Green River below Split Mountain.

Globally

This shrubland is found on the western slope of the Colorado Rocky Mountains, adjacent northeastern Utah and the Great Salt Lake Desert. This association may have a wider distribution as both diagnostic species are common in the semi-arid western U.S.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This desert shrubland occupies gently sloping (up to 12 degrees) valley toeslopes or Pleistocene river terraces oriented to the southeast at around 1470 m elevation. Bare soil and litter cover most of the unvegetated surface. Soils are generally sandy and are derived from alluvium.

Globally

This shrubland is found on the western slope of the Colorado Rocky Mountains, adjacent northeastern Utah and the Great Salt Lake Desert. Elevation ranges from approximately 1300-2454 m (4260-8545 feet). Stands occur on level desert plains, toeslopes, alluvial terraces and steep slopes at the base of mesas. Soils are well-drained, somewhat alkaline and include sandy clay loam.

VEGETATION DESCRIPTION

Dinosaur National Monument

This sparse mixed desert shrubland is characterized by an open (10 to 20% cover) shrub canopy dominated by *Atriplex canescens*. Other shrubs present with lesser cover include *Grayia spinosa* and *Chrysothamnus viscidiflorus*. The herbaceous layer also has between 10 and 20% cover, most of which is contributed by the bunchgrass *Achnatherum hymenoides*. Other herbaceous species present (usually with no more than a few percent cover) include *Sporobolus cryptandrus* and the exotic Bromus tectorum. No forbs were recorded in the sample plots.

Globally

This semi-desert to desert association is characterized by an open (10 to 25% cover) short-shrub layer that is dominated by *Atriplex canescens*, with an herbaceous layer dominated by the bunchgrass *Achnatherum hymenoides*. Associated shrubby species provide sparse cover and may include *Rhus trilobata, Grayia spinosa, Chrysothamnus viscidiflorus,* and *Krascheninnikovia lanata*. The herbaceous layer is low in species diversity and provides sparse to low cover. Additional species in Colorado may include the grasses *Elymus elymoides, Sporobolus cryptandrus*, and *Bouteloua gracilis*, with sparse cover of forbs, including *Eriogonum lonchophyllum, Sphaeralcea coccinea,* and *Stephanomeria minor* var. *minor*. *Bromus tectorum* may be abundant in disturbed stands.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Atriplex canescens*
Herb (field)	*Achnatherum hymenoides*

Globally

Stratum	**Species**
Short shrub/sapling	*Atriplex canescens*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Bromus tectorum

Globally

Bromus tectorum

CONSERVATION STATUS RANK
Global Rank & Reasons: G3G5 (23-Feb-1994).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Little information is available on this associations. More survey and classification work are needed to fully characterize it across its range.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is limited in its distribution in the park; the three plots were taken in a single polygon.
Dinosaur National Monument Data Sources: This association is described from accuracy assessment data collected in 2005 (3 plots: DINO_AA.A1091, DINO_AA.A1092, DINO_AA.A1093).
Local Description Authors: J. Coles
Global Description Authors: K.A. Schulz, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Vest 1962a

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	*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 association occurs on shale hills, mesas and valley floors at elevations between 1500 and 1900 m (4920-6235 feet) 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
Dinosaur National Monument
This association is known from the Billiard Table, the Gates of Lodore and Rainbow 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

Dinosaur National Monument

This association occupies shale hills and mesas at elevations between 1500 and 1800 m. Slope angles are typically level to moderate, and aspects are generally southerly. The fine-textured soils are mostly barren of organic litter and large rock and may have significant cover of biological crusts including moss, lichen and cryptogams.

Globally

This association occurs on shale hills, mesas and valley floors at elevations between 1500 and 1900 m (4920-6235 feet). 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

Dinosaur National Monument

Atriplex confertifolia and *Krascheninnikovia lanata* characterize this association with less than 20% total cover. It may contain a variety of other desert species with low cover, including *Artemisia nova, Artemisia tridentata* ssp. *wyomingensis, Picrothamnus desertorum*, and *Atriplex canescens.* Herbaceous vegetation is sparse and consists of grasses, especially *Bromus tectorum, Poa fendleriana, Achnatherum hymenoides*, or *Elymus elymoides.*

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

Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Atriplex confertifolia, Krascheninnikovia lanata*

Globally

Stratum	**Species**
Short shrub/sapling	*Atriplex confertifolia, Krascheninnikovia lanata*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Bromus tectorum

Globally

Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Dinosaur National Monument

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

Dinosaur National Monument Inventory Notes: This association is uncommon in the monument.

Dinosaur National Monument Data Sources: The description is based on 2002 field data (1 plot: DINO.0196, and 2

observation points: DINO.9044, DINO.9107).
Local Description Authors: J. Thompson, mod. J. Coles
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 / 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	*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 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 feet) 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 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.

DISTRIBUTION
Dinosaur National Monument
This rare association is known from a single site near Wagon Road Bench in the northwestern part of the monument. It can be distinguished from other *Atriplex confertifolia* associations by the relative dominance of *Achnatherum hymenoides.*

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
Dinosaur National Monument

This association is documented from the steep, east-facing slopes of a gully cut into Morrison Formation shale at 1670 m. Soils are fine-textured and derived from shale and from alluvium derived from shale. The substrate lacks organic matter in the soil and on the surface and is extremely erosive.

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 feet) 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
Dinosaur National Monument
This badland association is characterized by the codominance of *Atriplex confertifolia* and *Achnatherum hymenoides.* Few other shrubs are present. The total shrub cover is less than 10%. Herbaceous vegetation cover is less than 20%. Other herbaceous species found in this association include *Poa fendleriana, Poa secunda, Elymus elymoides*, and *Bromus tectorum*.

Globally
Low-growing *Atriplex confertifolia* is the dominant shrub, usually with up to 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
Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Atriplex confertifolia*
Herb (field)	*Achnatherum hymenoides, Poa fendleriana*

Globally

Stratum	**Species**
Short shrub/sapling	*Atriplex confertifolia*
Herb (field)	*Achnatherum hymenoides*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

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

Dinosaur National Monument
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
Dinosaur National Monument Inventory Notes: The Atriplex confertifolia alliance is common near the boundaries of the monument, where shale habitats are available, as well as on the Yampa Bench.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (1 plot: DINO.0141).
Local Description Authors: J. Thompson, mod. J. Coles
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 / Hesperostipa comata Shrubland
Shadscale / Needle-and-Thread Shrubland

CODE	CEGL001314
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 shrubland association typically occurs at elevations between 1800 and 2195 m (5900-7200 feet) on nearly level to gently sloping low terraces, narrow valley floodplains, mesatops, flat ridgetops and plateaus. It is documented from northwestern Colorado, but it is predicted that this community also occurs in adjacent southwestern Wyoming and northeastern Utah. One site is on a sheltered badland slope of Mancos shale. It can occur on steeper surfaces, but slopes generally do not exceed 10%. Precipitation is usually less than 25.4 cm (10 inches) per year. *Atriplex confertifolia* is a xeric shrub associated with subdesert ecosystems. The soils that are commonly associated with this community are moderately coarse to fine, calcareous, and saline-alkaline with an average pH of 7.9. Bare soil covers much of the ground surface. The vegetation cover in this community is sparse, and the surface of the soil is often described as a gravel pavement due to the scouring action of the wind. This association has relatively low species diversity, with *Atriplex confertifolia* dominating the shrub layer with 4-20% cover. Other desert shrubs are usually present in low percentages. *Hesperostipa comata* dominates the herbaceous layer with 10-30% cover. *Achnatherum hymenoides, Poa fendleriana*, and *Poa secunda* are generally present with much lower cover. At lower elevations or warmer sites where *Atriplex confertifolia* is more abundant, there is more *Pleuraphis jamesii*, and *Hesperostipa comata* does not become abundant until further uphill where the *Atriplex confertifolia* decreases in cover.

DISTRIBUTION
Dinosaur National Monument
This rare association is known from a single site in Lily Park on the east side of the monument.

Globally
This shrubland has only been documented from Moffat County in northwestern Colorado, but it is predicted that this community also occurs in adjacent southwestern Wyoming and northeastern Utah.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association was sampled at a single site on Mancos Shale badlands at 1800 m. The slope is gentle to moderate and has an eastern aspect, which helps in retaining moisture at the site. Soils are mostly bare ground, with some litter at the base of live plants. Moss and cryptogamic crusts may be present with low cover.

Globally
This plant association typically occurs at elevations between 1800 and 2195 m (5900-7200 feet) on nearly level to gently sloping low terraces, narrow valley floodplains, mesatops, flat ridgetops and plateaus. One site is on a sheltered badland slope of Mancos shale. It can occur on steeper surfaces, but slopes generally do not exceed 10%. Precipitation is usually less than 25.4 cm (10 inches) per year. *Atriplex confertifolia* is a xeric shrub associated with subdesert ecosystems. The soils that are commonly associated with this community are moderately coarse to fine, calcareous, and saline-alkaline with an average pH of 7.9. Bare soil covers much of the ground surface.

VEGETATION DESCRIPTION
Dinosaur National Monument
Codominance by the shrub *Atriplex confertifolia* and bunchgrass *Hesperostipa comata* defines this association. Few other shrubs are present, and total woody plant cover is less than 15%. Herbaceous vegetation cover is less than 20%. Other grasses commonly present include *Poa fendleriana, Achnatherum hymenoides, Pleuraphis jamesii,* and *Bromus tectorum*.

Globally
The vegetation cover in this community is sparse and the surface of the soil is often described as a gravel pavement due to the scouring action of the wind. This association has relatively low species diversity; *Atriplex confertifolia* dominates the shrub layer with 4-20% cover. Other desert shrubs are usually present with low cover. *Hesperostipa comata* dominates the herbaceous layer with 10-30% cover. *Achnatherum hymenoides, Poa fendleriana,* and *Poa secunda* are generally present with much lower cover. At lower elevations or warmer sites where *Atriplex confertifolia* is more abundant, there is more *Pleuraphis jamesii,* and *Hesperostipa comata* does not become abundant until further uphill where the *Atriplex confertifolia* decreases in cover (P. Lyon pers. comm. 2005).

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Atriplex confertifolia*
Herb (field)	*Hesperostipa comata*

Globally

Stratum	**Species**
Short shrub/sapling	*Atriplex confertifolia*
Herb (field)	*Hesperostipa comata*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G2 (30-Nov-1998). This association is known only in Colorado but predicted for Utah and Wyoming. The seven documented occurrences are restricted to Moffat County, Colorado. Site conditions are somewhat specific, and grazing has a negative effect on the association. The soils that are commonly associated with this community are moderately coarse to fine, calcareous, and saline-alkaline with an average pH of 7.9. The

vegetation cover in this community is sparse, and the surface of the soil is often described as a gravel pavement due to the scouring action of the wind. Sheep grazing generally decreases *Hesperostipa comata* and increases Poa secunda. Grazed *Atriplex confertifolia* may have low vigor, often with parts of the crown dead. The size of most of the occurrences is very small, 5 under 100 acres and only 1 over 100 acres.

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Look for this type on northern and eastern aspects of the badlands of Mancos or Morrison shales.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (1 plot: DINO.0305).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: D. Zoellner, mod. J. Coles

REFERENCES: Baker 1983c, Baker and Kennedy 1985, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Lyon pers. comm., Western Ecology Working Group n.d.

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

Dinosaur National Monument

This association is known from shale hogbacks near the western entrance and quarry area of the monument.

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

Dinosaur National Monument

This association occupies clay hills derived from Morrison or Mancos shales. Elevation is around 1500 m, slopes are gentle to moderate, and the aspect is generally west. Soils are coarse to fine-textured depending on whether the site has been scoured to a pebbly clay pavement.

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 hillslopes, canyonsides, benches and along toeslopes 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. Cryptogamic 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

Dinosaur National Monument

This association is dominated by *Atriplex confertifolia* and *Pleuraphis jamesii*. Few other shrubs are present, and total shrub cover is less than 10%. Herbaceous vegetation cover is 10 to 30%. *Bromus tectorum* is commonly present to codominant. Other graminoids and forbs are absent to sparse.

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 up 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

Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Atriplex confertifolia*
Herb (field)	*Bromus tectorum, Pleuraphis jamesii*

Globally

Stratum	**Species**
Short shrub/sapling	*Atriplex confertifolia*
Short shrub/sapling	*Gutierrezia sarothrae*
Herb (field)	*Pleuraphis jamesii*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Bromus tectorum

Globally
Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Dinosaur National Monument
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

Dinosaur National Monument Inventory Notes: This association has a higher herbaceous cover than *Atriplex confertifolia* Great Basin Shrubland (CEGL001294), and galleta is conspicuous in the spaces between plants.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (2 plots: DINO.0175, DINO.0178).
Local Description Authors: J. Thompson, mod. J. Coles
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	*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 shrub association occurs in scattered stands on ridges, flats, alluvial fans, talus slopes and badlands throughout the Colorado Plateau and Great Basin, often in a matrix of other high desert shrublands. Sites tend to occur on level to gentle slopes between 1158 and 2194 m (3800-7200 feet) elevation. Soils tend to be alkaline, shallow, well-drained clay loams, sometimes with a high rock or gravel content. Parent materials are variable but generally include a high percentage of calcareous source rocks. Total vegetation cover rarely exceeds 20% and is clearly dominated by *Atriplex confertifolia*. Many other species of shrubs may also be present, although they contribute little to the total canopy, including *Krascheninnikovia lanata, Kochia americana, Picrothamnus desertorum, Acamptopappus shockleyi, Atriplex canescens, Ephedra nevadensis*, 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

Dinosaur National Monument

This association is known from lower elevations near the east and west boundaries of the monument and on the Green River alluvial plain.

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

Dinosaur National Monument

This association occurs on adobe badlands or on talus overlying shale slopes at elevations ranging from 1475 to 1750 m. Slopes range from moderately to very steep and generally have a southerly aspect. Soils are fine-textured clay loams that tend to be unstable or highly erosive.

Globally

This shrub association occurs in scattered stands on ridges, flats, alluvial fans, talus slopes and badlands throughout the Colorado Plateau and Great Basin. Sites tend to occur on level to gentle slopes between 1158 and 2194 m (3800-7200 feet) elevation. Soils tend to be alkaline, shallow, well-drained and have clay loam textures, sometimes with a high rock and/or gravel content. Parent materials are variable but generally include a high percentage of calcareous source rocks.

VEGETATION DESCRIPTION

Dinosaur National Monument

This association is often characterized by sparse short-shrub cover dominated by *Atriplex confertifolia*. Other shrubs

that may be present in trace amounts include *Ephedra viridis* and *Tetradymia spinosa*. Herbaceous species occurring are diverse but have very low percent cover. Common species are primarily graminoids and include *Poa fendleriana, Poa secunda, Achnatherum hymenoides*, and *Bromus tectorum*.

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
Dinosaur National Monument

Stratum	Species
Short shrub/sapling	*Atriplex confertifolia*

Globally

Stratum	Species
Short shrub/sapling	*Atriplex confertifolia*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Bromus tectorum

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
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
Dinosaur National Monument Inventory Notes: This association describes sparse shadscale communities lacking a developed understory or any significant indicator species.
Dinosaur National Monument Data Sources: The description is based on 2002 and 2003 field data (5 plots: DINO.0180, DINO.0605, DINO.0634, DINO.0635, DINO.0698).
Local Description Authors: J. Thompson, mod. J. Coles
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

Amelanchier alnifolia / Symphoricarpos oreophilus Shrubland
Saskatoon Serviceberry / Mountain Snowberry Shrubland

CODE	CEGL002569
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 ALNIFOLIA* SHRUBLAND ALLIANCE (A.913) Saskatoon Serviceberry Shrubland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association has been documented only from Dinosaur National Monument. This summary only describes stands in that areas. It is known to occur in gently sloping drainages and benches of the undulating plateau country of the monument. Elevation ranges from 2100 to 2500 m, and slopes are commonly north- to east-facing. Soils are fine-textured silt or clay loams with a significant percent cover of organic litter on the surface. The vegetation is characterized by a moderate to dense canopy of *Amelanchier alnifolia* that is 2-3 m tall, and 10 to 20% cover of the short shrub *Symphoricarpos oreophilus* in the understory. Other shrubs commonly present with lesser cover include *Artemisia tridentata, Rosa woodsii*, or *Prunus virginiana*. The dwarf-shrubs *Mahonia repens, Paxistima myrsinites*, and *Juniperus communis* may also occur in the protected sites that this association inhabits. Herbaceous vegetation varies depending on the site; ridgetops have 20% cover and protected concave slopes 30 to 50% cover. The grass layer is always well-developed and diverse and often includes a combination of *Poa fendleriana, Achnatherum lettermanii, Hesperostipa comata, Elymus glaucus, Poa pratensis*, and/or *Elymus trachycaulus*. Forb species are variable in composition and low in cover. In some cases, individuals or small clumps of the trees *Juniperus scopulorum* or *Populus tremuloides* may occur but do not contribute enough cover to constitute a stratum.

DISTRIBUTION

Dinosaur National Monument

This association is known from high-elevation ridges in the vicinity of Douglas Mountain and Round Top Mountain.

Globally

This association is currently only known from high-elevation ridges in the vicinity of Douglas Mountain and Round Top Mountain in Dinosaur National Monument in Colorado and Utah.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occupies gently sloping drainages and benches of the undulating plateau country of the monument. Elevation ranges from 2100 to 2500 m, and slopes are commonly north- to east-facing. Soils are fine-textured silt or clay loams with a significant percent cover of organic litter on the surface.

Globally

This association has been documented only from Dinosaur National Monument. Without additional data, there is no global information.

VEGETATION DESCRIPTION

Dinosaur National Monument

This mountain shrub association is characterized by a moderate to dense canopy of *Amelanchier alnifolia* that is 2-3 m tall and 10 to 20% cover of the short shrub *Symphoricarpos oreophilus* in the understory. Other shrubs commonly present with lesser cover include *Artemisia tridentata, Rosa woodsii*, or *Prunus virginiana*. The dwarf-shrubs *Mahonia repens, Paxistima myrsinites*, and *Juniperus communis* may also occur in the protected, shallow-drainage sites that this association inhabits. Herbaceous vegetation varies depending on the site, ridgetops having 20% cover and protected concave slopes 30 to 50% cover. The grass layer is always well-developed and diverse, and often includes a combination of *Poa fendleriana, Achnatherum lettermanii, Hesperostipa comata, Elymus glaucus, Poa pratensis*, and/or *Elymus trachycaulus*. Forb species are variable in composition and low in cover. In some cases, individuals or small clumps of the trees *Populus tremuloides* and *Juniperus scopulorum* may occur but do not contribute enough percent cover to constitute a stratum.

Globally
This association has been documented only from Dinosaur National Monument. Without additional data, there is no global information.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	Species
Tall shrub/sapling	*Amelanchier alnifolia*
Short shrub/sapling	*Symphoricarpos oreophilus*
Herb (field)	*Achnatherum hymenoides, Hesperostipa comata, Poa fendleriana*

Globally
Data are not available.

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (6-Apr-2005).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Amelanchier alnifolia and *Amelanchier utahensis* can be difficult to differentiate where their environmental ranges cross, and especially if hybridization has occurred. As a result, there may be confusion in differentiating this association from those dominated by *Amelanchier utahensis*.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (3 plots: DINO.0240, DINO.0329, DINO.0514).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

Amelanchier (utahensis, alnifolia) - *Cercocarpus montanus* Shrubland (Utah Serviceberry, Saskatoon Serviceberry) - Mountain-mahogany Shrubland

CODE	CEGL001070
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Deciduous shrubland (III.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous shrubland (III.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
FORMATION	Temperate cold-deciduous shrubland (III.B.2.N.a.)
ALLIANCE	*AMELANCHIER UTAHENSIS* SHRUBLAND ALLIANCE (A.916) Utah Serviceberry Shrubland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

The description for this association is based on information from Colorado and Utah; its characteristics in Nevada are unknown and will be described when more information becomes available. This plant association is found on moderate to steeply sloping colluvial slopes, canyons, ridges and in alcoves. Sites may be oriented to any aspect. Elevation ranges between 1586 and 2595 m (5200-8500 feet). Relative to other mixed mountain shrub types, it is found on the driest sites with the least soil development and relatively low diversity. Soils range from shallow to deep but are generally always rocky with a high cover of surface rock. The vegetation is characterized by a more open shrub layer and a sparse understory relative to other mixed mountain shrub types. Total vegetation cover often does not exceed 50%. *Amelanchier utahensis* and *Cercocarpus montanus* are the dominants of as many as 16 shrub species in this association. Typical associated shrub species include *Artemisia bigelovii, Artemisia tridentata, Chrysothamnus viscidiflorus, Ephedra viridis, Ericameria nauseosa, Eriogonum corymbosum, Purshia tridentata, Rhus trilobata, Fraxinus anomala,* and *Tetradymia canescens. Symphoricarpos oreophilus* can dominate the lower shrub layer, which may also include *Brickellia microphylla, Eriogonum microthecum, Gutierrezia sarothrae, Mahonia repens,* and *Paxistima myrsinites*. Succulents such as *Opuntia* spp. or *Yucca* spp. may also have minor cover. If *Quercus gambelii* is present, cover is low (<5%). Scattered trees of *Juniperus osteosperma, Juniperus scopulorum,* or *Pinus edulis* may be present in some stands. *Achnatherum hymenoides* is the most common species in the diverse herbaceous layer. Other graminoid species may include *Poa fendleriana, Koeleria macrantha, Achnatherum lettermanii, Pseudoroegneria spicata, Elymus lanceolatus, Hesperostipa comata,* and *Leymus salinus.* Forb species may include *Arenaria fendleri, Chaenactis douglasii, Cryptantha flava, Balsamorhiza sagittata, Eriogonum umbellatum, Galium coloradoense, Heterotheca villosa, Lepidium montanum, Lithospermum ruderale, Petradoria pumila, Phlox longifolia, Physaria acutifolia, Senecio integerrimus, Sphaeralcea coccinea, Stanleya pinnata, Stenotus acaulis,* and *Streptanthella longirostris*. Disturbed sites may have high cover of *Bromus tectorum*.

DISTRIBUTION

Dinosaur National Monument

This association is known from the northern slopes of the high-elevation regions of the monument, including Douglas Mountain, Round Mountain, Tanks Peak, Wild Mountain, and Stuntz Ridge.

Globally

This association is documented from stands in western Colorado and eastern Utah. It has been reported from Nevada and is likely to occur in xeric areas of mixed mountain shrubland throughout the plateaus and foothills of Colorado and in higher elevations of the Colorado Plateau, western Rocky Mountains and Intermountain West.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This shrubland association occurs at elevations ranging from 2000 to 2500 m on gentle to moderately steep slopes and north to northeast aspects. Soils are sandy to clayey loams with some horizon development and greater than 60% cover of organic litter on the surface.

Globally

The description for this association is based on information from Colorado and Utah; its characteristics in Nevada are unknown and will be described when more information becomes available. This plant association is found on moderate to steeply sloping colluvial slopes, canyons, ridges and in alcoves. Sites may be oriented to any aspect. Elevations range between 1586 and 2500 m (5200-8200 feet). Relative to other mixed mountain shrub types, it is found on the driest sites with the least soil development and relatively low diversity. Exposed ground is moderate to extensive, averaging 40%. Soils range from shallow to deep but are generally always rocky with a high cover of surface rock.

VEGETATION DESCRIPTION

Dinosaur National Monument

This mixed mountain shrubland association is codominated by the shrubs *Amelanchier utahensis* and *Cercocarpus montanus*, with total cover ranging from 20 to 60% and heights reaching 1-2 m. Shrub and herbaceous species diversity is high. Shrubs that are typically occurring in this association include *Purshia tridentata, Symphoricarpos oreophilus, Artemisia tridentata,* and *Tetradymia canescens.* Dwarf-shrubs also commonly occur and include *Eriogonum microthecum, Mahonia repens,* and *Paxistima myrsinites*. Total herbaceous vegetation cover ranges from 10 to 30%. Common forb species include *Balsamorhiza sagittata, Eriogonum umbellatum, Petradoria pumila, Stenotus acaulis,* and *Lithospermum ruderale*. Grasses most consistently present include *Poa fendleriana, Koeleria*

macrantha, Achnatherum lettermanii, Achnatherum hymenoides, Pseudoroegneria spicata, and *Elymus lanceolatus*.

Globally
The vegetation is characterized by a more open shrub layer and a sparse understory relative to other mixed mountain shrub types. Total vegetation cover often does not exceed 50%. *Amelanchier utahensis* and *Cercocarpus montanus* are the dominants of as many as 16 shrub species in this association. Typical shrub species include *Artemisia bigelovii, Artemisia tridentata, Chrysothamnus viscidiflorus, Ephedra viridis, Ericameria nauseosa, Eriogonum corymbosum, Purshia tridentata, Rhus trilobata, Fraxinus anomala,* and *Tetradymia canescens. Symphoricarpos oreophilus* can dominate the lower shrub layer, which may also include *Brickellia microphylla, Eriogonum microthecum, Gutierrezia sarothrae, Mahonia repens,* and *Paxistima myrsinites*. Succulents such as *Opuntia* spp. or *Yucca* spp. may also have minor cover. *Achnatherum hymenoides* is the most common species in the diverse herbaceous layer. Other graminoid species may include *Poa fendleriana, Koeleria macrantha, Achnatherum lettermanii, Pseudoroegneria spicata, Elymus lanceolatus, Hesperostipa comata,* and *Leymus salinus*. Forb species may include *Arenaria fendleri, Chaenactis douglasii, Cryptantha flava, Balsamorhiza sagittata, Eriogonum umbellatum, Galium coloradoense, Heterotheca villosa, Lepidium montanum, Lithospermum ruderale, Petradoria pumila, Phlox longifolia, Physaria acutifolia, Senecio integerrimus, Sphaeralcea coccinea, Stanleya pinnata, Stenotus acaulis,* and *Streptanthella longirostris*. Disturbed sites may have high cover of *Bromus tectorum*.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Tall shrub/sapling	*Amelanchier alnifolia*
Tall shrub/sapling	*Cercocarpus montanus*
Short shrub/sapling	*Amelanchier utahensis, Symphoricarpos oreophilus*
Short shrub/sapling	*Cercocarpus montanus*
Herb (field)	*Eriogonum umbellatum, Paxistima myrsinites*

Globally

Stratum	**Species**
Tall shrub/sapling	*Amelanchier alnifolia*
Tall shrub/sapling	*Cercocarpus montanus*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Bromus tectorum

CONSERVATION STATUS RANK
Global Rank & Reasons: G2? (18-May-2001). This association is well-known only from a small area in Colorado, and very few occurrences have been documented. It also occurs in Utah and Nevada, but no information is available on its conservation status in those states. Very little is known about the larger scale abiotic factors that contribute to the distribution. The global rank should be at least a G3 based on the numbers of sites documented at Dinosaur and Colorado national monuments.

CLASSIFICATION COMMENTS

Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This common association occurs in large patches of several acres to several hundred acres. It is often flanked by other mixed mountain shrubland associations and contains patches of

Prunus virginiana shrubland on talus. *Amelanchier utahensis* and *Amelanchier alnifolia* can be difficult to differentiate; some plots of this association may contain one or both species.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (14 plots: DINO.0209, DINO.0212, DINO.0223, DINO.0267, DINO.0309, DINO.0328, DINO.0516, DINO.0559, DINO.0567, DINO.0591, DINO.0802, DINO.0804, DINO.0807, DINO.0911).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: L. Tasker, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data, CONHP unpubl. data 2003, Driscoll et al. 1984, NVNHP 2003, Tiedemann 1978, Vories 1974, Western Ecology Working Group n.d.

Amelanchier utahensis / Pseudoroegneria spicata Shrubland
Utah Serviceberry / Bluebunch Wheatgrass Shrubland

CODE	CEGL001069
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 on steep colluvial sites between 2400 and 2625 m (7875-8610 feet) elevation on south- and west-facing mountain slopes in Middle Park of north-central Colorado and between 1650 and 1800 m (5410-5900 feet) on north-facing canyon slopes in northwestern Colorado and adjacent Utah. Soils tend to be coarse and gravelly, with a high percentage of surface rock. The vegetation is somewhat heterogeneous but is characterized by a moderate to dense shrub layer that is usually dominated by *Amelanchier utahensis*, with *Symphoricarpos oreophilus* and the perennial bunchgrass *Pseudoroegneria spicata* always present in the herbaceous layer. Other shrubs may include *Artemisia tridentata* ssp. *wyomingensis, Cercocarpus montanus, Ephedra viridis, Holodiscus dumosus, Philadelphus microphyllus, Prunus virginiana, Purshia tridentata, Rhus trilobata*, and *Ribes cereum*. The herbaceous layer is variable among sites but often includes *Achnatherum hymenoides*. Commonly associated forb species include *Astragalus convallarius, Delphinium X occidentale, Delphinium bicolor* ssp. *bicolor, Castilleja flava, Linum lewisii, Packera cana,* and *Mertensia lanceolata*.

DISTRIBUTION
Dinosaur National Monument
This association is known from the slopes below Haystack Rock on the Yampa River and the canyon of Jones Hole Creek (a tributary of the Green River).

Globally
Despite the ecological breadth and range overlap of the key species, they are known to co-occur in this association only in Dinosaur National Monument and adjacent Utah and in Middle Park in north-central Colorado.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association occurs on steep, north-facing colluvial slopes in river canyons at elevations below 1800 m. The soil texture is sandy loam, and much of the ground surface is covered by large and small rocks.

Globally
This plant association occurs on steep colluvial sites between 2400 and 2625 m (7875-8610 feet) elevation on south

and west-facing mountain slopes in Middle Park of north-central Colorado and between 1650 and 1800 m (5410-5900 feet) on north-facing canyon slopes in northwestern Colorado. Soils tend to be coarse and gravelly, with a high percentage of surface rock.

VEGETATION DESCRIPTION

Dinosaur National Monument

Moderate cover by the tall shrub *Amelanchier utahensis* and bunchgrass *Pseudoroegneria spicata* characterizes this association. Other shrubs typically associated include *Philadelphus microphyllus, Ephedra viridis, Artemisia tridentata,* and *Holodiscus dumosus*. Although herbaceous species are usually present in addition to *Pseudoroegneria spicata*, no species are consistent or abundant enough to note.

Globally

The vegetation is somewhat heterogeneous but is characterized by a moderate to dense shrub layer that is usually dominated by *Amelanchier utahensis*, with *Symphoricarpos oreophilus* and the perennial bunchgrass *Pseudoroegneria spicata* always present in the herbaceous layer. Other shrubs may include *Artemisia tridentata* ssp. *wyomingensis, Cercocarpus montanus, Ephedra viridis, Holodiscus dumosus, Philadelphus microphyllus, Prunus virginiana, Purshia tridentata, Rhus trilobata,* and *Ribes cereum*. The herbaceous layer is variable among sites but often includes *Achnatherum hymenoides*. Commonly associated forb species include *Astragalus convallarius, Delphinium X occidentale, Delphinium bicolor* ssp. *bicolor, Castilleja flava, Linum lewisii, Packera cana,* and *Mertensia lanceolata*.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Tall shrub/sapling	*Amelanchier alnifolia*
Short shrub/sapling	*Philadelphus microphyllus*
Short shrub/sapling	*Artemisia tridentata, Ephedra viridis*
Herb (field)	*Pseudoroegneria spicata*

Globally

Stratum	**Species**
Tall shrub/sapling	*Amelanchier alnifolia*
Herb (field)	*Pseudoroegneria spicata*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Bromus tectorum

Globally

Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: G2G3 (30-Dec-2000). The association has only been documented from Dinosaur National Monument in northwestern Colorado and Middle Park in north-central Colorado. Although the diagnostic species *Amelanchier utahensis, Symphoricarpos oreophilus* and *Pseudoroegneria spicata* are widespread separately, they have only been reported to co-occur in a very few stands. More inventory is needed to assess current condition and threats.

CLASSIFICATION COMMENTS

Dinosaur National Monument

None

Globally

This plant association is similar to *Amelanchier alnifolia / Pseudoroegneria spicata* - Bunchgrass Shrubland (CEGL001065) that occurs in Wyoming and Montana; because of the difficulty of distinguishing *Amelanchier alnifolia* and *Amelanchier utahensis* in the field, some stands may be misidentified. Review of field data may result in lumping these two associations into one. This association was first identified as *Amelanchier utahensis - Symphoricarpos oreophilus / Pseudoroegneria spicata* Shrubland by the CONHP and appears to be endemic to northern Colorado.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is easily recognizable from a distance because of the intense, dark green of the serviceberry shrubs. It is distinguished from other *Amelanchier utahensis* shrubland associations by having *Pseudoroegneria spicata* dominant in the herbaceous layer.
Dinosaur National Monument Data Sources: The description is based on 2002 and 2003 field data (2 plots: DINO.1011, DINO.1020).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: A.E. Black, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Francis 1983, Soil Conservation Service 1978, Terwilliger and Tiedemann 1978, Tiedemann et al. 1987

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 mountain 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 mixture of perennial graminoids and forbs. Introduced species such as *Agropyron cristatum* and *Bromus tectorum* are common in disturbed stands.

DISTRIBUTION
Dinosaur National Monument
This association is known from Stuntz Ridge, Serviceberry Gap, the pipeline right-of-way at the west end of Split Mountain, and colluvial slopes below Jenny Lind Rock.

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
Dinosaur National Monument
This association occurs primarily in two environmental situations: (1) steep, north-facing colluvial canyon slopes at around 1600 m elevation and (2) moderately sloping, north- and east-facing ridges of high plateaus around 2400 m. One plot was located at the base of a sandstone wall where runoff collects. Soils are rapidly drained sandy loams,

with a significant element of loose rock on colluvial sites. Moss may be a significant ground cover element in protected sites.

Globally
This montane shrubland association occurs the foothills, canyons, mountains and mesas at elevations from 1480-2440 m (4855-8000 feet). Stands occur on moderate to steep slopes (9-37 degrees) 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
Dinosaur National Monument
This association is dominated by *Amelanchier utahensis*, usually forming a canopy 2-3 m tall with 20 to 60% cover. A variety of shorter shrubs may be present, most commonly *Symphoricarpos oreophilus* and *Artemisia tridentata*. *Juniperus scopulorum* and *Juniperus osteosperma* may be scattered through the canopy layer but have less than 10% cover. Herbaceous vegetation is variable in composition and percent cover, but typically grasses dominate and provide at least 20% cover. *Poa pratensis, Achnatherum lettermanii, Koeleria macrantha*, and *Poa fendleriana* are the most common and abundant grasses. The forb layer is diverse, with generally less cover than the grasses.

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
Dinosaur National Monument

Stratum	**Species**
Tall shrub/sapling	*Amelanchier utahensis, Prunus virginiana, Rhus trilobata*
Short shrub/sapling	*Symphoricarpos oreophilus*
Short shrub/sapling	*Artemisia tridentata* ssp. *vaseyana, Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Achnatherum lettermanii, Poa pratensis*

Globally

Stratum	**Species**
Tall shrub/sapling	*Amelanchier alnifolia*
Short shrub/sapling	*Symphoricarpos oreophilus*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Arabis fernaldiana var. *fernaldiana, Bromus inermis, Bromus tectorum*

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G4 (19-Sep-2000).

CLASSIFICATION COMMENTS
Dinosaur National Monument
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
Dinosaur National Monument Inventory Notes: There is a lot of floristic and environmental variability within this association. It serves as a good comprehensive classification for *Amelanchier utahensis* types that lack other diagnostic species.
Dinosaur National Monument Data Sources: The description is based on 2002 and 2003 field data (2 plots: DINO.0151, DINO.0696, and 2 observation points: DINO.9402, DINO.9901).
Local Description Authors: J. Thompson, mod. 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 Jaindl 1994, NVNHP 2003, Yake and Brotherson 1979

Cercocarpus montanus / Pseudoroegneria spicata Shrubland
Mountain-mahogany / Bluebunch Wheatgrass Shrubland

CODE	CEGL001090
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	*CERCOCARPUS MONTANUS* SHRUBLAND ALLIANCE (A.896) Mountain-mahogany Shrubland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This association occurs on windswept ridgelines and rocky slopes on foothills and high plateaus in northwestern Colorado, north-central Utah and western Wyoming. It often occurs as inclusions within larger areas of sagebrush. Elevations range from 1511 to 2600 m (4960-8530 feet). Slopes are moderate to very steep and generally oriented to a north to east aspect, except in Utah, where south-facing stands occur. The substrate is often calcareous, either limestone or colluvium derived from formations that include limestone. Soils are shallow to deep, rocky sandy or silty loams. The soil surface is abundantly covered with organic litter. The vegetation is characterized by a shrub canopy dominated by *Cercocarpus montanus* (20-45% cover) with an herbaceous understory dominated by *Pseudoroegneria spicata* (5-15% cover). Total vegetative cover rangies from 25% to more than 65%. Associated shrubs include *Artemisia tridentata, Amelanchier utahensis, Symphoricarpos oreophilus, Tetradymia canescens, Quercus gambelii,* and *Eriogonum microthecum*. The herbaceous stratum has sparse to moderate cover and consists mostly of graminoids, such as *Poa fendleriana, Koeleria macrantha, Achnatherum hymenoides, Poa secunda*, and *Hesperostipa comata*. Typical forbs present include *Stenotus acaulis* and *Eriogonum umbellatum*.

DISTRIBUTION
Dinosaur National Monument
This association is known from Snow Ranch Canyon, Martha's Peak, Tank's Peak, Serviceberry Gap, Miner's Draw Road, Five Springs, and other high elevations in the central and eastern parts of the monument.

Globally
This association is known from the Uinta Basin in northwestern Colorado, the foothills of the Wasatch Range in north-central Utah and scattered locations in western Wyoming. Baker and Kennedy (1985) speculate that this association is near its southern limit in northwestern Colorado.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument
This association occurs in small stands on windswept ridgelines and rocky slopes at elevations ranging from 1900 to 2600 m. Soils are shallow, rocky sandy or silty loams, and the soil surface is abundantly covered with organic litter.

Globally
This association occurs on windswept ridgelines and rocky slopes on foothills and high plateaus in northwestern Colorado, north-central Utah and western Wyoming. It often occurs as inclusions within larger areas of sagebrush. Elevations range from 1511 to 2600 m (4960-8530 feet). Slopes are moderately to very steep and generally are oriented to a north to east aspect, except in Utah, where south-facing stands occur. The substrate is often calcareous, such as limestone or colluvium derived from formations that include limestone. Soils are shallow to deep, rocky sandy or silty loams, and the soil surface is abundantly covered with organic litter.

VEGETATION DESCRIPTION
Dinosaur National Monument
This association is characterized by small stands dominated by *Cercocarpus montanus* with an herbaceous understory dominated by *Pseudoroegneria spicata*. It often occurs as inclusions within larger areas of sagebrush. The total vegetative cover is moderate to dense. Associated shrubs include *Artemisia tridentata* (ssp. *vaseyana*, ssp. *wyomingensis*), *Amelanchier utahensis, Tetradymia canescens, Symphoricarpos oreophilus*, and *Eriogonum microthecum*. The herbaceous stratum has sparse to moderate cover. Grasses associated with *Pseudoroegneria spicata* include *Poa fendleriana, Koeleria macrantha, Achnatherum hymenoides, Poa secunda*, and *Hesperostipa comata*. Typical forbs present include *Stenotus acaulis* and *Eriogonum umbellatum*.

Globally
This association is characterized by small stands dominated by *Cercocarpus montanus* (20-45% cover) with an herbaceous understory dominated by *Pseudoroegneria spicata* (5-15% cover). The total vegetative cover is moderate to dense, ranging from 25% to more than 65%. Associated shrubs include *Artemisia tridentata* (ssp. *vaseyana*, ssp. *wyomingensis*), *Amelanchier utahensis, Quercus gambelii, Tetradymia canescens, Symphoricarpos oreophilus*, and *Eriogonum microthecum*. The herbaceous stratum has sparse to moderate cover and consists mostly of graminoids, including *Poa fendleriana, Koeleria macrantha, Achnatherum hymenoides, Poa secunda*, and *Hesperostipa comata*.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Artemisia tridentata* ssp. *vaseyana, Cercocarpus montanus*
Herb (field)	*Pseudoroegneria spicata*

Globally

Stratum	**Species**
Short shrub/sapling	*Cercocarpus montanus*
Herb (field)	*Pseudoroegneria spicata*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Bromus tectorum

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Data are not available.
Dinosaur National Monument Data Sources: This description is based on 2002 and 2003 field data (26 plots: DINO.0016, DINO.0148, DINO.0208, DINO.0209, DINO.0212, DINO.0223, DINO.0239, DINO.0250, DINO.069, DINO.0335, DINO.0336, DINO.0337, DINO.0363, DINO.0512, DINO.0517, DINO.0520, DINO.0524, DINO.0562, DINO.0571, DINO.0572, DINO.0574, DINO.0578, DINO.0707, DINO.0802, DINO.0811, DINO.0902, and 2 observation points: DINO.9802, DINO.9804).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Baker 1982b, Baker 1983c, Baker and Kennedy 1985, Bourgeron and Engelking 1994, Brotherson et al. 1984, CONHP unpubl. data 2003, Driscoll et al. 1984, Western Ecology Working Group n.d.

Prunus virginiana - (Prunus americana) Shrubland
Choke Cherry - (American Plum) Shrubland

CODE	CEGL001108
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Deciduous shrubland (III.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous shrubland (III.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
FORMATION	Temperate cold-deciduous shrubland (III.B.2.N.a.)
ALLIANCE	*PRUNUS VIRGINIANA* SHRUBLAND ALLIANCE (A.919) Choke Cherry Shrubland Alliance
ECOLOGICAL SYSTEM(S):	Northern Rocky Mountain Montane-Foothill Deciduous Shrubland (CES306.994) Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822) Western Great Plains Wooded Draw and Ravine (CES303.680)
USFWS WETLAND SYSTEM:	Not applicable

CONCEPT SUMMARY
Globally
This is a widespread small-patch shrubland that is known from the Columbia Plateau of eastern Washington and eastern Oregon, eastern Nevada, southeastern Idaho, throughout Wyoming, Montana, Colorado and western South Dakota. It occurs in the foothills and lower slopes of mountain ranges, along higher creeks, and in draws and ravines of high plateaus and the Great Plains. The elevational range is 680 to 2652 m (2234-8700 feet). This association grows at the interface between larger riparian areas and the adjacent upland and occurs as small dense thickets, narrow bands, or irregular patches. It often occupies draws, ephemeral creeks in steep narrow-bottomed canyons, and shallow ravines. It can occur on slopes below seeps and springs and on high slopes where snow collects. Shrub cover ranges from 100% to more open stands of 30%. Shrub cover is generally greater in drainage bottoms and on lowermost slopes, and less on upper slopes. *Prunus virginiana* is usually the dominant shrub species, but *Prunus americana* may be solely present to codominant as well. Stands can be dominated by one species but are often a mix of three to six other shrub species, which can be as abundant and even more abundant than the Prunus. Other shrubs include *Rhus trilobata, Ribes aureum, Ribes lacustre, Ribes inerme, Salix exigua, Sambucus* spp., *Amelanchier* spp., *Amorpha canescens, Symphoricarpos oreophilus, Symphoricarpos occidentalis, Juniperus scopulorum, Rosa woodsii*, and *Toxicodendron rydbergii*. In drainage bottoms, herbaceous cover is usually sparse, less than 10%. On slopes, the shrubs typically occur in some grassland type, and graminoid cover can be greater than 75%. Herbaceous species include *Bromus inermis, Heracleum maximum, Juncus arcticus, Maianthemum stellatum, Poa pratensis, Cirsium arvense, Muhlenbergia montana, Leymus cinereus,* and *Bromus tectorum*.

DISTRIBUTION
Dinosaur National Monument
This association is known from three sites in the northern region of the monument in the vicinity of Massey Cabin, on Wild Mountain, and in Zenobia Basin. It was also documented in Thanksgiving Gorge south of the Yampa River.

Globally
This is a widespread, if small-patch, shrubland that is known from the Columbia Plateau of eastern Washington, eastern Oregon, eastern Nevada, southeastern Idaho, throughout Wyoming, Montana, Colorado and western South Dakota.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This vegetation association generally occurs on moderately steep concave slopes with northerly aspects and elevations ranging from 1700 to 2500 m. Soil texture is sandy loam to clay loam. Leaf litter from deciduous shrubs is the primary ground cover. Colluvial boulders and large rocks are often an important nonvegetative component of this association.

Globally
This is a widespread small-patch shrubland that is known from the Columbia Plateau of eastern Washington, eastern Oregon, eastern Nevada, southeastern Idaho, throughout Wyoming, Montana, Colorado and western South Dakota. It occurs in the foothills and lower slopes of mountains, along higher creeks, and in draws and ravines of plateaus and the Great Plains. The elevational range is 716 to 2652 m (2234-8700 feet). This association grows at the interface between larger riparian areas and the adjacent upland, as well as on high ridges where snow collects, and occurs as small dense thickets, narrow bands, or irregular patches. It often occupies draws, ephemeral creeks in steep narrow-bottomed canyons, and shallow ravines. It can occur on slopes below seeps and springs. Stands can also occur as small pockets on higher terraces or as narrow bands along the high-water mark of steep banks and incised channels. It also grows at the base of cliffs adjacent to rivers. Slope varies from flat to very steep, with variable aspects, and can be associated with rock outcrops and talus. Stands are typically on very well-drained, rocky soils but occasionally have finer soils. Soil texture ranges from sandy loam to clay loam.

VEGETATION DESCRIPTION
Dinosaur National Monument
This association is characterized by a tall-shrub layer dominated by *Prunus virginiana* var. *melanocarpa* with 40 to 60% cover and up to 5 m high. Understory shrubs may total 10 to 30% cover and include *Rhus trilobata, Amelanchier utahensis, Amelanchier alnifolia, Sambucus nigra* ssp. *caerulea, Artemisia tridentata* ssp. *tridentata, Ribes cereum, Rosa woodsii,* and *Symphoricarpos oreophilus*. The herbaceous layer is relatively dense (10 to 30% cover), with varied composition, but is generally dominated by the graminoid *Leymus cinereus*. Other graminoids known to occur with more than 1% cover are *Poa pratensis, Poa fendleriana, Bromus tectorum, Bromus carinatus,* and *Piptatherum micranthum*. Forbs present with greater than 1% cover are *Heterotheca villosa, Toxicodendron rydbergii,* and *Glycyrrhiza lepidota*.

Globally
Shrub cover ranges from 100% to more open stands of 30%, with the higher values tending to occur in sites located in drainage bottoms and on lowermost slopes, and the lower values on higher slopes. *Prunus virginiana* is usually the dominant shrub species, but *Prunus americana* may be solely present to codominant. Stands can be dominated by one species but are often a mix of three to six other shrub species, which can be as abundant and sometimes more abundant than the *Prunus*. Other shrubs include *Rhus trilobata, Ribes aureum, Ribes lacustre, Ribes inerme, Salix exigua, Sambucus* spp., *Amelanchier* spp., *Amorpha canescens, Artemisia tridentata, Symphoricarpos oreophilus, Symphoricarpos occidentalis, Juniperus scopulorum, Rosa woodsii, Mahonia repens*, and *Toxicodendron* spp. In drainage bottom situations, herbaceous cover is usually sparse, less than 10%. On slopes, the shrubs typically occur in a matrix of other shrubland or grassland types, and graminoid cover can be greater than 75%. Herbaceous species include *Bromus carinatus, Maianthemum stellatum, Poa pratensis, Poa fendleriana, Muhlenbergia montana, Leymus cinereus, Agastache urticifolia, Balsamorhiza sagittata*, and *Eriogonum umbellatum*. Exotic herbaceous species may be present, including *Cirsium arvense, Bromus inermis*, and *Bromus tectorum*.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Tall shrub/sapling	*Prunus virginiana* var. *melanocarpa*
Short shrub/sapling	*Rosa woodsii, Symphoricarpos oreophilus*

Globally

Stratum	**Species**
Short shrub/sapling	*Prunus americana, Prunus virginiana*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum, Poa pratensis

Globally
Bromus inermis, Bromus tectorum, Pascopyrum smithii, Poa pratensis, Prunus americana, Symphoricarpos occidentalis

CONSERVATION STATUS RANK
Global Rank & Reasons: G4Q (1-Feb-1996). This type is widespread, but it represents a broadly defined dominance type, with little information on the associated species or habitats that might help define the type more precisely. If, e.g. a Great Plains type was separated out from the other types, such a type could be relatively rare.

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
This is a widespread and highly variable, yet distinct, type. Kovalchik (1987) briefly describes a similar type called Mixed Shrub Canyon Bottom Association from 4 plots. It occurs in low-elevation canyons below U.S. Forest Service ownership in eastern Oregon. Tall shrubs include *Prunus virginiana, Amelanchier alnifolia, Rosa woodsii, Cornus sericea, Salix* spp., *Prunus subcordata*, and/or *Alnus incana*. This may be the same concept.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is well-documented and should be easily distinguished in the field because Prunus is the overwhelming dominant in the shrub canopy.
Dinosaur National Monument Data Sources: This association is described from 2002 and 2003 field data (4 plots: DINO.0224, DINO.0233, DINO.0245, DINO.1005, and 1 observation point: DINO.9803).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: D. Faber-Langendoen, mod. G. Kittel, J. Coles, K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, CONHP pers. comm., CONHP unpubl. data 2003, Caicco and Wellner 1983n, Carsey et al. 2003a, Copeland 1980a, Driscoll et al. 1984, Evans 1989a, Evans 1989b, Hall and Hansen 1997, Hansen et al. 1991, Hansen et al. 1995, IDCDC 2005, Johnston 1987, Jones 1992b, Jones and Walford 1995, Kagan et al. 2000, Kittel et al. 1996, Kittel et al. 1999b, Kovalchik 1987, Kudray et al. 2004, MTNHP 2002b, Manning and Padgett 1995, Marriott pers. comm., NVNHP 2003, Von Loh et al. 1999

Rhus trilobata Intermittently Flooded Shrubland
Threeleaf Sumac 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	*RHUS TRILOBATA* INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.938) Threeleaf Sumac 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 toeslopes 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 downcutting, 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

Dinosaur National Monument

This association occurs intermittently on the banks of the Green River, especially below Split Mountain; other examples occur in lower Rainbow Park and on the banks of the Yampa River at Big Joe.

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

Dinosaur National Monument

This uncommon association is best developed on sandy and middle terraces on the banks of the Green and Yampa rivers. Smaller stands occur on rocky slopes in the vicinity of sheltered upland seeps.

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 feet). These small shrublands are reported from stream and river bottoms and terraces, and upland in mesic swales and on hillslopes below seeps and springs. Along the Yampa, San Miguel, and Dolores rivers stands often form linear bands on rocky, well-drained benches and toeslopes 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 downcutting, 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

Dinosaur National Monument

Rhus trilobata dominates the short-shrub layer, often forming a dense, closed canopy. In drier, more open stands, *Rhus* may be accompanied by *Artemisia tridentata* ssp. *tridentata, Amelanchier utahensis, Chrysothamnus linifolius*, and/or *Salix exigua. Tamarix ramosissima* may occur as a tall shrub with less than 10% cover. Herbaceous cover ranges from sparse (in closed stands) to significant (in open stands), and the composition is variable. Herbaceous species known to occur include *Distichlis spicata, Spartina pectinata, Muhlenbergia asperifolia*, and *Glycyrrhiza*

lepidota. Seedlings of *Populus deltoides* ssp. *wislizeni* and *Populus angustifolia* occur with minimal cover.

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
Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Rhus trilobata*
Short shrub/sapling	*Artemisia tridentata* ssp. *tridentata*
Herb (field)	*Heterotheca villosa*
Herb (field)	*Distichlis spicata, Spartina pectinata*

Globally

Stratum	**Species**
Tall shrub/sapling	*Salix exigua*
Short shrub/sapling	*Rhus trilobata*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Lepidium latifolium

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
Dinosaur National Monument
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
Dinosaur National Monument Inventory Notes: The plots and observation point used for this description include a mixture of upland and palustrine species. At least one site could be split into very small linear upland and wetland associations, but this was impractical.
Dinosaur National Monument Data Sources: This association is described from field data collected in the 1990s and in 2002 (3 plots: DINO.0637, GR092, GR119, and 1 observation point: DINO.9808).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: K.A. Schulz, mod. C. Murphy, J. Drake, J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP 2001, Cole 1995, Cole 1996, Driscoll et al. 1984, Goodrich and Neese 1986, Hall and Hansen 1997, Hansen and Hall 2002, IDCDC 2005, IDCDC unpubl. data 2002, Jankovsky-Jones et al. 2001, Kittel and Lederer 1993, Kittel et al. 1999b, Padgett et al. 1989, Welsh et al. 1987

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	*SALIX (EXIGUA, INTERIOR)* TEMPORARILY FLOODED SHRUBLAND ALLIANCE (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 streambanks.

DISTRIBUTION
Dinosaur National Monument
This common riparian association occurs along the Yampa and Green rivers as well as some side canyon tributaries that are susceptible to annual spring flooding.

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

Dinosaur National Monument

This riparian association occupies sandbars, islands, banks, and low terraces within the active river floodplain at elevations below 2000 m. The substrate is typically composed of alluvial sands, gravels, and cobbles, and is frequently inundated by scouring floods that remove the herbaceous understory and organic litter.

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 streambanks 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

Dinosaur National Monument

In this tall-shrub association, *Salix exigua* stands range from a few scattered shrubs to dense thickets. Other shrubs and trees known to occur with minimal cover are *Rhus trilobata, Artemisia tridentata* ssp. *tridentata, Chrysothamnus viscidiflorus, Salix scouleriana, Populus deltoides* ssp. *wislizeni, Populus angustifolia,* and *Acer negundo*. Herbaceous species are sparse on the barren substrate, and their composition varies among sites. Some that are known to commonly occur include *Apocynum cannabinum, Glycyrrhiza lepidota, Helenium autumnale* var. *montanum,* and *Equisetum hyemale* var. *affine*.

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

Dinosaur National Monument

Stratum	**Species**
Tall shrub/sapling	*Salix exigua*

Globally

Stratum	**Species**
Tall shrub/sapling	*Salix exigua*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Data are not available.

Globally

Bromus tectorum, Melilotus officinalis, Tamarix chinensis, Xanthium strumarium

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (15-Jun-2001).

CLASSIFICATION COMMENTS
Dinosaur National Monument
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
Dinosaur National Monument Inventory Notes: This associate is distinguished from other Salix exigua shrubland associations by the lack of a developed herbaceous understory.
Dinosaur National Monument Data Sources: This association is described from field data collected in the 1990s and in 2003 (8 plots: DINO.0686, DINO.0711, DINO.1407, GR033, GR037, GR038, GR040, GR058).
Local Description Authors: J. Thompson, mod. J. Coles
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 Forbs Shrubland
Coyote Willow / Mesic Forbs Shrubland

CODE	CEGL001202
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Deciduous shrubland (III.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous shrubland (III.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
FORMATION	Temporarily flooded cold-deciduous shrubland (III.B.2.N.d.)
ALLIANCE	*SALIX (EXIGUA, INTERIOR)* TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.947) (Coyote Willow, Sandbar Willow) Temporarily Flooded Shrubland Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY
Globally
This association typically occurs between 1464 and 2562 m (4800-8400 feet) elevation in Utah, western Colorado, central Nevada and eastern Idaho, where it occupies streambanks, terraces, and meadows along a wide variety of low- to moderate-gradient stream types. In contrast, a low-elevation phase of this plant association is found below 1128 m (3700 feet) in south-central and southwestern Idaho on annually flooded banks, islands, and terraces of reservoirs and large rivers (e.g., the Snake River and Boise River). This type usually occurs on well-developed sandy to silty alluvial loam soils, on the wettest (often flooded) but stable sites supporting *Salix exigua* associations. Both phases are dominated by a tall-shrub overstory of open to dense *Salix exigua*, although *Salix lutea, Ribes* spp., and *Rosa woodsii* are sometimes also present in lesser amounts. In the typical phase, the herbaceous understory is clearly dominated by a lush understory of mixed tall forbs, each with moderate cover, with *Aconitum columbianum, Equisetum arvense, Heracleum maximum, Maianthemum stellatum, Mertensia ciliata, Rudbeckia* spp., *Solidago canadensis*, and *Urtica dioica* being most common. No single forb has consistently high constancy and cover across the association's range. In the low-elevation phase, flood-disturbed stands in riverine habitats contain abundant native colonizing forbs (e.g., *Apocynum cannabinum, Euthamia occidentalis, Glycyrrhiza lepidota*, and *Polygonum*

spp.) often mixed with dense exotic forbs (e.g., *Dipsacus fullonum, Lythrum salicaria, Melilotus officinalis,* and *Xanthium strumarium*). Total mesic graminoid cover is low in both phases of this association (with each species having only low cover) and composed of both native species (e.g., *Carex* spp., *Elymus glaucus*) and/or exotics (e.g., *Phalaris arundinacea, Poa pratensis*).

DISTRIBUTION

Dinosaur National Monument

This association is documented specifically from near New Rapid and below Buster Basin on the Green River. It occurs throughout the monument on the banks of the Green and Yampa rivers, as well as less frequently in side canyons and alcoves with wet conditions.

Globally

This association has been documented to occur at mid elevations in central Nevada, Utah and western Colorado, north through eastern Idaho. It is expected to occur in similar habitats in Wyoming.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This riparian association occurs on banks, low terraces, and abandoned channels of gentle-gradient rivers or streams at elevations below 2000 m. Flooding is less frequent than the flood-scoured *Salix exigua* / Barren Shrubland (CEGL001200). Soils are sandy alluvium, somewhat developed, and overlain with organic litter.

Globally

This association typically occurs between 1464 and 2562 m (4800-8400 feet) elevation in Utah, western Colorado, central Nevada and eastern Idaho, where it occupies streambanks, terraces, and meadows along a wide variety of low- to moderate-gradient stream types. In contrast, a low-elevation phase of this plant association is found below 1128 m (3700 feet) in south-central and southwestern Idaho on annually flooded banks, islands, and terraces of reservoirs and large rivers (e.g., the Snake River and Boise River). This type usually occurs on well-developed sandy to silty alluvial loam soils, on the wettest (often flooded) but stable sites supporting Salix exigua associations.

VEGETATION DESCRIPTION

Dinosaur National Monument

In this association, the tall shrub *Salix exigua* has at least 20% cover. *Tamarix ramosissima* may be present with lesser cover. A lush mesic forb understory dominates the herbaceous layer with 20 to 100% cover. Forb species composition is variable; however, some that commonly occur with significant cover include *Equisetum hyemale, Glycyrrhiza lepidota, Asclepias speciosa, Euthamia occidentalis, and Apocynum cannabinum*. A rare species of special interest, *Spiranthes diluvialis,* is also known to occur in stands of this association. Graminoid species are absent or low in cover.

Globally

Both phases are dominated by a tall-shrub overstory of open to dense *Salix exigua, although Salix lutea, Ribes* spp., and *Rosa woodsii* are sometimes also present in lesser amounts. Sapling *Populus angustifolia* or *Tamarix ramosissima* may also be present. In the typical phase, the herbaceous understory is clearly dominated by a lush understory of mixed tall forbs, each with moderate cover, with *Aconitum columbianum, Asclepias speciosa, Equisetum arvense, Heracleum maximum, Maianthemum stellatum, Mertensia ciliata, Rudbeckia* spp., *Solidago canadensis*, and *Urtica dioica* being most common. No single forb has consistently high constancy and cover across the association's range. In the low-elevation phase, flood-disturbed stands in riverine habitats contain abundant native colonizing forbs (e.g., *Apocynum cannabinum, Euthamia occidentalis, Glycyrrhiza lepidota, Veronica anagallis-aquatica*, and *Polygonum* spp.) often mixed with dense exotic forbs (e.g., *Ambrosia trifida, Dipsacus fullonum, Lythrum salicaria, Melilotus officinalis, Tripleurospermum perforata,* and *Xanthium strumarium*). Total mesic graminoid cover is low in both phases of this association (with each species having only low cover) and composed of both native species (e.g., *Carex* spp., *Elymus glaucus*) and/or exotics (e.g., *Phalaris arundinacea, Poa pratensis*).

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Salix exigua*
Herb (field)	*Apocynum cannabinum*
Herb (field)	*Equisetum hyemale*

Globally

Stratum	**Species**
Tall shrub/sapling	*Salix exigua*
Herb (field)	*Aconitum columbianum, Asclepias speciosa, Heracleum maximum, Maianthemum stellatum, Mertensia ciliata, Solidago canadensis, Urtica dioica*
Herb (field)	*Equisetum hyemale*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Spiranthes diluvialis

Globally
Alopecurus aequalis, Ambrosia trifida, Cirsium arvense, Linaria vulgaris, Lythrum salicaria, Melilotus officinalis, Phalaris arundinacea, Plantago major, Poa pratensis, Spiranthes diluvialis, Trifolium repens, Tripleurospermum perforata, Xanthium strumarium

CONSERVATION STATUS RANK
Global Rank & Reasons: G2 (22-Oct-2002). This association is moderately wide-ranging but infrequently sampled throughout the core of its range at mid elevations in central Nevada, western Colorado and Utah, north through eastern Idaho. In this range, the association occurs along a wide variety of streams and river types on various fluvial landforms. However, it is mid- to late-seral and mostly limited to wet but stable sites with well-developed loamy soil. A dense understory layer of heterogeneous tall mesic forbs and low cover of mesic graminoid species characterizes the typical phase of this association. Stands are threatened by livestock overgrazing leading to invasion by exotic graminoid species. A low-elevation, disturbance-induced phase of this association is known from about 15 stands on the lower Snake River and its larger tributaries of southwestern Idaho. This phase is often in poor to fair ecological condition and may be better classified as *Salix exigua / Euthamia occidentalis* or another type. There are only about 15 to 20 known occurrences of the higher elevation, less-disturbed phase of the association, despite the abundance of other Salix exigua associations in this region. Only the higher elevation typical stands were considered in changing the rank from G2? to G2.

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
This association is quantitatively described from 22 plots, of which 4 plots are in Utah and southeastern Idaho (Padgett et al. 1989) and 4 plots in central Nevada (Manning and Padgett 1995). The low-elevation phase is described from at least 14 plots of *Salix exigua* / mixed riparian forb plant association sampled along the middle Snake River by Cole (1996), as well as *Salix exigua* communities with understories dominated by colonizing forbs such as *Apocynum cannabinum* and *Melilotus officinalis* (Cole 1995, Holmstead 2001). *Euthamia occidentalis* has high constancy and sometimes high cover in many of these low-elevation stands. The higher elevation phase is usually a stable, mid- to late-seral association (unless disturbed by excessive grazing), while the low-elevation phase is an early-seral association. The compositional heterogeneity inherent in early-seral, flood-disturbed *Salix exigua* stands has led some researchers to lump stands into a *Salix exigua* dominance type (e.g., Hansen et al. (1995) in Montana; Crowe and Clausnitzer (1997) in eastern Oregon; Crawford (2001) in eastern Washington; Hansen and Hall (2002) in southeastern Idaho). Examination of composition data for the *Salix exigua* dominance type reveals that most stands have greater graminoid cover than forb cover and have no mesic forb species with moderate to high cover and constancy. Some of these stands would better fit with the *Salix exigua / Equisetum arvense* association described by Youngblood et al. (1985a) but do not (except for rare cases) include stands of *Salix exigua* / mesic forbs. The *Salix exigua* / mesic forbs association is probably successionally related to the *Salix exigua* / bench community type described by Manning and Padgett (1995) from 8 locations in Nevada. *Salix exigua* ssp. *melanopsis* is now synonymous with *Salix melanopsis*. Although recent classifications (i.e., Crowe et al. 2002) have separated *Salix exigua* and *Salix melanopsis* associations, most *Salix melanopsis* stands are considered synonymous with *Salix exigua* associations by other researchers.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Dinosaur National Monument Inventory Notes: This association is distinguished from other *Salix exigua* associations by the presence of a well-developed, forb-dominated understory. Forb species composition is likely to vary considerably among sites and often include exotics.
Dinosaur National Monument Data Sources: This association is described from 2002 field data (2 plots: DINO.0018, DINO.0318).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Bourgeron and Engelking 1994, Cole 1995, Cole 1996, Crawford 2001, Crowe and Clausnitzer 1997, Crowe et al. 2002, Driscoll et al. 1984, Hansen and Hall 2002, Hansen et al. 1995, Holmstead 2001, IDCDC 2005, IDCDC unpubl. data 2002, Jankovsky-Jones et al. 2001, Jones 1992b, Manning and Padgett 1995, NVNHP 2003, Padgett et al. 1988b, Padgett et al. 1989, Western Ecology Working Group n.d.

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	*SALIX (EXIGUA, INTERIOR)* 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 mericanus, 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
Dinosaur National Monument
This association is known to occur on the banks of the Green and Yampa rivers.

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
Dinosaur National Monument
This association occurs on low terraces and abandoned channels of gentle-gradient rivers and streams at elevations below 2000 m. Annual flooding occurs but does not typically scour the site. As a result, soil can be somewhat

developed and soil texture ranges from loamy sand to clay. Organic litter covers most of the nonvegetated surface.

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 feet). 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
Dinosaur National Monument
Salix exigua dominates the tall-shrub canopy with at least 20% cover. *Tamarix ramosissima* may also occur with lesser cover. The herbaceous layer is largely comprised of graminoid species. Species known to occur are *Carex* spp., *Phragmites australis, Phalaris arundinacea, Elymus repens, Agrostis stolonifera, Poa pratensis,* and *Distichlis spicata.* Forbs may be present, often including exotic species, but with lesser cover than the graminoids.

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
Dinosaur National Monument

Stratum	**Species**
Tall shrub/sapling	*Salix exigua*
Herb (field)	*Agrostis stolonifera, Elymus repens*

Globally

Stratum	**Species**
Tall shrub/sapling	*Salix exigua*
Herb (field)	*Pascopyrum smithii, Poa pratensis, Schoenoplectus americanus, Sorghastrum nutans*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Agrostis stolonifera, Elymus repens, Poa pratensis, Tamarix ramosissima

Globally
Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (7-Apr-1998).

CLASSIFICATION COMMENTS
Dinosaur National Monument
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
Dinosaur National Monument Inventory Notes: This association is distinguished from other Salix exigua associations by the presence of a graminoid-dominated understory.
Dinosaur National Monument Data Sources: This association is described from 2002 field data (2 plots: DINO.0025, DINO.0640).
Local Description Authors: J. Thompson, mod. J. Coles
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 Rolfsmeier 2000, Walford et al. 2001, Western Ecology Working Group n.d.

Betula occidentalis / Mesic Graminoids Shrubland
Water Birch / Mesic Graminoids Shrubland

CODE	CEGL002654
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Deciduous shrubland (III.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous shrubland (III.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
FORMATION	Seasonally flooded cold-deciduous shrubland (III.B.2.N.e.)
ALLIANCE	*BETULA OCCIDENTALIS* SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.996) Water Birch Seasonally Flooded Shrubland Alliance
ECOLOGICAL SYSTEM(S):	Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland (CES304.045) Rocky Mountain Subalpine-Montane Riparian Shrubland (CES306.832)
USFWS WETLAND SYSTEM:	Palustrine

CONCEPT SUMMARY
Globally
This shrubland association often occurs as dense bands up to 35 m wide along moderately wide to wide floodplains in mountain valleys of Colorado, Nevada and Utah. Stands also occur in small patches at higher elevations and around seeps and isolated springs on hillslopes away from the valley bottom. These shrublands are characterized by bands of vegetation dominated by *Betula occidentalis* (40-60% canopy cover) but often including *Ribes inerme* and *Salix bebbiana*. This vegetation may extend well way from the channel edge in deep pockets of sandy loam soils. *Alnus incana* may be codominant. *Picea pungens* and *Juniperus scopulorum* may also be present but usually with low cover. Stands with a dense shrub layer may have a limited (<10%) but diverse herbaceous cover. Graminoids

typically dominate the herbaceous layer where the most abundant species usually include *Carex pellita , Carex deweyana*, or *Carex nebrascensis*. *Deschampsia caespitosa* and *Carex utriculata* are often present as well. Forb cover often includes *Achillea millefolium, Cardamine cordifolia, Heracleum maximum, Maianthemum stellatum,* and *Vicia americana*. Scouring rushes (*Equisetum* spp.) may also have significant cover. The introduced grasses *Agrostis stolonifera* and *Poa pratensis* may be present in disturbed stands. Diagnostic of this association is the dominance of *Betula occidentalis* in the shrub layer and the dominance of mesic graminoids in the herbaceous layer.

DISTRIBUTION

Dinosaur National Monument

This association is known to occur in Ely Creek and Bull Canyon and is likely to occur in small, narrow, shady side canyons and alcoves throughout the monument.

Globally

This shrubland association often occurs as dense bands along moderately wide to wide floodplains in mountain valleys of Colorado, Nevada, and Utah.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs in wet situations along streams in narrow side canyons at elevations around 1600 m. Soils are sandy alluvium. Leaf litter constitutes the majority of the nonvegetated ground cover.

Globally

This lower montane riparian shrubland association is found in mountain valleys and canyons in Colorado, Nevada and probably Utah, from 1600-2530 m (5250-8300 feet) elevation. Streams were classified as wide, meandering, and cobble-bottomed (Rosgen's Channel Type: C3) (Rosgen 1996, Kittel et al. 1999b). Stands often occur as dense bands up to 35 m wide along streams in moderately wide to wide floodplains. Sites are often floodplains, stream terraces and benches, but it may also occur in smaller patches around seeps and isolated springs on hillslopes to 35 m away from the valley bottom (Manning and Padgett 1995). Substrates are relatively deep, organic or more commonly moderately well-drained to poorly drained mineral soils. Soil textures range from sandy loam to clay loam with signs of mottling within the top 30 cm (12 inches), and soils are saturated all or most of the growing season (Manning and Padgett 1995, Kittel et al. 1999b, Carsey et al. 2003a, 2003b).

VEGETATION DESCRIPTION

Dinosaur National Monument

The *Betula occidentalis* tall-shrub canopy provides 30 to 60% cover and is between 2 and 5 m high. *Salix exigua* is a common secondary shrub, usually with less cover. *Rosa woodsii* and *Rhus trilobata* may occur with low cover. Herbaceous cover is significant (70 to 80%) and characterized by a diversity of mesic species. Dominant species documented include *Agrostis gigantea, Equisetum arvense, Equisetum laevigatum, Equisetum hyemale*, and *Eleocharis palustris*.

Globally

These shrublands are characterized by bands of vegetation along streams that are dominated by *Betula occidentalis* (40-60% canopy cover) with a lush mesic graminoid understory. Other shrubs present often include *Acer glabrum, Ribes inerme, Rosa woodsii, Rhus trilobata, Salix bebbiana, Salix exigua,* or *Salix lutea. Alnus incana* may be codominant. *Picea pungens, Populus angustifolia,* and *Juniperus scopulorum* may also be present but usually with low cover. Stands with a dense shrub layer may have a limited (<10%) but diverse herbaceous cover. Graminoids typically dominate the herbaceous layer where the most abundant species usually include *Agrostis gigantea, Carex pellita, Carex deweyana*, or *Carex nebrascensis. Calamagrostis canadensis, Carex utriculata, Deschampsia caespitosa, Eleocharis palustris*, and *Glyceria striata* are often present as well. Forb cover is typically low. *Achillea millefolium, Cardamine cordifolia, Heracleum maximum, Maianthemum stellatum, Mimulus guttatus, Rudbeckia laciniata*, and *Vicia americana* are common associates (Manning and Padgett 1997, Kittel et al. 1999b, Carsey et al. 2003a, 2003b). Scouring rushes (*Equisetum arvense, Equisetum laevigatum, Equisetum hyemale*) may also have significant cover. The introduced grasses and forbs *Agrostis stolonifera, Phleum pratense, Poa pratensis*, and *Taraxacum officinale* are common in disturbed stands. Large, near-pristine stands are rare.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Tall shrub/sapling	*Betula occidentalis*
Herb (field)	*Agrostis gigantea, Eleocharis palustris*
Herb (field)	*Equisetum arvense, Equisetum hyemale, Equisetum laevigatum*

Globally

Stratum	Species
Tall shrub/sapling	*Alnus incana* ssp. *tenuifolia, Betula occidentalis*
Herb (field)	*Calamagrostis canadensis, Carex deweyana, Carex nebrascensis, Carex pellita, Carex utriculata*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Dactylis glomerata, Epipactis gigantea, Platanthera zothecina, Poa pratensis

Globally
Agrostis stolonifera, Phleum pratense, Poa pratensis, Taraxacum officinale

CONSERVATION STATUS RANK
Global Rank & Reasons: G3 (30-Dec-2000). Although the association occurs across a large distributional range, it remains threatened by improper livestock grazing, streamflow alterations, heavy recreational use, and invasion by exotics. Only 10 stands have been documented in Colorado, with 10-20 more estimated to occur. Few high-quality sites exist in Colorado. The number and condition of occurrences in Nevada and Utah are unknown, but most low- to moderate-elevation riparian areas have been damaged by the same impacts as those in Colorado.

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
This plant association has been documented in Nevada, Colorado and Utah. It occurs at slightly lower elevations and on lower-gradient stream reaches than *Alnus incana*. Presence of coniferous trees in the canopy of some stands may indicate that the stand will become a tree-dominated type. It occupies wetter sites than *Betula occidentalis / Maianthemum stellatum* Shrubland (CEGL001162).

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: In the field, this association can be differentiated from *Betula occidentalis* Shrubland (CEGL001080) by the dominance of mesic graminoid species in the understory.
Dinosaur National Monument Data Sources: This association is described from 2002 field data (2 plots: DINO.0202, DINO.0237).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: A.E. Black, mod. K.A. Schulz and J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Carsey et al. 2003a, Carsey et al. 2003b, Hall and Hansen 1997, Hansen et al. 1995, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1999a, Kittel et al. 1999b, Manning and Padgett 1995, NVNHP 2003, Padgett et al. 1989, Richard et al. 1996, Rosgen 1996, Western Ecology Working Group n.d.

Betula occidentalis Shrubland
Water Birch Shrubland

CODE	CEGL001080
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Deciduous shrubland (III.B.)
PHYSIOGNOMIC GROUP	Cold-deciduous shrubland (III.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)

FORMATION	Seasonally flooded cold-deciduous shrubland (III.B.2.N.e.)
ALLIANCE	*BETULA OCCIDENTALIS* SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.996) 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 streambank. 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 that is 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

Dinosaur National Monument

This association is known from Sage Creek and likely to occur along other small, permanent streams in tributary canyons of the Yampa and Green rivers.

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

Dinosaur National Monument

This association occupies alluvial terraces of gentle- to moderate-gradient streams at elevations below 2000 m. The substrate is alluvium and the soil texture is silty loam. Nonvegetated ground cover is primarily leaf litter.

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 feet). Stands also occur along small floodplains of steep-gradient, narrow streams where the valley sideslope meets the stream edge. In high-gradient situations, the community often occurs as narrow, linear stringers where Betula occidentalis forms a closed canopy crowding the streambank. Broader stands occur around seeps adjacent to the stream channel, or along isolated springs on hillslopes away from the valley bottom, and on the floodplains of low-gradient streams. Surface water is present for extended periods during the growing season. After flooding ceases, the water table is variable and ranges from nearly saturated to well below the ground surface.

Soils are fairly shallow, ranging from 30 cm to greater than 60 cm, often overlying river cobbles. Most soils have a surface layer of 50-90% organic matter. Subsurface layers range from loam to sand with abundant gravel throughout the profile (Hansen et al. 1995). Skeletal layers, derived from alluvium, occur at a greater depth. In the northern

range of Yellowstone National Park, soils typically have a large ash component. Stands along narrow, steep stream channels occur between large alluvial and colluvial boulders and have almost no soil development.

VEGETATION DESCRIPTION

Dinosaur National Monument

Betula occidentalis forms a canopy 5 to 7 m tall with 80% cover. The short-shrub layer is up to 2 m high with 10 to 15% total cover and includes *Prunus virginiana* var. *melanocarpa* and *Rhus trilobata*. The herbaceous layer has 10 to 15% cover and is dominated by *Lupinus* spp. Other herbaceous species present with minimal cover include *Toxicodendron rydbergii*, *Equisetum arvense, Maianthemum stellatum, Clematis ligusticifolia,* and *Poa pratensis*.

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

Dinosaur National Monument

Stratum	**Species**
Tall shrub/sapling	*Betula occidentalis*

Globally

Stratum	**Species**
Tall shrub/sapling	*Betula occidentalis*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Poa pratensis

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 streambanks, floodplains, islands, and alluvial terraces in western and central Montana, northern Wyoming, and central and southern Idaho. It occurs in low-gradient situations in canyon bottoms in the Colorado Plateau of Utah and Colorado. Discontinuous linear stands are present between 915 and 1920 m (3000-6300 feet) elevation on various aspects where the water table is high and soils are of clay, silt or loam. Stand degradation is increasing as a result of threats such as alteration of stream hydrology due to the deposits of excess sedimentation from outside the stream system, road construction, livestock grazing and trailing, introduction of exotic species, and noxious weeds. However, this type is widespread in distribution and is defined to include disturbed stands, so its conservation status is unlikely to be rare.

CLASSIFICATION COMMENTS

Dinosaur National Monument
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
Dinosaur National Monument Inventory Notes: This vegetation association is based on one plot; as a result, there is likely to be more variation in this association at Dinosaur National Monument than is captured by this description. A canopy of *Betula occidentalis* shrubs is always present, but other species will vary.
Dinosaur National Monument Data Sources: This association is described from 2002 field data (1 plot: DINO.0324).
Local Description Authors: J. Thompson, mod. J. Coles
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 / Achnatherum hymenoides Shrubland
Spiny Hopsage / Indian Ricegrass Shrubland

CODE	CEGL001350
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	*GRAYIA SPINOSA* SHRUBLAND ALLIANCE (A.1038) Spiny Hopsage Shrubland Alliance
ECOLOGICAL SYSTEM(S):	Great Basin Xeric Mixed Sagebrush Shrubland (CES304.774) Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This unusual shrubland association is known from isolated occurrences in northwestern Colorado and is reported from northern Nevada, Wyoming and southeastern Oregon. It is likely also to occur in eastern California. It occurs on level to gently sloping benches, partly stabilized dunes and terraces. Elevations range from 1600 to 1800 m (5250-5900 feet). Soils are deep, well-drained, alkaline sandy loams or loamy sands derived from underlying bedrock or eolian sands. Soil lichens, mosses and litter may have significant cover, especially in areas that have not been grazed in recent decades. The vegetation is characterized by the co-occurrence of *Grayia spinosa, Sarcobatus vermiculatus*, and *Artemisia tridentata* ssp. *wyomingensis*, although in some stands either *Artemisia* or *Sarcobatus* may be missing. Total shrub cover is typically 30% or less. Other shrubs may occasionally be present with low cover, including *Chrysothamnus viscidiflorus, Atriplex confertifolia*, and *Ephedra* spp. Commonly associated species in the herbaceous layer include native grasses *Achnatherum hymenoides, Distichlis spicata, Hesperostipa comata, Poa secunda*, and the exotic annual grass *Bromus tectorum*. Forbs are absent to sparse in cover and

inconsistent in composition. Total herbaceous cover is typically less than 10%, with no single species except *Bromus tectorum* regularly exceeding 5% cover. Scattered juniper are occasionally present.

DISTRIBUTION

Dinosaur National Monument
This association is only known from Conway Ridge and Brown's Park in the northern reaches of the monument.

Globally
This association is known from isolated occurrences in northwestern Colorado and is reported from northern Nevada, Wyoming and southeastern Oregon. It is likely to also occur in eastern California.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument
This association occurs on level to gently sloping benches and terraces east of the Gates of Lodore. Elevations range from 1600 to 1800 m. Soils are deep, rapidly drained, alkaline sandy loams derived from Brown's Park Formation. Soil lichens and moss often have significant cover, especially in areas that have not been grazed in recent decades.

Globally
This association occurs on level to gently sloping benches, partly stabilized dunes and terraces. Elevations range from 1600 to 1800 m (5250-5900 feet). Soils are deep, well-drained, alkaline sandy loams or loamy sands derived from underlying bedrock or eolian sands. Soil lichens, mosses and litter may have significant cover, especially in areas that have not been grazed in recent decades.

VEGETATION DESCRIPTION

Dinosaur National Monument
This association is characterized by the co-occurrence of the three shrubs *Grayia spinosa, Sarcobatus vermiculatus,* and *Artemisia tridentata* ssp. *wyomingensis*. Total shrub cover is typically 30% or less. Commonly associated herbaceous species include *Achnatherum hymenoides, Hesperostipa comata,* and the exotic annual grass *Bromus tectorum*. Forbs are absent to sparse in cover. Total herbaceous cover is typically less than 10%.

Globally
This association is characterized by the co-occurrence of *Grayia spinosa, Sarcobatus vermiculatus*, and *Artemisia tridentata* ssp. *wyomingensis*, although in some stands either *Artemisia* or *Sarcobatus* may be missing. Total shrub cover is typically 30% or less. Other shrubs occasionally present with low cover may include *Chrysothamnus viscidiflorus, Atriplex confertifolia*, and *Ephedra* spp. Commonly herbaceous associates include native grasses *Achnatherum hymenoides, Distichlis spicata, Hesperostipa comata, Poa secunda*, and the exotic grass *Bromus tectorum*. A variety of forbs provide sparse cover. Total herbaceous cover is typically less than 10%, with no single species except *Bromus tectorum* regularly exceeding 5% cover. Scattered juniper are occasionally present.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Grayia spinosa, Sarcobatus vermiculatus*
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Achnatherum hymenoides, Bromus tectorum, Sporobolus cryptandrus*

Globally

Stratum	**Species**
Short shrub/sapling	*Grayia spinosa, Sarcobatus vermiculatus*
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Achnatherum hymenoides*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Bromus tectorum

Globally
Bromus tectorum

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

CLASSIFICATION COMMENTS
Dinosaur National Monument

Globally
This association is characterized by *Grayia spinosa* as a dominant or codominant in the shrub layer and *Achnatherum hymenoides* as a dominant or codominant in the herbaceous layer. *Artemisia tridentata* and *Sarcobatus vermiculatus* are often also present.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This type is limited to level benches of Brown's Park Formation in the vicinity of the Gates of Lodore. It continues onto BLM lands east of the monument into adjacent parts of the Vermilion Creek drainage. It is easy to distinguish from sagebrush shrublands or sagebrush-black greasewood shrublands by the presence of Grayia spinosa. The three dominant shrubs in this community are not always evenly distributed, but in small stands any may dominate.
Dinosaur National Monument Data Sources: This description is based on 2002 and 2004 field data (3 plots: DINO.0817, DINO.0818, DINO.0829, and 2 observation points: DINO.9045, DINO.9049).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Blackburn et al. 1968a, Bourgeron and Engelking 1994, Copeland 1979, Driscoll et al. 1984, Kagan et al. 2000, NVNHP 2003, 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	*SARCOBATUS VERMICULATUS* 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
Dinosaur National Monument
This association is known from many lower elevation regions of the monument, including Cub Creek, Walt Hollow,

Twelvemile Gulch, and the Gates of Lodore.

Globally
Data are not available.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association occupies broad, level, abandoned stream channels, alluvial plains or valley floors at elevations ranging from 1500 to 1800 m. Soils are silty or sandy loams. Organic litter and bare soil are approximately equal in ground cover percentages.

Globally
This minor shrub association occurs on stream terraces, alluvial fans, floodplains, toeslopes 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 up to 60% cover.

VEGETATION DESCRIPTION
Dinosaur National Monument
Extensive stands of Sarcobatus vermiculatus and *Artemisia tridentata* (ssp. *tridentata*, ssp. *wyomingensis*) codominate this shrubland association, totaling 20 to 50% cover. *Atriplex confertifolia* is typically associated and has low cover. Exotic annual grass *Bromus tectorum* often dominates the herbaceous layer. Other herbaceous species are inconsistent and have minimal 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 crassisepala, Descurainia pinnata*, and *Salsola tragus*. Scattered *Juniperus osteosperma* may be present in some stands.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Sarcobatus vermiculatus*
Short shrub/sapling	*Artemisia tridentata* ssp. *tridentata, Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Bromus tectorum*

Globally

Stratum	**Species**
Short shrub/sapling	*Sarcobatus vermiculatus*
Short shrub/sapling	*Artemisia tridentata* ssp. *tridentata, Artemisia tridentata* ssp. *wyomingensis*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Data are not available.

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

CLASSIFICATION COMMENTS
Dinosaur National Monument

Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Data are not available.
Dinosaur National Monument Data Sources: The description is based on 2002 and 2003 field data (3 plots: DINO.0158, DINO.0163, DINO.0619, and 3 observation points: DINO.9113, DINO.9431, DINO.9813).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, Lesica and DeVelice 1992, MTNHP 2002b

Sarcobatus vermiculatus / Atriplex gardneri Shrubland
Black Greasewood / Gardner's Saltbush Shrubland

CODE	CEGL001360
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	*SARCOBATUS VERMICULATUS* 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) Western Great Plains Badlands (CES303.663) Inter-Mountain Basins Playa (CES304.786)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY
Globally
This "badlands" association is reported from western Colorado, eastern Montana, Big Horn Basin in north-central Wyoming, and northeastern Utah. Stands occur on all aspects of moderately steep to steep eroded slopes or on toeslopes composed of clay or shale sediments. Substrates are fine-textured, alkaline and saline, have low permeability, and are composed of acid shale, bentonite, or some other highly erodible material. Bare ground and gravel make up the majority (80%) of the ground surface. The vegetation is characterized by a sparse to moderately dense (20-40% cover) woody layer codominated by the short shrub *Sarcobatus vermiculatus* and the dwarf-shrub *Atriplex gardneri*. Other shrubs and dwarf-shrubs include scattered *Artemisia tridentata, Picrothamnus desertorum, Atriplex confertifolia, Ericameria nauseosa, Gutierrezia sarothrae, Suaeda calceoliformis*, and *Suaeda moquinii*. The graminoid layer, if present, is sparse and may include *Poa secunda, Achnatherum hymenoides, Elymus elymoides*, and the introduced annual *Bromus tectorum*. The forb layer is highly variable in cover and composition because much of it is annual, such as *Endolepis dioica* and *Lappula squarrosa*. Common perennial forbs include *Iva axillaris, Machaeranthera canescens*, and *Allium textile*.

DISTRIBUTION
Dinosaur National Monument
This association is known from barren Mancos shale flats north of the Yampa River in Deerlodge Park at the eastern end of the monument.

Globally
This shrubland association occurs in Colorado, eastern Montana, Big Horn Basin in north-central Wyoming, and northeastern Utah.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs in small stands where runoff from surrounding Mancos shale hills collects and evaporates, leaving a white alkaline crust. Elevation of the single sample is 1700 m. Soils have a clay texture.

Globally

This "badlands" association is reported from lower to middle elevations. Stands occur on all aspects of level to moderately steep to steep eroded slopes or toeslopes or evaporational depressions eroded in clay or shale sediments. Substrates are fine-textured, alkaline and saline, have low permeability, and are derived from marine shale, bentonite, or other highly erodible material. Bare ground and gravel make up the majority (80% or more) of the ground surface, which may also have a white crust from the evaporation of saline soil water.

VEGETATION DESCRIPTION

Dinosaur National Monument

This sparse shrubland association is dominated by the short shrub *Sarcobatus vermiculatus* and the dwarf-shrub *Atriplex gardneri*. Total vegetation cover is less than 15%. Herbaceous species other than the exotic forb *Halogeton glomeratus* occur only with trace cover.

Globally

The vegetation in this association is characterized by a sparse to moderately dense (less than 15 to 40% cover) woody layer codominated by the short shrub *Sarcobatus vermiculatus* and the dwarf-shrub *Atriplex gardneri*. Other shrubs and dwarf-shrubs include scattered *Artemisia tridentata, Picrothamnus desertorum, Atriplex confertifolia, Ericameria nauseosa, Gutierrezia sarothrae, Suaeda calceoliformis*, and *Suaeda moquinii*. The graminoid layer, if present, is sparse and may include *Poa secunda, Achnatherum hymenoides, Elymus elymoides*, and the introduced annual *Bromus tectorum*. The forb layer is highly variable in cover and composition because much of it is annual, such as *Endolepis dioica* and *Lappula squarrosa*. Common perennial forbs include *Iva axillaris, Machaeranthera canescens,* and *Allium textile*. The exotic species *Halogeton glomeratus* may be abundant in disturbed stands.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Sarcobatus vermiculatus*
Herb (field)	*Atriplex gardneri*

Globally

Stratum	**Species**
Short shrub/sapling	*Sarcobatus vermiculatus*
Short shrub/sapling	*Atriplex gardneri, Gutierrezia sarothrae*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Halogeton glomeratus

Globally
Halogeton glomeratus

CONSERVATION STATUS RANK

Global Rank & Reasons: G4? (1-Feb-1996).

CLASSIFICATION COMMENTS

Dinosaur National Monument

Data are not available.

Globally

This type should be compared to *Sarcobatus vermiculatus / Pseudoroegneria spicata* Shrubland (CEGL001367). The two types may be synonymous since they occupy the same badlands slope habitat.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is uncommon in the monument and is apparently limited to evaporation depressions on the Yampa River floodplain.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (1 plot: DINO.0601).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: K.A. Schulz, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, Branson et al. 1976, DeVelice and Lesica 1993, DeVelice et al. 1991, DeVelice et al. 1995, Driscoll et al. 1984, Hamner 1964, Jones 1992b, MTNHP 2002b, Medicine Bow Mine Application n.d., Sweetwater Uranium Project 1978, Ungar et al. 1969, Von Loh 2000

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	*SARCOBATUS VERMICULATUS* 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 feet) 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. l*anceolatus*, and *Distichlis spicata*. Forbs generally contribute little cover, although several weedy or exotic forbs may be abundant.

DISTRIBUTION
Dinosaur National Monument
This association is known from the Dinosaur Quarry area and may occur on terraces of the Green and Yampa rivers.

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
Dinosaur National Monument
This association occupies low-elevation alluvial terraces and swales of broad river valleys. It is intermittently flooded, somewhat rapidly drained, and typically occurs above a high water table. Soils are fine-textured clays and mostly covered by organic litter.

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 feet) 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
Dinosaur National
Monument *Sarcobatus vermiculatus* dominates this association with at least 10% cover. Other shrubs known to be present are *Ericameria nauseosa, Artemisia tridentata* ssp. *wyomingensis,* and *Atriplex confertifolia*. In the herbaceous layer, *Distichlis spicata* has sparse to dense cover and may codominate with *Sporobolus airoides* and *Bromus tectorum*. Forbs are sparse to absent.

Globally
Sarcobatus vermiculatus dominates the shrub layer with between 10 and 50% cover. Other shrubs present 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* and usually a number of other species, including *Pascopyrum smithii, Hordeum jubatum, Bouteloua gracilis, Elymus elymoides, Elymus lanceolatus* ssp. *lanceolatus,* and *Distichlis spicata*. Forbs generally contribute little cover, although weedy or exotic forbs may be abundant.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Ericameria nauseosa, Sarcobatus vermiculatus*
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Distichlis spicata, Sporobolus airoides*

Globally

Stratum	**Species**
Short shrub/sapling	*Sarcobatus vermiculatus*
Herb (field)	*Sporobolus airoides*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

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
Dinosaur National Monument
Data are not available.

Globally
This association was renamed to a shrubland association and 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

Dinosaur National Monument Inventory Notes: This is a rare association within the monument, occurring in small, scattered patches, often in a mosaic of other greasewood associations.
Dinosaur National Monument Data Sources: This association is described from 2002 field data (1 plot: DINO.0656 and 1 observation point: DINO.9157).
Local Description Authors: J. Thompson, mod. 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	*SARCOBATUS VERMICULATUS* 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, toeslopes 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 conditions of heavy grazing, since the shrub is only moderately palatable and is somewhat poisonous 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

Dinosaur National Monument
This association is documented from the river valleys at Browns Park, Deerlodge Park, Echo Park, Lily Park, Dinosaur Quarry and Rainbow Park sections of the monument. It is distributed regularly in extensive stands on broad, low-elevation alluvial plains throughout the monument.

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
Dinosaur National Monument
This association occurs on alluvial flats, terraces and toeslopes of broad river valleys at elevations below 2000 m. The water table is typically shallow, perched within the deep, fine-textured, saline soils.

Globally
This widespread but patchy shrubland association occurs on terraces, swales, coppice dunes, alluvial fans, valley floors, toeslopes and ridges throughout the Colorado Plateau and Great Basin. Elevations range between 1200 and 2073 m (3940-6800 feet), 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, up to 80%, unless *Bromus tectorum* is a major component of the system, in which case litter cover values are high.

VEGETATION DESCRIPTION
Dinosaur National Monument
Sarcobatus vermiculatus dominates the shrub layer with cover ranging 20 to 40%. *Atriplex canescens, Tetradymia canescens, Artemisia tridentata* ssp. *wyomingensis, Atriplex confertifolia, Ericameria nauseosa,* and *Opuntia* spp. may occur with lesser cover. The herbaceous understory ranges from sparse to moderate. Species composition is variable but often characterized by exotics, including *Bromus tectorum, Alyssum desertorum,* and *Lepidium latifolium.* Perennial native grasses that may occur with low cover *include Pascopyrum smithii, Poa secunda, Poa fendleriana, Elymus lanceolatus, Achnatherum hymenoides, Sporobolus airoides,* and *Hesperostipa comata*.

Globally
This shrubland 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
Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Sarcobatus vermiculatus*
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis, Atriplex canescens*
Herb (field)	*Bromus tectorum*

Globally

Stratum	**Species**
Short shrub/sapling	*Sarcobatus vermiculatus*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum, Halogeton glomeratus, Lepidium latifolium

Globally
Bromus tectorum

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
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
Dinosaur National Monument Inventory Notes: This association is easily distinguished by the lack of *Artemisia tridentata* ssp. *tridentata* in the shrub layer. If an herbaceous layer is present, it is generally dominated by exotic species; where the layer is sparse, native species may be more common.
Dinosaur National Monument Data Sources: This association is described from 2002 and 2003 field data (10 plots: DINO.0026, DINO.0119, DINO.0368, DINO.0122, DINO.0323, DINO.0596, DINO.0657, DINO.0714, DINO.0715, DINO.0717, and 6 observation points: DINO.8412, DINO.9002, DINO.9103, DINO.9109, DINO.9118, DINO.9432.
Local Description Authors: J. Thompson, mod. J. Coles
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 / Hesperostipa comata Dwarf-shrubland
Winter-fat / Needle-and-Thread Dwarf-shrubland

Winter-fat / Needle-and-Thread Dwarf-shrub Prairie

CODE	CEGL001327
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	*KRASCHENINNIKOVIA LANATA* DWARF-SHRUBLAND ALLIANCE (A.1104) Winter-fat Dwarf-shrubland Alliance
ECOLOGICAL SYSTEM(S):	Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784) Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)
USFWS WETLAND SYSTEM:	Palustrine

CONCEPT SUMMARY
Globally
This association is known from the Colorado Plateau in northwestern Colorado and eastern and southeastern Utah and the northwestern Great Plains in northeastern Montana. It has also been reported from Washington and may occur in Saskatchewan. In the Colorado Plateau stands occur on colluvial slopes at around 2000 m elevation and a canyon bottom at 1780 m elevation. Soils are moderately deep and sandy. In northeastern Montana, it is a minor type that occurs on the periphery of badlands and breaks usually on alluvial flats and gently sloping footslopes. Vegetation is characterized by an open to moderate (10-60% cover) dwarf-shrub layer dominated by *Krascheninnikovia lanata* with an open to moderate herbaceous layer dominated by *Hesperostipa comata*. On the Colorado Plateau, other shrubs occurring with minimal cover include *Artemisia tridentata* ssp. *wyomingensis, Chrysothamnus viscidiflorus,* and *Gutierrezia sarothrae*. The herbaceous layer is dominated by *Hesperostipa comata*; other grasses, such as *Bromus tectorum, Poa secunda, Poa fendleriana,* and *Achnatherum hymenoides,* may occur with few forbs. In the northwestern Great Plains, constant associates are *Artemisia frigida, Bouteloua gracilis,* and *Carex filifolia with Atriplex nuttallii, Artemisia tridentata, Gutierrezia sarothrae, Koeleria macrantha,* and *Poa secunda*. Forbs such as *Phlox hoodii, Plantago patagonica,* and *Sphaeralcea coccinea* are inconspicuous and contribute little cover. Introduced species *Bromus japonicus, Bromus tectorum,* and *Melilotus officinalis* are often

present but not abundant.

DISTRIBUTION

Dinosaur National Monument

This association is known from 2 km north of Viva's Cake Hill on the Yampa Bench.

Globally

This association is known from the Colorado Plateau in northwestern Colorado and eastern and southeastern Utah . It has also been reported from northeastern Montana (DeVelice et al. 1991), Utah and Washington, and may occur in Saskatchewan, Canada.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs at the bottom of a southeast-facing colluvial slope at an elevation of 2000 m. Soils are somewhat deep and sandy with a considerable amount of organic litter covering the surface.

Globally

This association is known from the Colorado Plateau in northwestern Colorado and eastern Utah and the northwestern Great Plains in northeastern Montana. It has also been reported from Washington and may occur in Saskatchewan. In the Colorado Plateau, stands occur on colluvial slopes at around 2000 m elevation. Exposed soil covers most of the unvegetated surface with low to moderate litter cover. Biological soil crusts have up to 13% cover. Soils include sandy loam and silty clay loam. In northeastern Montana, it is a minor type that occurs on the periphery of badlands and breaks usually on alluvial flats and gently sloping footslopes.

VEGETATION DESCRIPTION

Dinosaur National Monument

This sparse association is dominated by the dwarf-shrub *Krascheninnikovia lanata* with 10% cover. Other shrubs occurring with minimal cover include *Artemisia tridentata* ssp. *wyomingensis, Chrysothamnus viscidiflorus,* and *Gutierrezia sarothrae*. The herbaceous layer is dominated by *Hesperostipa comata*. Other grasses present include *Bromus tectorum, Poa secunda, Poa fendleriana,* and *Achnatherum hymenoides*. Forbs are inconspicuous.

Globally

This association is characterized by an open to moderately dense (10-60% cover) dwarf-shrub layer dominated by *Krascheninnikovia lanata* with an open to moderate herbaceous layer dominated by *Hesperostipa comata*. On the Colorado Plateau, other shrubs occurring with minimal cover include *Artemisia tridentata* ssp. *wyomingensis, Chrysothamnus viscidiflorus,* and *Gutierrezia sarothrae*. The herbaceous layer is dominated by *Hesperostipa comata*. Other grasses present include *Bromus tectorum, Poa secunda, Poa fendleriana, Bouteloua gracilis,* and *Achnatherum hymenoides* with few forbs such as *Delphinium andersonii, Helianthus annuus, Mentzelia albicaulis, Plantago patagonica, Oenothera albicaulis,* and *Sphaeralcea coccinea*. In the northwestern Great Plains, DeVelice et al. (1995) reported constant associates as *Artemisia frigida, Bouteloua gracilis,* and *Carex filifolia*. Other common taxa include *Atriplex nuttallii, Artemisia tridentata, Gutierrezia sarothrae, Koeleria macrantha, Nassella viridula, Poa secunda,* and *Pseudoroegneria spicata*. Scattered forbs such as *Phlox hoodii, Plantago patagonica,* and *Sphaeralcea coccinea* are typically present and contribute little cover. Introduced species *Bromus japonicus, Bromus tectorum,* and *Melilotus officinalis* are often present but not abundant.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Krascheninnikovia lanata*
Herb (field)	*Bromus tectorum, Hesperostipa comata*

Globally

Stratum	**Species**
Short shrub/sapling	*Krascheninnikovia lanata*
Herb (field)	*Hesperostipa comata*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Bromus tectorum

Globally
Bromus tectorum

CONSERVATION STATUS RANK
Global Rank & Reasons: G3 (1-Feb-1996). This association is reported from small, widely scattered occurrences over a large part of the interior West.

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
This associations is closely related to *Krascheninnikovia lanata / Pleuraphis jamesii* Dwarf-shrubland (CEGL001322) in the Colorado Plateau. DeVelice et al. (1995) suggested a putative *Krascheninnikovia lanata / Pseudoroegneria* spicata plant association the would represent the late-seral stage of this type in the northwestern Great Plains. Stands in the Colorado Plateau and northwestern Great Plains have significant differences in associated species. More data and analysis are needed to determine if they should be classified together.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is uncommon in the monument, and when it does occur, it is likely to be as small stands occurring in a matrix with other shrublands or pinyon-juniper woodlands.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (1 plot: DINO.0633).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, DeVelice et al. 1991, DeVelice et al. 1995, Driscoll et al. 1984, MTNHP 2002b, Western Ecology Working Group n.d.

Krascheninnikovia lanata / Poa secunda Dwarf-shrubland
Winter-fat / Curly Bluegrass Dwarf-shrubland

CODE	CEGL001326
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	*KRASCHENINNIKOVIA LANATA* DWARF-SHRUBLAND ALLIANCE (A.1104) Winter-fat Dwarf-shrubland Alliance
ECOLOGICAL SYSTEM(S):	Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788) Inter-Mountain Basins Playa (CES304.786)
USFWS WETLAND SYSTEM:	Palustrine

CONCEPT SUMMARY
Globally
This dwarf-shrub association is a minor community type in Washington found in Benton, Yakima, Grant and adjacent counties. In Oregon, it occurs only in the northern Basin and Range in Malheur and Harney counties. It is reported from Idaho and is likely to occur in northern Nevada. In Colorado, it occurs on steep colluvial canyon slopes at around 1700 m elevation; otherwise, environmental information is lacking. The association has open vegetation with most of the total cover found in only two lifeforms: dwarf-shrub and shortgrass. *Krascheninnikovia lanata*, less than 1 m tall, dominates these communities contributing 10-50% to total plant cover. Associated dwarf-shrubs include *Eriogonum corymbosum*, *Artemisia frigida*, and *Opuntia polyacantha. Poa secunda* is often the only conspicuous perennial grass, although *Achnatherum hymenoides* is a common associate. Forb species are diverse, weedy, low in cover, and inconsistent among sites, but native recorded species include *Erigeron piperianus,*

Sphaeralcea munroana, and *Helianthus cusickii*. Annuals usually appear in all communities; the exotic grass *Bromus tectorum* is the most abundant annual. *Pseudoroegneria spicata* is absent to <1% cover. Mosses and lichens cover the soil surface in many sites.

DISTRIBUTION

Dinosaur National Monument

This association is known from Thanksgiving Gorge, at the eastern end of the Yampa Bench.

Globally

This association is a minor type in Washington found in Benton, Yakima, Grant and adjacent counties. In Oregon, it is only found in the northern Basin and Range, from two small patches in Malheur County (one in Mendi Gore Playa Proposed Research Natural Area) and a few large patches in Harney County. In Colorado it is known from a single site in the northwestern corner of the state. It is reported in Idaho and is likely to be found in northern Nevada.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs on steep colluvial canyon slopes at around 1700 m elevation. Soils are sandy loams strewn with large rocks.

Globally

This association is a minor community type in Washington found in Benton, Yakima, Grant and adjacent counties. In Oregon, it occurs only in the northern Basin and Range in Malheur and Harney counties. It is reported from Idaho and is likely to occur in northern Nevada. In Colorado, it occurs on steep colluvial canyon slopes at around 1700 m elevation.

VEGETATION DESCRIPTION

Dinosaur National Monument

Low to moderate cover of the dwarf-shrub *Krascheninnikovia lanata* and the perennial bunchgrass *Poa secunda* characterize this association. Other dwarf-shrubs that may be associated include *Eriogonum corymbosum, Artemisia frigida,* and *Opuntia polyacantha*. Grasses have moderate cover. The most common species include *Poa secunda, Pseudoroegneria spicata,* and *Achnatherum hymenoides. Bromus tectorum* is also likely to be present and contribute significant cover. Forb species are diverse, weedy, low in cover, and inconsistent among sites.

Globally

The association has open vegetation with most of the total cover provide by dwarf shrubs and short grasses. *Krascheninnikovia lanata* dominates these communities, contributing 10-50% cover. Associated dwarf-shrubs include *Eriogonum corymbosum, Artemisia frigida,* and *Opuntia polyacantha. Poa secunda* is often the only conspicuous perennial grass, although *Achnatherum hymenoides* is a common associate. Forb species are diverse, weedy, low in cover, and inconsistent among sites, but native recorded species include *Erigeron piperianus, Sphaeralcea munroana,* and *Helianthus cusickii*. Annuals usually appear in all communities; the exotic grass *Bromus tectorum* is the most abundant annual. *Pseudoroegneria spicata* is absent to <1% cover. Mosses and lichens cover the soil surface in many sites.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Krascheninnikovia lanata*
Herb (field)	*Descurainia pinnata*
Herb (field)	*Bromus tectorum, Poa secunda*

Globally

Stratum	**Species**
Short shrub/sapling	*Krascheninnikovia lanata*
Herb (field)	*Poa secunda*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Bromus tectorum, Descurainia pinnata, Lactuca serriola

Globally
Bromus tectorum, Descurainia pinnata

CONSERVATION STATUS RANK
Global Rank & Reasons: G3 (11-Dec-2000). Although this community is widespread, locally it never is very common. It occurs in very hot, dry habitats and provides significant protein for livestock in the winter (hence the common name winter-fat). Cattle have significantly degraded most occurrences. Many remnants in Oregon are included in Research Natural Areas, which provides limited protection from livestock. The number of occurrences is estimated from a single local vegetation classification survey and state heritage program information. This association is also threatened by introduced plants, such as *Bromus tectorum*, and agriculture conversion.

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Although this association was documented only once, it may occur in small stands in the eastern Yampa River corridor.
Dinosaur National Monument Data Sources: This description was based on 2003 field data (1 plot: DINO.1007).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: R.C. Crawford, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, Daubenmire 1970, Driscoll et al. 1984, Kagan et al. 2000, NVNHP 2003, WNHP unpubl. data, 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 hillslopes, 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 that is dominated by the halophytic evergreen 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* are often present.

DISTRIBUTION

Dinosaur National Monument

This association is found in the badlands derived from Mancos or Morrison shales at low elevations. It is best developed in both the east and west extremes of the project area, in Lily Park and Deerlodge Park. Most examples are in the environs, not the monument.

Globally

Shrublands in this association are found on lower hillslopes and alkaline flats on Colorado Plateau portions of northwestern New Mexico, western Colorado and eastern Utah.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occupies moderate to steep slopes of various aspects on Mancos shale badlands at elevations below 1700 m. Soils are rapidly drained, fine-textured, saline clays. The ground cover is primarily barren with some organic litter under the shrub canopy.

Globally

This dwarf-shrubland association is found on lower hillslopes, 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 feet). 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

Dinosaur National Monument

This badland association is characterized by its barren clay soils and sparsely distributed dwarf-shrub *Atriplex corrugata*. Other shrubs and dwarf-shrubs also known to occur are *Atriplex confertifolia, Atriplex gardneri,* and *Krascheninnikovia lanata*. The herbaceous cover ranges from sparse to moderately sparse depending on the aspect of the slope it occupies. North- and east-facing slopes support scattered tufts of the bunch grasses *Achnatherum hymenoides, Poa fendleriana, Poa secunda,* and *Elymus elymoides*. South-facing slopes with intense solar radiation usually lack any herbaceous cover and also have lower cover of woody species.

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 that is 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 because of high erosion on these sites.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**

Short shrub/sapling	*Atriplex corrugata*
Herb (field)	*Achnatherum hymenoides, Poa fendleriana*

Globally

Stratum	**Species**
Short shrub/sapling	*Atriplex corrugata*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Halogeton glomeratus, Malcolmia africana

Globally
Bromus tectorum, Malcolmia africana

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
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 Ibraham 1968, Ibraham 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 an as 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
Dinosaur National Monument Inventory Notes: This association is restricted to a specific environment and is easily found and identified in the field. In cases where Atriplex corrugata is mixed with other dwarf-shrubs, it should be assigned to this community if Atriplex corrugata is dominant or codominant.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (3 plots: DINO.0012, DINO.0174, DINO.0435, and 1 observation point: DINO.9119).
Local Description Authors: J. Thompson, mod. J. Coles
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, Western Ecology Working Group n.d.

Atriplex gardneri Dwarf-shrubland
Gardner's 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 GARDNERI* 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 *Atriplex confertifolia, Atriplex corrugata, Chrysothamnus viscidiflorus, Ephedra torreyana, Eriogonum corymbosum, Gutierrezia sarothrae, Picrothamnus desertorum, Sarcobatus vermiculatus,* and/or *Tetradymia spinosa*. 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 up to 50% of the ground surface. The dominance of *Atriplex gardneri* and the lack of a significant herbaceous layer are diagnostic of this association.

DISTRIBUTION

Dinosaur National Monument

This association is known from an outcrop of Morrison Formation shale along the Sound of Silence Trail at the west end of the monument.

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

Dinosaur National Monument

This association occupies alluvial fans and badlands associated with the Green River at elevations below 1700 m. Slope angles are flat to steep and of various aspects. Soils are highly saline, fine-textured clays. The ground cover is strikingly barren or occasionally gravelly.

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 canyonsides, 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

Dinosaur National Monument

This association is characterized by a sparse cover of *Atriplex gardneri* with few other species and a barren clay substrate. Some species known to be associated are *Picrothamnus desertorum, Poa fendleriana, Achnatherum hymenoides, Elymus elymoides, Platyschkuhria integrifolia,* and *Kochia americana*.

Globally

This association is broadly defined as a dwarf-shrubland 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*, A. corrugata, *Chrysothamnus viscidiflorus, Ephedra torreyana, Eriogonum corymbosum, Gutierrezia sarothrae, Picrothamnus desertorum, Sarcobatus vermiculatus,* and *Tetradymia spinosa*. No herbaceous layer is evident, 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 true herbaceous layer are diagnostic of this association.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	Species
Short shrub/sapling	*Atriplex gardneri*

Globally

Stratum	Species
Short shrub/sapling	*Atriplex gardneri*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G3G5 (23-Feb-1994).

CLASSIFICATION COMMENTS
Dinosaur National Monument

Globally
This association is poorly defined and is only referred to as a "pure, evidently stable stand of saltsage" in Mitchell et al. (1966), who were investigating 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
Dinosaur National Monument Inventory Notes: This association has very restricted environmental requirements and may only occur in small patches in the badlands of the western region of the monument.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (1 plot: DINO.0179).
Local Description Authors: J. Thompson, mod. J. Coles
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

Leymus cinereus - Pascopyrum smithii Herbaceous Vegetation
Great Basin Lyme Grass - Western Wheatgrass Herbaceous Vegetation

Basin Wild Rye / Western Wheatgrass Tallgrass Prairie

CODE	CEGL001483
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	Tall bunch temperate grassland (V.A.5.N.b.)
ALLIANCE	*LEYMUS CINEREUS* HERBACEOUS ALLIANCE (A.1204)

Great Basin Lyme Grass Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Playa (CES304.786)
Inter-Mountain Basins Wash (CES304.781)
Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This unusual tall-grass association occurs in upland swales and broad valley floors in northwestern Colorado, northeastern Utah and northwestern Montana. The known sites are around 884 m (2900 feet) in elevation in Montana and 2310 m (7580 feet) in Colorado. Slopes range from level to gentle and aspect is not important. Soils are somewhat saline or alkaline and fine-textured, being derived from sedimentary rocks such as shale. Litter covers nearly all the unvegetated ground surface. In the few documented sites of this association, *Leymus cinereus* dominates or codominates the herbaceous layer with *Pascopyrum smithii. Puccinellia distans* is also an important species in Montana stands, while in Colorado, *Poa pratensis, Carex occidentalis, Carex praegracilis, Balsamorhiza sagittata, Lupinus argenteus,* and *Phlox longifolia* may have measurable cover. Scattered shrubs may include *Ericameria nauseosa*.

DISTRIBUTION

Dinosaur National Monument

This association is known from the Yampa Plateau near the Island Park Overlook and is likely to occur in small patches across the high plateaus in the monument.

Globally

This association is known from one site in northwestern Colorado and northeastern Utah and is reported to occur at a single site in northwestern Montana near Polson. Additional occurrences are difficult to predict; although the two diagnostic species are broadly distributed throughout the interior western U.S., they rarely seem to occur together as dominants.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occupies a small concave patch on the northerly aspect of a plateau slope above 2000 m elevation. Soil is clay loam and mostly covered with leaf litter.

Globally

This association occurs in upland swales and broad valley floors in northwestern Colorado and northwestern Montana. The known sites are around 884 m (2900 feet) in elevation in Montana and 2310 m (7580 feet) in Colorado. Slopes range from level to gentle and aspect is not important. Soils are somewhat saline or alkaline and fine-textured, being derived from sedimentary rocks such as shale. Litter covers nearly all the unvegetated ground surface.

VEGETATION DESCRIPTION

Dinosaur National Monument

Leymus cinereus dominates the herbaceous layer with 30% cover. *Pascopyrum smithii* has 10% cover. Other species present with minimal cover are *Poa pratensis, Carex occidentalis, Carex praegracilis, Balsamorhiza sagittata, Lupinus argenteus,* and *Phlox longifolia*.

Globally

In this unusual tall-grass association, *Leymus cinereus* dominates or codominates the herbaceous layer with *Pascopyrum smithii. Puccinellia distans* is also an important species in Montana stands, while in Colorado, *Poa pratensis, Carex occidentalis, Carex praegracilis, Balsamorhiza sagittata, Lupinus argenteus,* and *Phlox longifolia* may have measurable cover. Scattered shrubs may include *Ericameria nauseosa*.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Leymus cinereus*

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Poa pratensis

Globally
Poa pratensis

CONSERVATION STATUS RANK
Global Rank & Reasons: G3Q (1-Feb-1996). This association appears to be restricted to small, isolated occurrences.

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This type could be difficult to distinguish from other *Leymus cinereus* associations, but note that the sampled sites are upland rather than valley floor sites.
Dinosaur National Monument Data Sources: This association is described from 2002 field data (1 plot: DINO.0106).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Bourgeron and Engelking 1994, Driscoll et al. 1984, MTNHP 2002b, Mueggler and Stewart 1980, Western Ecology Working Group n.d.

Elymus lanceolatus Herbaceous Vegetation Streamside Wild Rye Herbaceous Vegetation

CODE	CEGL002588
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
FORMATION	Medium-tall sod temperate or subpolar grassland (V.A.5.N.c.)
ALLIANCE	*ELYMUS LANCEOLATUS* HERBACEOUS ALLIANCE (A.1242) Streamside Wild Rye Herbaceous Alliance
ECOLOGICAL SYSTEM(S):	Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824) Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This grassland association occurs on rolling upland terrain in northwestern Colorado, northeastern Utah and southwestern Wyoming. Sites are located on generally level to gentle slopes, and elevations range from 1600 to 2470 m (5250-8100 feet). Aspect is not important in determining this community. Soils are generally well-developed, fine-textured silt loams or clay loams derived from shale or eolian loess, less often from alluvium. Litter or bare soil cover much of the unvegetated ground surface. The vegetation is dominated by the perennial grass Elymus lanceolatus. Other grasses are generally present, usually with much less cover, including *Hesperostipa comata, Poa fendleriana, Poa secunda, Achnatherum hymenoides, Pseudoroegneria spicata*, and *Bromus tectorum*. A variety of forb species may also be present with low to moderate cover. Some of the more consistent species include *Lupinus argenteus, Silene menziesii, Agoseris glauca, Sphaeralcea coccinea*, and *Phlox* spp. Shrubs such as *Amelanchier utahensis* and *Symphoricarpos oreophilus* may occur with minimal cover. Shrubs may provide trace

cover, including *Chrysothamnus viscidiflorus* and *Krascheninnikovia lanata*.

DISTRIBUTION
Dinosaur National Monument
This association is known from Iron Springs Bench and Brown's Park.

Globally
This association is known from northwestern Colorado, northeastern Utah and southwestern Wyoming.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association occupies flat to gentle slopes of valleys, benches, and stream terraces, typically with westerly aspects and elevations ranging from 1600 to 2300 m. Soils are fine-textured clay silt loams and are somewhat developed. The nonvegetated ground cover is primarily organic litter.

Globally
This grassland type occurs on rolling upland terrain in northwestern Colorado, northeastern Utah and southwestern Wyoming. Sites are located on generally level to gentle slopes, and elevations range from 1600 to 2470 m (5250-8100 feet). Aspect is not important in determining this community. Soils are generally well-developed, fine-textured silt loams or clay loams derived from shale or eolian loess, less often from alluvium. Litter or bare soil cover much of the unvegetated ground surface.

VEGETATION DESCRIPTION
Dinosaur National Monument
This herbaceous association is dominated by the perennial grass *Elymus lanceolatus.* Other grasses that occur with lesser cover are *Hesperostipa comata, Poa fendleriana, Achnatherum hymenoides, Pseudoroegneria spicata,* and *Bromus tectorum*. A variety of forb species may also be present with low to moderate cover. Some of the more consistent species include *Lupinus argenteus, Silene menziesii, Agoseris glauca, Sphaeralcea coccinea,* and *Phlox* spp. Shrubs such as *Amelanchier utahensis* and *Symphoricarpos oreophilus* may occur with minimal cover.

Globally
This grassland association is dominated by the perennial grass *Elymus lanceolatus*. Other grasses are generally present, usually with much less cover, including *Hesperostipa comata, Poa fendleriana, Poa secunda, Achnatherum hymenoides, Pseudoroegneria spicata,* and *Bromus tectorum.* A variety of forb species may also be present with low to moderate cover. Some of the more consistently present species include *Lupinus argenteus, Silene menziesii, Agoseris glauca, Sphaeralcea coccinea,* and *Phlox* spp. Shrubs such as *Amelanchier utahensis* and *Symphoricarpos oreophilus* may occur with minimal cover. Shrubs may provide trace cover, including *Chrysothamnus viscidiflorus* and *Krascheninnikovia lanata*.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Herb (field)	*Elymus lanceolatus*

Globally
Data are not available.

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Bromus tectorum

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (7-Apr-2005).

CLASSIFICATION COMMENTS
Dinosaur National Monument

Data are not available.

Globally
Rhizomatous Elymus lanceolatus can easily be confused with the bunchgrass *Pseudoroegneria spicata*, especially in disturbed areas or on steep slopes, where bunches can spread out. It is also difficult to distinguish reliably from the hybrid of the two species, *Elymus albicans*, which is prevalent east of the Continental Divide but which also occurs at Dinosaur National Monument. Further work is necessary to clarify the ranges and habitats of the three grasses so that *Elymus lanceolatus* Herbaceous Vegetation (CEGL002588) can be readily distinguished from *Pseudoroegneria spicata* Herbaceous Vegetation (CEGL001660).

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Rhizomatous Elymus lanceolatus can easily be confused with the bunchgrass *Pseudoroegneria spicata*, especially in disturbed areas or on steep slopes, where bunches can spread out, making this association and *Pseudoroegneria spicata* Herbaceous Vegetation (CEGL001660) difficult to discern. The environmental characteristics and associated vegetation of the two are similar.
Dinosaur National Monument Data Sources: The description is based on 2002 and 2003 field data (4 plots: DINO.0114, DINO.0115, DINO.0193, DINO.0718).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

Elymus repens Semi-natural Herbaceous Vegetation
Creeping Wild Rye Semi-natural Herbaceous Vegetation

CODE	CEGL005868
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
FORMATION	Medium-tall sod temperate or subpolar grassland (V.A.5.N.c.)
ALLIANCE	*ELYMUS REPENS* HERBACEOUS ALLIANCE (A.2658) Creeping Wild Rye Herbaceous Alliance
ECOLOGICAL SYSTEM(S):	Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland (CES306.040) Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821) Rocky Mountain Subalpine-Montane Riparian Shrubland (CES306.832)
USFWS WETLAND SYSTEM:	Not applicable

CONCEPT SUMMARY
Globally
This association occurs on disturbed low-elevation sites, including floodplains, on the east side of Glacier National Park in Montana and in western Colorado. This community develops in response to disturbance and is composed mainly of noxious weeds, exotics and native increaser species. This association was sampled on flat to gently sloping lower slopes, toeslopes and valley bottoms at elevations between 1450 and 1555 m (4750-5100 feet) in Montana and between 1710 and 2285 m (5610-7500 feet) in Colorado. Soils are derived from glacial or fluvial deposits but are variable in soil texture, ranging from moderately well-drained sandy loams to clay loams to poorly drained gravel and rock. Litter dominates the ground surface. This montane, mesic to subhygric herbaceous association has low overall species diversity due to the dominance of *Elymus repens*, an exotic rhizomatous grass. *Elymus repens* is a highly invasive species in mesic areas and tends to exclude other species once established. Overall herbaceous cover ranges from 25-85% with *Elymus repens* clearly dominating this association with 5-80% cover. Other species sometimes present with low cover include *Cerastium arvense, Carex* spp., *Symphyotrichum laeve, Achillea millefolium, Equisetum laevigatum, Iva axillaris, Taraxacum officinale, Poa palustris,* and *Penstemon confertus*.

DISTRIBUTION

Dinosaur National Monument

This association is known from Deerlodge Park at the eastern entrance to the monument on the Yampa River and from Canyon of Lodore on the Green River.

Globally

This association has been documented from stands in northwestern Montana and western Colorado. It is likely to be much more common and widely distributed than the limited data indicate.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

The samples of this association occupy rarely flooded overflow channels on river terraces below 1700 m elevation. The soils are clay loam and covered by a dense mass of organic litter.

Globally

This association is characteristic of disturbed low-elevation sites, including floodplains, in western Colorado and in Glacier National Park, Montana. It is very likely to be more common and widespread than is currently documented. This community develops in response to disturbance and is composed mainly of noxious weeds, exotics and native increaser species. It occurs on flat to gently sloping lower slopes, toeslopes and valley bottoms at elevations between 1450 and 1555 m (4750-5100 feet) in Montana and between 1710 and 2285 m (5610-7500 feet) in Colorado. Soils are derived from glacial or fluvial deposits but are variable in soil texture, ranging from moderately well-drained sandy loams to clay loams to poorly drained gravel and rock. Litter dominates the ground surface.

VEGETATION DESCRIPTION

Dinosaur National Monument

This association is dominated by the exotic invasive perennial *Elymus repens* with 20% cover. Other herbaceous species with significant cover include *Equisetum laevigatum* and *Iva axillaris*. Shrubs and trees are absent.

Globally

This montane, mesic to subhygric herbaceous association has low overall species diversity due to the dominance of *Elymus repens*, an exotic rhizomatous grass. *Elymus repens* is a highly invasive species in mesic areas and tends to exclude other species once established. Overall herbaceous cover ranges from 25-85% with *Elymus repens* clearly dominating this association with 5-80% cover. Other species sometimes present with low cover include *Cerastium arvense, Carex* spp., *Symphyotrichum laeve, Achillea millefolium, Equisetum laevigatum, Iva axillaris, Taraxacum officinale, Poa palustris,* and *Penstemon confertus*.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Herb (field)	*Apocynum cannabinum*
Herb (field)	*Elymus repens*
Herb (field)	*Equisetum laevigatum*

Globally

Stratum	Species
Herb (field)	*Elymus repens*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Cirsium arvense, Elymus repens

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (invasive) (4-Feb-2004).

CLASSIFICATION COMMENTS

Dinosaur National Monument
Data are not available.

Globally
Identification of this association is usually unequivocal as *Elymus repens* tends to form dense monocultures exclusive of most other species.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association occupies small patches on terraces within a mosaic of other riparian communities. It usually occupies low spots on the terrace that are too wet to support woody vegetation but not wet enough to support *Eleocharis, Spartina,* or *Schoenoplectus* associations.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (1 plot: DINO.0603, 1 observation point: DINO.9016).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Beetle 1955, Gross and Werner 1982, Western Ecology Working Group n.d.

Pascopyrum smithii Herbaceous Vegetation
Western Wheatgrass Herbaceous Vegetation

Western Wheatgrass Mixedgrass Prairie

CODE	CEGL001577
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
FORMATION	Medium-tall sod temperate or subpolar grassland (V.A.5.N.c.)
ALLIANCE	*PASCOPYRUM SMITHII* HERBACEOUS ALLIANCE (A.1232) Western Wheatgrass Herbaceous Alliance
ECOLOGICAL SYSTEM(S):	Central Mixedgrass Prairie (CES303.659) Northwestern Great Plains Mixedgrass Prairie (CES303.674) Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824) Inter-Mountain Basins Semi-Desert Grassland (CES304.787)
USFWS WETLAND SYSTEM:	Palustrine

CONCEPT SUMMARY
Globally
This midgrass prairie type is found in the northern and western Great Plains, Rocky Mountains, the interior western United States and Canada. Stands occur on level to gently sloping terrain. They are found on alluvial fans, swales, river terraces, floodplains, valley floors and basins. The soils are typically clay, clay loam, and silt loam. Pascopyrum smithii strongly dominates the moderate to dense (40-100% cover) mixedgrass herbaceous canopy that grows 0.5-1 m tall. Other graminoids that co-occur and may achieve local dominance are *Koeleria macrantha, Eleocharis palustris*, and *Poa* spp. Many other species common in midgrass prairies are also found in this community. These include *Artemisia ludoviciana, Eriogonum* spp., *Bouteloua gracilis, Nassella viridula,* and *Hesperostipa comata*. Shrubs and dwarf-shrubs are rare in this community, but occasional woody plants, such as *Artemisia tridentata, Symphoricarpos* spp., *Ericameria nauseosa,* or *Krascheninnikovia lanata,* may be present. Introduced species, such as *Bromus tectorum, Bromus inermis, Poa pratensis, Melilotus* spp. or *Cirsium arvense,* are common in some stands, especially where disturbed.

DISTRIBUTION
Dinosaur National Monument
This association is known from Island Park Overlook, Iron Mine Ridge, Zenobia Basin and Plug Hat Rock of the monument's plateau and mountainous regions. It also occurs in Rainbow Park near the Green River.

Globally
This midgrass prairie type is found in the northern and western Great Plains, Rocky Mountains, intermountain western United States and Canada, ranging from North Dakota and Saskatchewan, south to Nebraska and Colorado, and west to northern Arizona, Utah and Idaho.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association generally occurs in swales and on gentle slopes of high-elevation plateaus above 2000 m. It is also known to occur at lower elevations on the river valley floors. All plot samples are scattered with charred tree and shrub stumps, implying previous fire disturbance in the area. Soils are silty or clayey in texture, somewhat developed, and partially covered with organic litter.

Globally
This grassland association is widespread in the northern and western Great Plains of the U.S. and Canada, Rocky Mountains and the intermountain western United States. Elevation ranges from 600-3000 m. Stands occur on level to gently sloping terrain. They are found on alluvial fans, swales, river terraces, floodplains, valley bottoms and basins. The soils are deep (40-100 cm) and well-developed with clay, clay loam, and silt loam textures and may be slightly alkaline. Some stands occur on perched water tables.

VEGETATION DESCRIPTION
Dinosaur National Monument
This herbaceous vegetation association is strongly dominated by *Pascopyrum smithii*, with cover ranging between 20 and 50%. Other herbaceous species typically present with lesser cover include *Lupinus argenteus, Balsamorhiza sagittata, Eriogonum umbellatum, Achnatherum lettermanii, Poa fendleriana,* and *Hesperostipa comata*. Shrubs and trees are absent or sparsely distributed.

Globally
This association is characterized by a moderate to dense (30-100% cover) mixedgrass herbaceous canopy that grows 0.5-1 m tall and is strongly dominated by *Pascopyrum smithii*. Herbaceous cover may be significantly less on drier sites or after low cool-season precipitation. Other graminoids that co-occur and may achieve local dominance are *Koeleria macrantha, Eleocharis palustris*, and *Poa* spp. Many other species common in midgrass prairies are also found in this community. These include *Artemisia frigida, Artemisia ludoviciana, Achillea* sp., *Carex* spp., *Eriogonum* spp., *Bouteloua gracilis, Nassella viridula*, and *Hesperostipa comata*. Shrubs and dwarf-shrubs are rare in this community, but occasional woody plants, such as *Symphoricarpos* spp., *Ericameria nauseosa*, or *Krascheninnikovia lanata,* may be present. Introduced species, such as *Bromus tectorum, Bromus inermis, Poa pratensis, Melilotus* spp., *Cirsium arvense, Taraxacum officinale,* or *Salsola kali,* are common in some stands, especially where disturbed.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Herb (field)	*Pascopyrum smithii*

Globally

Stratum	**Species**
Herb (field)	*Pascopyrum smithii*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G3G5Q (1-Feb-1996).

CLASSIFICATION COMMENTS

Dinosaur National Monument
Data are not available.

Globally
This community is similar to several others that are dominated or codominated by *Pascopyrum smithii*. As currently defined, it represents a western Great Plains and foothills version of the western wheatgrass types in the central Great Plains. Further work needs to be done to refine the differences in composition and environmental characteristics. See recent descriptions by Thilenius et al. (1995) (*Pascopyrum smithii* sodgrass steppe, a more playa-like wheatgrass type) and by Steinauer and Rolfsmeier (2000). In Nebraska, Steinauer and Rolfsmeier (2000) suggest that their stands may resemble *Pascopyrum smithii - Nassella viridula* Herbaceous Vegetation (CEGL001583). In Alberta, this association is clearly dominated by dense, nearly pure stands of *Pascopyrum smithii* and tends to occur in depressions in areas of fine-textured saline soils with a hardpan layer. The hardpan holds rain and spring runoff.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association may also occur in narrow patches following swales within unburned sagebrush stands. Because most stands have burned, the list of associated species varies greatly from site to site.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (5 plots: DINO.0103, DINO.0105, DINO.0128, DINO.0251, DINO.0331, 1 observation point: DINO.9137).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Drake, mod. K.A. Schulz and J. Coles

REFERENCES: ANHIC 2005, Aldous and Shantz 1924, Baker 1983c, Baker 1984a, Baker and Kennedy 1985, Bourgeron and Engelking 1994, Bunin 1985, CONHP unpubl. data 2003, Christensen and Welsh 1963, Driscoll et al. 1984, Godfread 1994, Hall and Hansen 1997, Hansen et al. 1991, Hansen et al. 1995, Hansen et al. 2004c, IDCDC 2005, Jones and Walford 1995, MTNHP 2002b, Marr and Buckner 1974, Ramaley 1916b, Ramaley 1919b, Ramaley 1942, Shanks 1977, Soil Conservation Service 1978, Steinauer and Rolfsmeier 2000, Thilenius et al. 1995, Thompson and Hansen 2002, Von Loh 2000, Vujnovic and Bentz 2001, 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	*ACHNATHERUM HYMENOIDES* 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 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, Poliomintha incana, Vanclevea 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

Dinosaur National Monument

This association is known from a high terrace of the Green River below Split Mountain.

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

Dinosaur National Monument

This association occupies a moderately sloping (up to 15 degrees) sandsheet deposited on a Pleistocene terrace of the Green River below Split Mountain. The sites are oriented to the southeast at around 1470 m elevation. Bare soil or litter covers the unvegetated surface. Soils are sandy and are derived from eolian deposits.

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

Dinosaur National Monument

This sparse grassland has a total vegetation cover of around 20 to 25%, dominated by the native bunchgrass *Achnatherum hymenoides* with up to 12% cover. Associated grasses include *Hesperostipa comata, Sporobolus cryptandrus*, and *Bromus tectorum*. No forbs were recorded in the plots, although there were likely to be a few species that thrive on sandy substrates such as *Sphaeralcea* sp. Short shrubs are scattered throughout the community, although their total cover does not exceed 5%; *Atriplex canescens* and *Grayia spinosa* are the most consistent species.

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 is usually quite sparse, rarely exceeding 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 *Vanclevea 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

Dinosaur National Monument

Stratum	**Species**
Herb (field)	*Achnatherum hymenoides, Hesperostipa comata*

Globally

Stratum	**Species**
Herb (field)	*Achnatherum hymenoides*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Bromus tectorum

Globally
Bromus tectorum, Salsola tragus

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (16-Mar-2005).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association occurs as a small island of grass on a plain otherwise dominated by *Artemisia tridentata*, *Tetradymia canescens*, and *Bromus tectorum*.
Dinosaur National Monument Data Sources: This association is described from accuracy assessment data collected in 2005 (2 plots: DINO_AA.A1079, DINO_AA.A1081).
Local Description Authors: J. Coles
Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

Hesperostipa comata - Achnatherum hymenoides Herbaceous Vegetation
Needle-and-Thread - Indian Ricegrass Herbaceous Vegetation

Needle-and-Thread - Indian Ricegrass Mixedgrass Prairie

CODE	CEGL001703
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
FORMATION	Medium-tall bunch temperate or subpolar grassland (V.A.5.N.d.)
ALLIANCE	*HESPEROSTIPA COMATA* BUNCH HERBACEOUS ALLIANCE (A.1270) Needle-and-Thread Bunch Herbaceous Alliance
ECOLOGICAL SYSTEM(S):	Inter-Mountain Basins Semi-Desert Grassland (CES304.787) Western Great Plains Foothill and Piedmont Grassland (CES303.817)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This grassland association has been described from western Colorado, northeastern Utah and south-central Wyoming. Stands develop on benches, plateaus and ridges ranging in elevation from 1550 to 2560 m (5085-8400 feet). The stands recorded in northwestern Colorado resulted from burning sagebrush shrublands on sandy soils. Slopes are gentle to moderately steep and may be oriented to any aspect. Soils tend to be well-drained, deep and sandy, although they may be derived from a variety of sources. The unvegetated ground surface is mostly covered by litter and bare ground. This grassland occurs in small to medium-sized patches, often in sagebrush shrublands that have burned. Total vegetation cover often does not exceed 40% and may be as low as 20%. *Hesperostipa comata* and *Achnatherum hymenoides* codominate the vegetation, and *Pascopyrum smithii* and *Elymus elymoides* are common secondary species. Forbs have moderate diversity but are inconsistent among sites; common species include *Phlox hoodii*, *Eriogonum flavum*, and *Sphaeralcea coccinea*. Scattered shrubs are often present, including

Artemisia tridentata ssp. *wyomingensis, Krascheninnikovia lanata, Gutierrezia sarothrae*, and *Ericameria nauseosa*. Other species sometimes present with low cover include *Cerastium arvense, Carex* spp., *Symphyotrichum laeve, Achillea millefolium, Equisetum laevigatum, Iva axillaris, Taraxacum officinale, Poa palustris*, and *Penstemon confertus*.

DISTRIBUTION

Dinosaur National Monument

This association is known from scattered locations throughout the monument, including Rainbow Park, the Sounds of Silence Trail, and Iron Mine Basin.

Globally

This type has been described from western Colorado, northeastern Utah and the Great Divide Basin of south-central Wyoming. Other basins in south-central and southwestern Wyoming are similar in climate and geology, and this association may well extend over a wide area of the two states.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs in shrubland and woodland openings. Slopes are gentle, aspects tend to be east or southeast, and the terrain tends to be upland benches and plateaus. Elevations range from 1550 to 2200 m. Soils are derived from a variety of substrates and are typically deep, sandy, and rapidly drained.

Globally

This grassland association has been described from western Colorado, northeastern Utah and the Great Divide Basin in south-central Wyoming. Stands develop on benches, plateaus and ridges ranging in elevation from 1550 to 2560 m (5085-8400 feet). Slopes are gentle to moderately steep and may be oriented to any aspect. Soils tend to be well-drained, deep and sandy, although they may be derived from a variety of sources. The unvegetated ground surface is mostly covered by litter and bare ground.

VEGETATION DESCRIPTION

Dinosaur National Monument

The perennial bunch grasses *Hesperostipa comata* and *Achnatherum hymenoides* codominate this association with 10 to 30% total cover. Other grasses and forbs occur but contribute minimal cover. Scattered individuals and patches of *Ericameria nauseosa* and *Artemisia tridentata* ssp. *wyomingensis* may be present, with too little cover to constitute a shrub layer.

Globally

This grassland occurs in small to medium-sized patches, often in sagebrush shrublands that have burned. Total vegetation cover often does not exceed 40% and may be as low as 20%. *Hesperostipa comata* and *Achnatherum hymenoides* codominate the vegetation, and *Pascopyrum smithii* and *Elymus elymoides* are common secondary species. Forbs have moderate diversity but are inconsistent among sites; common species include *Phlox hoodii, Eriogonum flavum*, and *Sphaeralcea coccinea*. Scattered shrubs are often present, including *Artemisia tridentata* ssp. *wyomingensis, Krascheninnikovia lanata, Gutierrezia sarothrae*, and *Ericameria nauseosa*.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Herb (field)	*Achnatherum hymenoides, Hesperostipa comata*

Globally

Stratum	**Species**
Herb (field)	*Achnatherum hymenoides, Hesperostipa comata*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Bromus tectorum

Globally

Bromus tectorum

CONSERVATION STATUS RANK
Global Rank & Reasons: G2? (30-Nov-1998). This type apparently has been described in western Colorado and in the Great Divide Basin of south-central Wyoming. Other basins in south-central and southwestern Wyoming are similar in climate and geology, and this association may well extend over a wide area of the two states. The G2 portion of the rank is based on a limited known range and few known stands. The "?" portion of the rank indicates the strong uncertainty over the distribution of this association and its relationship to *Hesperostipa comata* types named from other areas.

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
This grassland needs to be rechecked against the *Oryzopsis hymenoides - Stipa comata* montane grassland in Baker (1984a), and a thorough comparison is needed between the information on this association and the descriptions of other grassland types in the region. Sparse stands or those with significant *Bouteloua gracilis* may be difficult to separate from Artemisia frigida - (*Bouteloua gracilis, Achnatherum hymenoides, Poa secunda*) - Lichens Rocky Mesa Dwarf-shrubland (CEGL002344). Codominance by *Achnatherum hymenoides* distinguishes this association from *Hesperostipa comata* Great Basin Herbaceous Vegetation (CEGL001705) that is widespread in the Great Basin and Colorado Plateau.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Data are not available.
Dinosaur National Monument Data Sources: This description is derived from 2002 field data (5 plots: DINO.0136, DINO.0138, DINO.0171, DINO.0279, DINO.0290).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: G.P. Jones, mod. J. Coles

REFERENCES: Baker 1984a, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Sweetwater Uranium Project 1978, 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	*HESPEROSTIPA COMATA* 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 hillslopes, knolls and bluffs, mesatops, 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) that is 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

Dinosaur National Monument

This association is known from Iron Mine Basin, Yampa Bench, Pearl Park, Brown's Park, Echo Park, Plug Hat Rock, Jenny Lind Rock, and East and West Cactus Flats.

Globally

This grassland is found in the Colorado Plateau and Great Basin in Colorado and Utah and probably in adjacent states.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs on gentle to moderate slopes on valley floors, plateaus and ridges at elevations ranging from 1550 to 2150 m. Stands occur both as small inclusions within shrublands or woodlands and as extensive grasslands. In most sites, wildfires or prescribed fires have cleared the area of woody vegetation. Soils are typically deep sandy loams or loamy sands but can also be silt loams. Cryptobiotic crust and moss are present at most sites.

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 hillslopes, knolls and bluffs, mesatops, 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

Dinosaur National Monument

This association is characterized by the overwhelming dominance of *Hesperostipa comata*. Sampled stands had between 10 to 40% cover. *Bromus tectorum* may be present with low to moderate cover. Other grass species frequently occurring with low cover include *Achnatherum hymenoides, Sporobolus cryptandrus, Pascopyrum smithii,* and *Koeleria macrantha*. Shrubs and trees, including *Artemisia tridentata* ssp. *wyomingensis* and *Juniperus osteosperma,* may be scattered within stands. *Sphaeralcea coccinea* is a commonly associated forb; otherwise, forbs vary greatly in composition among sites and generally contribute minimal cover.

Globally

This association is characterized by a relatively sparse to moderate herbaceous layer (10-40% cover) that is 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 dracunculus, Artemisia ludoviciana, Balsamorhiza sagittata, Cirsium arizonicum, Cryptantha crassisepala, Hymenopappus filifolius, Machaeranthera canescens, Sphaeralcea coccinea, Vicia americana,* and species of *Antennaria, Astragalus, Eriogonum, Gilia*, and *Lappula*. Scattered shrubs and dwarf-shrubs may present with less than 5% total cover. *Artemisia tridentata* ssp. *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

Dinosaur National Monument

Stratum	Species
Herb (field)	*Hesperostipa comata, Koeleria macrantha, Pascopyrum smithii, Sporobolus cryptandrus*

Globally

Stratum	Species
Herb (field)	*Hesperostipa comata*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Cirsium arizonicum

CONSERVATION STATUS RANK
Global Rank & Reasons: G2G4 (23-Feb-1994).

CLASSIFICATION COMMENTS
Dinosaur National Monument
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
Dinosaur National Monument Inventory Notes: This association is common and widely distributed across the middle elevation plateaus in the monument.
Dinosaur National Monument Data Sources: This description is derived from 2002 and 2003 field data (22 plots: DINO.0195, DINO.0282, DINO.0287, DINO.0326, DINO.0332, DINO.0353, DINO.0355, DINO.0359, DINO.0458, DINO.0466, DINO.0467, DINO.0479, DINO.0480, DINO.0716, DINO.0720, DINO.0832, DINO.1019, DINO.1406, DINO.1414, DINO.1417, DINO.1420, DINO.1424).
Local Description Authors: J. Thompson, mod. J. Coles
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.

Pseudoroegneria spicata - Cushion Plants Herbaceous Vegetation
Bluebunch Wheatgrass - Cushion Plants Herbaceous Vegetation

CODE	CEGL001705
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
FORMATION	Medium-tall bunch temperate or subpolar grassland (V.A.5.N.d.)
ALLIANCE	*HESPEROSTIPA COMATA* BUNCH HERBACEOUS ALLIANCE (A.1270) Needle-and-Thread Bunch Herbaceous Alliance
ECOLOGICAL SYSTEM(S):	Rocky Mountain Alpine Turf (CES306.816) Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This association is found in foothills of southwestern and south-central Montana. It is also known from the high limestone plateaus and ridges of Dinosaur National Monument in northwestern Colorado. In south-central Montana, this type occurs at elevations between 1250 and 1680 m (4100-5500 feet). In southwestern Montana, it has been documented from 2580 m (8450 feet) elevation but is noted in reconnaissance from 2075 to 2685 m (6800-8800

feet) elevation. In Colorado, elevations range from 1650 to 2650 m (5400-8700 feet). This community occurs on moderately deep, rocky and gravelly soils derived from limestone or calcareous sandstone of mesas, ridgetops, plateaus and saddles and the upper slopes of outwash plains. The primary influencing environmental factor is wind; in most examples of this type, wind deflation has produced a gravel-paved surface. This herbaceous type is characterized by the presence of short-statured, compact cushion plants of the genera *Arenaria, Astragalus, Hymenoxys, Phlox, Cryptantha, Stenotus, Heterotheca, Eriogonum*, and in the Bighorn region, *Sphaeromeria capitata. Pseudoroegneria spicata* is present at relatively low canopy cover, although many other species of grasses may also be present. Scattered dwarfed shrubs may be scattered throughout.

DISTRIBUTION

Dinosaur National Monument

This association is known from Douglas Mountain, Limestone Ridge, Zenobia Peak, Martha's Peak, Tanks Peak, and Round Top Mountain.

Globally

This association is found in the Tendoy Mountains in southwestern Montana, the Pryor Mountains and adjacent Bighorn Canyon area in south-central Montana, and in Dinosaur National Monument in northwestern Colorado. It may also occur in the Bighorn Mountains of north-central Wyoming.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occupies windswept ridges, saddles, and mesas at elevations between 1650 and 2650 m. Substrates may be level to steeply sloping. Stands occur on any aspect but are least abundant on east-facing slopes. Soils are silt loams, clay loams or sandy loams and usually are derived from calcareous sources such as the Madison or Round Valley limestones. The soil surface is often covered by a near-pavement of large and small rocks.

Globally

This association is found in the Tendoy Mountains in southwestern Montana and the Pryor Mountains and adjacent Bighorn Canyon area in south-central Montana. It is also known from the high limestone plateaus and ridges of Dinosaur National Monument in northwestern Colorado. In the Pryor Mountains, this type occurs at foothill elevations between 1250 and 1680 m (4100-5500 feet). In the Tendoy Mountains, it has been documented from 2580 m (8450 feet) elevation but is noted in reconnaissance from 2075 to 2685 m (6800-8800 feet) elevation. In Colorado, elevations range from 1650 to 2650 m (5400-8700 feet). This community occurs on moderately deep, rocky and gravelly soils derived from limestone or calcareous sandstone of mesas, ridgetops, plateaus and saddles and the upper slopes of outwash plains. Slopes are moderately steep to steep and may be oriented to any aspect.

VEGETATION DESCRIPTION

Dinosaur National Monument

This herbaceous association is highly diverse and characterized by a mixture of grasses and "cushion" forbs, with a scattering of low-statured shrubs. *Pseudoroegneria spicata* dominates the herbaceous stratum with 3 to 10% cover. Other grasses likely to be present include *Hesperostipa comata, Poa fendleriana, Poa secunda, Koeleria macrantha*, and *Achnatherum hymenoides*. Forb species include *Cryptantha* spp., *Phlox hoodii, Astragalus spatulatus, Stenotus acaulis*, and *Heterotheca villosa*, along with many others. Total herbaceous cover is typically less than 15%. Common shrubs and dwarf-shrubs include *Artemisia tridentata* ssp. *vaseyana, Cercocarpus montanus, Artemisia nova, Artemisia frigida*, and *Gutierrezia sarothrae*.

Globally

At first glance from the distance, this association appears as a barren, windswept ridge. Under closer observation, it is a species-rich, diverse community of grasses and forbs. This herbaceous type is characterized by the presence of short-statured, compact cushion plants in the genera *Arenaria, Astragalus, Hymenoxys, Phlox, Cryptantha, Stenotus, Heterotheca, Eriogonum*, and in the Bighorn region, *Sphaeromeria capitata. Pseudoroegneria spicata* is present at relatively low canopy cover, and other grasses present may include *Hesperostipa comata, Poa fendleriana, Poa secunda, Koeleria macrantha*, and *Achnatherum hymenoides*. Dwarfed shrubs may be scattered throughout the community, including *Artemisia tridentata* ssp. *vaseyana, Krascheninnikovia lanata, Tetradymia canescens, Cercocarpus montanus, Artemisia nova, Artemisia frigida*, and *Gutierrezia sarothrae*.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Short shrub/sapling	*Gutierrezia sarothrae*
Herb (field)	*Astragalus spatulatus, Balsamorhiza sagittata, Erigeron nematophyllus, Eriogonum tumulosum, Heterotheca villosa, Petradoria pumila, Phlox austromontana, Phlox hoodii, Stenotus acaulis, Tetraneuris acaulis*
Herb (field)	*Achnatherum hymenoides, Hesperostipa comata, Koeleria macrantha, Poa fendleriana, Poa secunda, Pseudoroegneria spicata*

Globally

Stratum	Species
Herb (field)	*Astragalus spatulatus, Erigeron nematophyllus, Eriogonum tumulosum, Heterotheca villosa, Petradoria pumila, Phlox austromontana, Phlox hoodii, Stenotus acaulis*
Herb (field)	*Achnatherum hymenoides, Hesperostipa comata, Koeleria macrantha, Poa fendleriana, Poa secunda, Pseudoroegneria spicata*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G3? (28-Dec-1999). This association is known from two geographic areas in Montana; the low hills and outwash plains along the south slope of the Pryor Mountains and Bighorn Canyon in south-central Montana, and the Tendoy Mountains in south-west Montana. This type also is suspected to correlate with an exposed-site, *Pseudoroegneria spicata*-dominated type in western Montana, wherein *Eriogonum ovalifolium* (cushion form) is codominant. This vegetation is naturally found as small landscape patches and may be more extensive than currently known.

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
This type was described by DeVelice and Lesica (1993) as the *Agropyron spicatum* / cushion plant community type, but no clear vegetational parameters were described for the type; in their key this was a default type dropping out at the bottom of the key. To incorporate this type into a comprehensive classification a means of treating the `cushion plant' component would have to be found. It would be a first step to name the various cushion plants that could serve as alternative diagnostic species and also specify what species would not be expected due to severity of these sites.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: At first glance from the distance, this association appears as a barren, windswept ridge. Under close observation, it is a species-rich, diverse community of grasses and forbs.
Dinosaur National Monument Data Sources: This association is described from 2002 and 2003 field data (26 plots: DINO.0205, DINO.0221, DINO.0246, DINO.0260, DINO.0263, DINO.0272, DINO.0277, DINO.0286, DINO.0293, DINO.0302, DINO.0333, DINO.0348, DINO.0365, DINO.0425, DINO.0477, DINO.0549, DINO.0575, DINO.0584, DINO.0684, DINO.0699, DINO.0700, DINO.0710, DINO.0908, DINO.0915, DINO.1010, DINO.1400).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: C. Jean, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, Cooper et al. 1999, DeVelice and Lesica 1993, Driscoll et al. 1984, MTNHP 2002b, Western Ecology Working Group n.d.

Pseudoroegneria spicata Herbaceous Vegetation
Bluebunch Wheatgrass Herbaceous Vegetation

CODE	CEGL001660
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	*PSEUDOROEGNERIA SPICATA* HERBACEOUS ALLIANCE (A.1265) Bluebunch Wheatgrass Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Western Great Plains Foothill and Piedmont Grassland (CES303.817)
Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)
Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This grassland association occurs on rock outcrops, talus, mesas, plateaus, windswept bluffs, ridgetops and mountains in northern Colorado, northeastern Utah and western Wyoming. It frequently occurs on moderately to steep, mid- to high-slope landforms, although gentle slopes are not uncommon. Sites are relatively xeric and are often found on southerly aspects at lower elevations or on harsh or on windswept areas at higher elevation sites. Substrates are typically shallow, often calcareous, rocky soils. Ground surface often has significant cover of bare ground, gravel and/or rock (10-90% cover). Stands are also reported east of the Continental Divide in Rocky Mountain National Park on a windward knoll and at Grand Teton National Park from a very steep northeast-facing high slope. The vegetation is characterized by an open herbaceous layer that is typically dominated by the cool-season, perennial bunchgrass *Pseudoroegneria spicata* with low to moderate cover (5-30%) and low-growing forbs. *Koeleria macrantha* is repeatedly present in low abundance. Other dry grasses may be present with low cover (less than half the cover of *Pseudoroegneria spicata*). A sparse dwarf-shrub layer (<10% cover) occurs with a variety of woody species of *Artemisia, Atriplex confertifolia, Cercocarpus, Eriogonum, Gutierrezia, Krascheninnikovia* or *Tetradymia* depending on elevation and substrate. There are several to many low-growing forbs (cushion plants) present with low cover, such as *Arenaria* spp., *Arenaria hookeri, Astragalus* spp., *Paronychia sessiliflora, Phlox* spp., *Stenotus acaulis, Tetraneuris acaulis,* and *Townsendia incana*. There are no clear dominants in this list, and the percent cover of each species present will vary from site to site. A diverse and abundant forb layer probably indicates a degraded occurrence.

DISTRIBUTION

Dinosaur National Monument

This association is known from Chew Basin, Pot Creek, Five Springs Draw, and Anderson Hole.

Globally

This association occurs in Piceance Basin and Dinosaur National Park in western Colorado and the Cache Valley of northeastern Utah. Stands are reported from Grand Teton National Park in Wyoming and Rocky Mountain National Park.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association typically occurs on rocky, moderate to steep slopes with northwestern exposures, and at elevations ranging from 1550 to 2260 m. Sites are generally windswept ridges, bluffs, and mesatops. Soil texture varies from sandy to silty to clay loam, and large rocks and gravel make up a significant portion of the ground surface.

Globally

This herbaceous association occurs in northern Colorado, northeastern Utah and western Wyoming (Hull and Hull 1974, Baker 1982b, Baker and Kennedy 1985). Stands occur on rock outcrops, talus, mesas, plateaus, windswept bluffs, ridgetops and mountains. It frequently occurs on moderately to steep, mid- to high-slope landforms, although gentle slopes are not uncommon. Elevation ranges between 1680 and 2840 m (5500-9310 feet) in Colorado and down to 1340-1590 m (4400-5200 feet) in Cache Valley of Utah. One stand is reported at Grand Teton National Park from a very steep northeast-facing high slope at an elevation of 2234 m (7328 feet) on well-drained clay soils

that are very prone to erosion. Sites are relatively xeric and are often found on southerly aspects at lower elevations or on harsh, steep or windswept areas at higher elevation sites. Substrates are typically shallow, often calcareous, rocky soils and include sandstone and marlstone of the Uinta and Green River formations, Madison limestone, Mancos shale, and Morgan/Round Valley and Lodore formations and granite. Ground surface often has significant cover of bare ground, gravel and/or rock (10-90% cover). Evidence of erosion is often present.

VEGETATION DESCRIPTION

Dinosaur National Monument

Pseudoroegneria spicata is the dominant graminoid species present with 10 to 30% cover. Other grasses typically present with less cover include *Achnatherum hymenoides, Hesperostipa comata*, and *Poa fendleriana*. A variety of forb species are associated and contribute low cover. Species most frequently present are *Phlox hoodii, Sphaeralcea coccinea, Arenaria fendleri*, and *Chaetopappa ericoides*. Low shrubs occur with high diversity and minimal cover and include *Gutierrezia, Eriogonum, Artemisia, Atriplex*, and *Tetradymia*.

Globally

This association is characterized by an open vegetation layer that is typically dominated by the cool-season, perennial bunchgrass *Pseudoroegneria spicata* with low to moderate cover (7-30%) and low-growing forbs. *Koeleria macrantha* is repeatedly present in low abundance. Other grasses may include *Achnatherum hymenoides, Hesperostipa comata, Leptodactylon pungens, Poa fendleriana, Poa secunda*; if present they have low cover (less than half the cover of *Pseudoroegneria spicata*). A sparse dwarf-shrub layer (<10% cover) may be present and includes a variety of woody species, such as *Artemisia frigida, Artemisia nova, Artemisia tridentata, Atriplex confertifolia, Cercocarpus intricatus, Cercocarpus montanus, Eriogonum corymbosum, Eriogonum microthecum, Gutierrezia sarothrae, Krascheninnikovia lanata, Chrysothamnus greenei, Chrysothamnus viscidiflorus, Heterotheca villosa, Rosa woodsii, Ribes cereum*, or *Tetradymia canescens*, depending on elevation and substrate. The several to many low-growing forbs (cushion plants) are present with low cover. Species may include *Arenaria fendleri, Arenaria hookeri, Astragalus spatulatus, Astragalus tenellus, Draba oligosperma, Eriogonum lonchophyllum, Lesquerella alpina, Machaeranthera grindelioides, Paronychia sessiliflora, Phlox austromontana, Phlox hoodii, Stenotus acaulis, Tetraneuris acaulis*, and *Townsendia incana*. There are no clear dominants in this list, and the percent cover of each species present will vary from site to site. A diverse and abundant forb layer probably indicates a degraded occurrence (R. Rondeau pers. comm. 1998).

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Herb (field)	*Phlox hoodii*
Herb (field)	*Hesperostipa comata, Poa fendleriana, Pseudoroegneria spicata*

Globally

Stratum	**Species**
Herb (field)	*Heterotheca villosa*
Herb (field)	*Pseudoroegneria spicata*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Bromus tectorum

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G2 (30-Nov-1998). This association is known only from northern Colorado and northwestern Wyoming but is expected to occur in Utah. Grazing has a negative effect on this association, and it is believed that it now occupies a very small portion of the original range. Baker (1982b) reports that *Pseudoroegneria spicata* does not tolerate grazing and will eventually convert to *Koeleria macrantha* or *Poa secunda* grassland if grazing pressures continue. Baker (1982b) also estimates that at least two-thirds of the original *Pseudoroegneria spicata* grassland community in the Piceance Basin has been replaced by *Koeleria macrantha* grasslands. The size of most occurrences is very small, five under 15 acres and two under 60 acres.

CLASSIFICATION COMMENTS

Dinosaur National Monument
Data are not available.

Globally
This association needs to be compared with *Pseudoroegneria spicata* - Cushion Plants Herbaceous Vegetation (CEGL001666) of Pryor Mountains and Bighorn Canyon in south-central Montana, the Tendoy Mountains in southwest Montana and as described in Dinosaur National Monument in northwestern Colorado. It is distinguished by its lack of significant cover by cushion plants. Both associations occur on windswept ridgelines on calcareous substrates, have relatively sparse vegetation cover and contain cushion plants. The range of this association needs further review, especially disjunct stands, because the diagnostic grass in this association can be readily confused with awned *Elymus lanceolatus* (note if rhizomes are present, whereas *Pseudoroegneria spicata* has no rhizomes). Also *Pseudoroegneria spicata* ssp. *inermis* (awnless) is often confused with *Pascopyrum smithii* (note asymmetrical glume) or other wheatgrasses.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is found in small stands. It is distinguished from the closely related Pseudoroegneria spicata - Cushion Plants Herbaceous Vegetation (CEGL001666) in its lack of significant cover by cushion plants.
Dinosaur National Monument Data Sources: This description is derived from 2002 and 2003 field data (5 plots: DINO.0113, DINO.0183, DINO.0214, DINO.0568, DINO.1405).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: D. Zoellner, mod. K.A. Schulz and J. Coles

REFERENCES: Baker 1982b, Baker and Kennedy 1985, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Hull and Hull 1974, Jones and Ogle 2000, Rondeau pers. comm.

Sporobolus cryptandrus Great Basin Herbaceous Vegetation
Sand Dropseed Great Basin Herbaceous Vegetation

CODE	CEGL002691
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 CRYPTANDRUS* HERBACEOUS ALLIANCE (A.1252) Sand Dropseed Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This plant association is described from the Uinta Basin and Colorado Plateau where it occurs on alluvial terraces of major rivers, sandy upper stream terraces along intermittent washes, and on sand deposits on mesas and plains. Elevation ranges from 1226 to 1630 m. Soils are loamy sands and sandy loams derived from alluvium, eolian deposits or sandstone residuum. Sites have generally been disturbed by flooding, shifting sands, livestock grazing, or human recreation. The vegetation is dominated by the warm-season perennial graminoid *Sporobolus cryptandrus*. *Hesperostipa comata, Pleuraphis jamesii, Sporobolus contractus, Sporobolus giganteus,* or *Equisetum variegatum* frequently occur in low abundance. Low cover of native forbs such as *Sphaeralcea grossulariifolia* or *Chamaesyce fendleri* may be present. The introduced annual grass *Bromus tectorum* and several other exotic species such as *Bromus rigidus, Salsola kali, Helianthus annuus, Sisymbrium altissimum,* or *Tribulus terrestris* may be present to abundant, especially on disturbed riparian stands. Occasional *Brickellia* spp. or other shrubs may occur, but they are not dense enough to form a shrub layer.

DISTRIBUTION

Dinosaur National Monument
This association is known from a single site on eolian sands covering hogbacks near the Dinosaur Quarry/Visitor Center at the west end of the monument.

Globally
The association is found on terraces of large rivers in the Colorado Plateau and Uinta Basin and likely occurs elsewhere in the southwestern U.S.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association occurs at a single site on a north-facing knoll of eolian sands. Elevation is 1500 m. The soil texture is rapidly drained loamy sand.

Globally
This grassland is described from the Uinta Basin and Colorado Plateau where it occurs on alluvial terraces of large rivers, sandy upper stream terraces along intermittent washes, and on sand deposits on mesas and plains. Elevation ranges from 1226-1630 m. Sites are flat to gently sloping valley bottoms, plains or plateaus. Soils are loamy sands and sandy loams derived from alluvium, eolian deposits or sandstone residuum. Biological soil crusts are generally present and may provide up to 30% cover. Stands have generally been disturbed by flooding, shifting sands, livestock grazing, or human recreation.

VEGETATION DESCRIPTION
Dinosaur National Monument
This herbaceous vegetation association is dominated by the bunchgrass *Sporobolus cryptandrus*, with 10 to 20% cover. *Achnatherum hymenoides* is also likely to be present. Shrubs commonly present with less than 5% total cover *include Chrysothamnus greenei.* Sites may have extensive cryptobiotic crusts on the soil surface.

Globally
This plant association is found on alluvial terraces of large rivers and on sand deposits on mesas and plains. The sparse to moderately dense (10-30% cover) herbaceous layer is characterized by the dominance of the warm-season perennial graminoid *Sporobolus cryptandrus. Hesperostipa comata, Pleuraphis jamesii, Sporobolus contractus, Sporobolus giganteus,* or *Equisetum variegatum* may occur in low abundance. Low cover of native forbs, such as *Abronia fragrans, Chamaesyce fendleri, Plantago patagonica, Sphaeralcea grossulariifolia, Sphaeralcea parvifolia,* or the succulent *Opuntia polyacantha* may be present. The widespread introduced annual grass *Bromus tectorum* and several other exotic species such as *Bromus rigidus, Salsola kali, Helianthus annuus, Sisymbrium altissimum,* or *Tribulus terrestris* may be present to abundant, especially on disturbed riparian stands. An occasional *Brickellia* spp or other shrubs may occur, but they are not dense enough to form a shrub layer. Moss is important in some stands.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Herb (field)	*Achnatherum hymenoides, Sporobolus cryptandrus*

Globally

Stratum	**Species**
Herb (field)	*Sporobolus cryptandrus*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Bromus tectorum

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (26-Jul-2001).

CLASSIFICATION COMMENTS

Dinosaur National Monument
Data are not available.

Globally
The association is broadly defined to include Sporobolus cryptandrus-dominated stands from both riparian and sandy upland sites. This plant association is similar to the threatened, regionally endemic *Sporobolus cryptandrus* plant associations from the Columbia Basin and lower Snake River that have declined significantly due to loss of habitat from hydroelectric dam construction and conversion of land to cultivation. Many of the riparian stands in these associations are in poor condition because of past management and invasion of introduced species.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This is a rare association at Dinosaur National Monument, because *Sporobolus cryptandrus* usually is out-competed by cheatgrass or other annual weedy species.
Dinosaur National Monument Data Sources: This description was derived from 2002 field data (1 plot: DINO.0176).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: K.A. Schulz

REFERENCES: Cogan et al. 2004, Cowardin et al. 1979, USFS 1937, Von Loh et al. 2002

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	*PLEURAPHIS JAMESII* 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 mesatops 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 that is 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
Dinosaur National Monument
This association is known from Cub Creek and Brown's Draw, at the east and west ends of the monument, respectively.

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

Dinosaur National Monument
This association occurs on hills, benches and saddles, well above the river level but generally in the valleys of the major rivers. In the monument this association was sampled on moderate to steep slopes with southerly aspects at elevations of 1500 to 1700 m. The soil substrate can be rocky or smooth with extensive cryptogamic crust. Soil texture is sandy clay or clay loam.

Globally
This widespread grassland association is found on a variety of sites, including alluvial flats, toeslopes, 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 mesatops and slopes to basin floors. Sites are flat to moderately steep (up 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 lavaflow, basaltic cobbles, black or red cinders, or alluvium derived from relict Pleistocene river cobbles, sandstone, sand, or clay soils.

VEGETATION DESCRIPTION
Dinosaur National Monument
This association is dominated by *Pleuraphis jamesii* with sparse to moderate cover. Shrubs and dwarf-shrubs may occur with less than 5% cover. Shrubs that may be present include *Ephedra viridis, Ephedra torreyana, Artemisia tridentata* ssp. *wyomingensis, Opuntia* spp., and *Gutierrezia sarothrae*. Other herbaceous species are sparse and vary from site to site.

Globally
This association is characterized by a sparse to moderately dense perennial herbaceous layer (5-60% cover) that is 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
Dinosaur National Monument

Stratum	**Species**
Herb (field)	*Pleuraphis jamesii*

Globally

Stratum	**Species**
Herb (field)	*Pleuraphis jamesii*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: G2G4 (23-Feb-1994).

CLASSIFICATION COMMENTS

Dinosaur National Monument
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
Dinosaur National Monument Inventory Notes: There are numerous small occurrences of this association on the north side of the Yampa River opposite the confluence with Dry Woman Canyon.
Dinosaur National Monument Data Sources: This description was derived from 2002 and 2003 field data (2 plots: DINO.0647, DINO.1013).
Local Description Authors: J. Thompson, mod. J. Coles
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.

Distichlis spicata Herbaceous Vegetation
Saltgrass Herbaceous Vegetation

Saltgrass Saline Prairie

CODE	CEGL001770
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	Intermittently flooded temperate or subpolar grassland (V.A.5.N.i.)
ALLIANCE	*DISTICHLIS SPICATA* INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1332) Saltgrass Intermittently Flooded Herbaceous Alliance
ECOLOGICAL SYSTEM(S):	Inter-Mountain Basins Greasewood Flat (CES304.780) Inter-Mountain Basins Wash (CES304.781) Chihuahuan Mixed Salt Desert Scrub (CES302.017) Inter-Mountain Basins Playa (CES304.786) Sonora-Mojave Mixed Salt Desert Scrub (CES302.749) Western Great Plains Saline Depression Wetland (CES303.669) Inter-Mountain Basins Alkaline Closed Depression (CES304.998) North American Warm Desert Lower Montane Riparian Woodland and Shrubland (CES302.748)
USFWS WETLAND SYSTEM:	Palustrine

CONCEPT SUMMARY
Globally
These grasslands occur in semi-arid and arid western North America from southern Saskatchewan, Canada, to Mexico. Stands are found in lowland habitats such as playas, swales, and terraces along washes that are typically intermittently to seasonally flooded. The flooding is usually the result of highly localized thunderstorms or winter rains which can flood one basin and leave the next dry. However, this association may also occur in other flood regimes (temporarily and semipermanently). Soil texture ranges from clay loam, silty loam, to sandy clay. These soils are often deep, saline and alkaline. They generally have an impermeable layer and therefore are poorly drained. When the soil is dry, the surface usually has salt accumulations. Salinity is likely more important than flooding as an environmental factor.

Vegetation cover is sparse to dense and is dominated by *Distichlis spicata*, occurring in nearly pure stands. Minor cover of associated graminoids may include *Muhlenbergia asperifolia, Hordeum jubatum, Pascopyrum smithii, Sporobolus airoides, Carex filifolia, Eleocharis palustris, Puccinellia nuttalliana*, and *Juncus balticus*. Associated forbs, such as *Iva axillaris, Helianthus* spp., *Asteraceae* spp. (from lower salinity sites), *Salicornia rubra, Triglochin maritima*, and *Suaeda* spp., may also be present. Shrubs are rare, but scattered *Atriplex canescens* and *Sarcobatus vermiculatus* may be present.

DISTRIBUTION

Dinosaur National Monument

Large patches of this association are known from the terraces at the confluence of the Green and Yampa rivers, the Lake Bench area above the Yampa River and an old irrigated field on the Yampa Bench. It is likely to occur in small patches anywhere alkaline groundwater is available at the surface, including the McKee Springs area and Deerlodge Park.

Globally

This grassland association occurs in low areas in semi-arid and arid western North America from southern Saskatchewan, Canada, west to Washington and south to Arizona, California, New Mexico, and possibly northern Mexico.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occupies flat, sandy, alluvial terraces and floodplains, as well as loamy soils on moderately to steeply sloping upland benches. Litter and some large rocks cover most of the nonvegetated surface.

Globally

These grasslands occur in semi-arid and arid western North America on saline and alkaline soils from southern Saskatchewan, Canada, to Mexico. Elevation ranges from 1000-2300 m (3280-7545 feet). Stands are found in lowland habitats such as playas, swales, floodplains, and terraces along washes that are typically intermittently or seasonally flooded. The flooding is usually the result of highly localized thunderstorms or winter rains which can flood one basin and leave the next dry. However, this association may also occur in other flood regimes (temporarily and semipermanently). Soil texture ranges from clay loam, silty loam, to sandy clay (Johnston 1987). These soils are often deep, saline and alkaline. They generally have an impermeable layer and therefore are poorly drained. When the soil is dry, the surface usually has salt accumulations. Salinity is likely more important than flooding as an environmental factor.

VEGETATION DESCRIPTION

Dinosaur National Monument

Total herbaceous vegetation cover ranges between 30 and 45% in this association. *Distichlis spicata* and *Bromus tectorum* dominate, each with 10% cover. Other graminoids that occur are *Juncus balticus, Sporobolus airoides, Equisetum* spp., and *Pascopyrum smithii*. Forb species are mostly exotics and contribute little cover. Shrubs are scattered and sparse and may include *Ericameria nauseosa* or *Chrysothamnus viscidiflorus*.

Globally

Cover is sparse to dense and is dominated by *Distichlis spicata*, occurring in nearly pure stands. Stands have higher diversity and cover during wet years and near boundaries with other vegetation types. Higher soil salinity favors *Distichlis spicata* over less salt-tolerant species. However, very high salinity will dwarf the *Distichlis spicata* and reduce cover. Generally, vegetation height and cover and species diversity tend to vary inversely with salinity on the plains but may increase on very saline sites (Brotherson 1987). Minor cover of associated graminoids may include *Muhlenbergia asperifolia, Hordeum jubatum, Pascopyrum smithii, Sporobolus airoides, Carex filifolia, Eleocharis palustris, Puccinellia nuttalliana*, and *Juncus balticus*. Associated forbs, such as *Iva axillaris, Helianthus* spp. and *Asteraceae* spp. (from lower salinity sites), *Salicornia rubra, Triglochin maritima*, and *Suaeda* spp., may also be present. Shrubs are rare, but scattered *Atriplex canescens, Chrysothamnus viscidiflorus, Ericameria nauseosa*, and *Sarcobatus vermiculatus* may be present. Introduced species are present in some stands and may include *Bromus tectorum, Elymus repens, Lepidium latifolium, Lepidium perfoliatum, Bassia scoparia*, and occasionally *Tamarix* spp.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Herb (field)	*Bromus tectorum, Distichlis spicata, Sporobolus airoides*

Globally

Stratum	**Species**
Herb (field)	*Distichlis spicata*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Bromus tectorum, Elymus repens, Lepidium latifolium, Lepidium perfoliatum

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
This graminoid association is characteristically dominated by *Distichlis spicata*. Closely related communities include *Pascopyrum smithii - Distichlis spicata* Herbaceous Vegetation (CEGL001580), *Sporobolus airoides - Distichlis spicata* Herbaceous Vegetation (CEGL001687), and several others.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Only one plot and one observation point were assigned to this association. It is likely to occur more often but in stands too small for plots.
Dinosaur National Monument Data Sources: This association is described from 2002 and 2003 field data (1 plot: DINO.0695, 2 observation points: DINO.8403, DINO.9408).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: K.A. Schulz, mod. J. Coles, G. Kittel, J. Evens

REFERENCES: Baker 1984a, Beatley 1976, Bourgeron and Engelking 1994, Brotherson 1987, Bunin 1985, CONHP unpubl. data 2003, Carsey et al. 2003a, Costello 1944b, Crouch 1961a, Daniels 1911, Daubenmire 1970, Dodd and Coupland 1966, Driscoll et al. 1984, Franklin and Dyrness 1973, Graham 1937, Hansen et al. 1991, Hansen et al. 1995, Hyder et al. 1966, IDCDC 2005, Johnston 1987, Jones and Walford 1995, Kagan et al. 2000, Keeler-Wolf and Vaghti 2000, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1999a, Kittel et al. 1999b, Klipple and Costello 1960, MTNHP 2002b, Muldavin et al. 2000a, NVNHP 2003, Osborn 1974, Pickart 2006, Ralston 1969, Ramaley 1942, Rogers 1953, Sawyer and Keeler-Wolf 1995, Shanks 1977, Shupe et al. 1986, Soil Conservation Service 1978, Stearns-Roger, Inc. 1978, Tuhy and Jensen 1982, Ungar 1967, Ungar 1968, Ungar 1970, Ungar et al. 1969, Vestal 1914, WNHP unpubl. data, Weaver and Albertson 1956

Leymus cinereus - Distichlis spicata Herbaceous Vegetation
Great Basin Lyme Grass - Saltgrass Herbaceous Vegetation

CODE	CEGL001481
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	Intermittently flooded temperate or subpolar grassland (V.A.5.N.i.)
ALLIANCE	*LEYMUS CINEREUS* INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1329) Great Basin Lyme Grass Intermittently Flooded Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Greasewood Flat (CES304.780)

Inter-Mountain Basins Playa (CES304.786)
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This community is located on the Columbia Plateau in Idaho, Oregon, Nevada, Washington and California, as well as the Uinta Basin of northwestern Colorado. This is a small-patch community ranging from 1-1000 acres in size that is restricted to alkaline or saline soils, often in swales or stream terraces. The water table can be shallow, or soils may have an impermeable layer holding a perched water table or may have a fine texture (e.g., clay loam) that holds water well. The community is composed of *Leymus cinereus* that forms an open 4-foot tall or taller bunchgrass layer and a 2-foot tall or less, dense rhizomatous *Distichlis spicata* grass cover. *Leymus cinereus* and *Distichlis spicata* are always present and can be the only vascular species present. *Carex praegracilis, Equisetum laevigatum, Pascopyrum smithii, Poa fendleriana, Poa secunda*, and *Spartina gracilis* may be present, although usually with less cover than the diagnostic species. Patches of exposed ground are common in more saline sites. The exotic annual grass *Bromus tectorum* is present to abundant in disturbed sites. *Achillea millefolium* is found in most sites in the Great Basin, and *Asclepias speciosa* is common in Uinta Basin stands. This is a low-diversity community with 5-17 species per plot. Total vegetative cover is rarely less than 50%.

DISTRIBUTION

Dinosaur National Monument

This association is known from the confluence of the Green and Yampa rivers and likely occurs in small patches along both rivers.

Globally

This community is located on the Columbia Plateau in Idaho, Oregon, Nevada, California and Washington, as well as the Uinta Basin of northwestern Colorado. It may also extend into British Columbia and Utah. This description is primarily based on samples from Adams County and plots from Daubenmire (1970) in Douglas, Walla Walla and Yakima counties in Washington.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs in small patches on flat stream terraces at elevations below 2000 m. Soils vary from sandy loams to clay loams. The nonvegetated ground cover is dense with organic litter.

Globally

This community is located on the Columbia Plateau in Idaho, Oregon, Nevada, Washington and California, as well as the Uinta Basin of northwestern Colorado. This is a small-patch community ranging from 1-1000 acres in size that is restricted to alkaline or saline soils, often in swales or stream terraces. The water table can be shallow, or soils may have an impermeable layer holding a perched water table or may have a fine texture (e.g., clay loam) that holds water well.

VEGETATION DESCRIPTION

Dinosaur National Monument

This association is a part of a larger, patchy, herbaceous riparian community. *Leymus cinereus, Distichlis spicata*, and *Bromus tectorum* dominate with a total of 50% cover. Other species present with minimal cover are *Pascopyrum smithii, Poa fendleriana, Equisetum laevigatum, Prunella vulgaris, Lepidium perfoliatum*, and *Asclepias speciosa*.

Globally

The community is composed of *Leymus cinereus* that forms an open 4-foot tall or taller bunchgrass layer and a 2-foot tall or less, dense rhizomatous *Distichlis spicata* grass cover. *Leymus cinereus* and *Distichlis spicata* are always present and can be the only vascular species present. *Carex praegracilis, Equisetum laevigatum, Pascopyrum smithii, Poa fendleriana, Poa secunda*, and *Spartina gracilis* may be present, although usually with less cover than the diagnostic species. Patches of exposed ground are common in more saline sites. The exotic annual grass *Bromus tectorum* is present to abundant in disturbed sites. *Achillea millefolium* is found in most sites in the Great Basin, and *Asclepias speciosa* is common in Uinta Basin stands. This is a low-diversity community with 5-17 species per plot.

Total vegetative cover is rarely less than 50%.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	Species
Herb (field)	*Bromus tectorum, Distichlis spicata, Leymus cinereus*

Globally

Stratum	Species
Herb (field)	*Distichlis spicata, Leymus cinereus*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum, Lepidium perfoliatum

Globally
Bromus tectorum, Lepidium perfoliatum

CONSERVATION STATUS RANK
Global Rank & Reasons: G3 (11-Dec-2000). This community occurs on the Columbia Plateau in Idaho, Oregon, Nevada, California and Washington, as well as in the Uinta Basin of northwestern Colorado. This is a small-patch community (1-1000 acres) dominated by an open 4-foot tall or taller bunchgrass layer with a dense, shorter rhizomatous grass cover. This community is restricted environmentally and is associated with stream terraces, swales, vernal pools and depressions that stay moist into the growing season. Soils are fine-textured, poor to moderately drained, and alkaline or high in sodium. The type is naturally restricted, although individual occurrences can exceed 1000 acres. There are well over 100 occurrences in all conditions across its range. The number of occurrences is estimated from vegetation surveys and observations. Most occurrences are in fair to poor condition due to alterations of hydrology and grazing. Many sites have been lost due to conversion to other land uses. The global rank was changed from G1 to G3 to reflect the wider geographic area of occurrence and higher number of occurrences than previously estimated.

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
In Washington, there are three distinct *Leymus cinereus* communities: *Leymus cinereus - Distichlis spicata* as described here; *Leymus cinereus* Bottomland Herbaceous Vegetation (CEGL001480) with more *Carex praegracilis* cover than *Distichlis spicata*. It also occurs on better drained or subirrigated, less saline sites with more *Poa pratensis* and more forbs, especially mesic weeds. M. Jankovsky-Jones and R. Crawford recall, as discussed at the 1999 WA OR ID riparian crosswalk meeting, that CEGL001480 is a less alkaline bottomland type and that *Leymus cinereus - Distichlis spicata* Herbaceous Vegetation (CEGL001481) is an alkaline type. A third type is dominated by *Leymus cinereus* and *Bromus tectorum* with little or no *Distichlis spicata* or *Carex praegracilis* and occurs on more upland, well-drained, and more disturbed sites. The first two are natural vegetation; the third is a mix affected by livestock grazing/stream downcutting or ditching/sowing of *Leymus cinereus* and is best described as modified vegetation.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Data are not available.
Dinosaur National Monument Data Sources: This association is described from field data plots collected in 2003 (1 plot: DINO.0694).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: R.C. Crawford, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, Daubenmire 1970, Driscoll et al. 1984, Franklin and Dyrness 1973, IDCDC 2005, Kagan et al. 2000, NVNHP 2003, ORNHP unpubl. data, Poulton 1955, WNHP unpubl. data

Spartina pectinata Western Herbaceous Vegetation

Prairie Cordgrass Western Herbaceous Vegetation

CODE	CEGL001476
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	Temporarily flooded temperate or subpolar grassland (V.A.5.N.j.)
ALLIANCE	*SPARTINA PECTINATA* TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1347) Prairie Cordgrass Temporarily Flooded Herbaceous Alliance
ECOLOGICAL SYSTEM(S):	North American Arid West Emergent Marsh (CES300.729) Northwestern Great Plains Floodplain (CES303.676) Western Great Plains Tallgrass Prairie (CES303.673) Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This association is common in wetlands and riparian areas of the Great Plains from eastern Montana south to Wyoming and Colorado, west to eastern Oregon and Washington, and occurs in small, scattered areas along rivers in the Colorado Plateau. Elevation ranges from 716-1770 m (2350-5800 feet). On large river floodplains, this type occurs as distinct patches and is distinguished from adjacent riparian types by micro-topography and degree of soil saturation. Substrates are usually poorly to moderately well-drained, finer textured soils, but vary to coarser textures. Stands generally occur as distinct patches in a matrix of other tallgrass and wetland associations, separated by differences in micro-topography and degree of soil saturation. This is a dense to moderately dense, tallgrass wet meadow that is characterized by being composed almost entirely of *Spartina pectinata*. Other herbaceous species such as *Andropogon gerardii, Calamagrostis canadensis, Carex nebrascensis, Carex pellita, Carex praegracilis, Equisetum hyemale, Glycyrrhiza lepidota, Panicum virgatum*, and *Pascopyrum smithii* may be present but contribute low cover. However, *Schoenoplectus pungens* may codominate some stands. Scattered woody species may also be present such as *Amorpha fruticosa, Chrysothamnus linifolius, Populus deltoides* ssp. *wislizeni, Salix exigua*, and the invasive exotic *Tamarix ramosissima*. The invasive thistle *Cirsium arvense* may be abundant in some stands. Historic sources cite large stands in mudflats along the Missouri and Platte rivers. Large stands have been observed south of Denver that are now threatened by housing and golf course developments.

DISTRIBUTION

Dinosaur National Monument

This common riparian / wetland association is known specifically from Jones Hole on the Green River and other sites along the Green and Yampa rivers. It is a common association but often occurs in patches too small or too narrow to sample.

Globally

This association is common in wetlands and riparian areas of the Great Plains from Montana south to Wyoming, Colorado and Utah, and west to eastern Oregon and Washington; it occurs in small, scattered areas along rivers in the Colorado Plateau. Historic sources cite large stands in mudflats along the Missouri and Platte rivers.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This seasonally flooded tallgrass meadow association occurs in drainage bottoms and on river terraces up to 2 m above late-summer river levels. Elevations do not exceed 1600 m. Soils are usually poorly to moderately well-drained, and texture is generally sandy.

Globally

This association is common in wetlands and riparian areas of the Great Plains west to eastern Oregon and Washington, and occurs in small, scattered areas along rivers in the Colorado Plateau. Historic sources cite large stands in mudflats along the Missouri and Platte rivers. Large stands have been observed south of Denver that are now threatened by housing and golf course developments. This seasonally flooded tallgrass meadow association

occurs in swales, drainage bottoms and on river terraces up to 2 m above late-summer river levels. Elevation ranges from 716-1770 m (2350-5800 feet). On large river floodplains, this type occurs as distinct patches and is distinguished from adjacent riparian types by micro-topography and degree of soil saturation. Substrates are usually poorly to moderately well-drained, finer textured soils, but vary to coarser textures (Hansen et al. 1995, Jones and Walford 1995, Kittel et al. 1999b, Carsey et al. 2003a). Stands generally occur as distinct patches in a matrix of other tallgrass and wetland associations, separated by differences in micro-topography and degree of soil saturation. Stands occurring in small swales on the plains and on floodplains of larger rivers are sometimes included in other tallgrass prairie plant associations.

VEGETATION DESCRIPTION

Dinosaur National Monument

This association is characterized by monocultures of moderately dense to dense stands of *Spartina pectinata*. Other herbaceous species may occur with low cover. Species scattered through the *Spartina stands include Carex pellita, Equisetum hyemale* var. *affine, Pascopyrum smithii*, and *Glycyrrhiza lepidota*. Some samples included scattered *Populus deltoides* ssp. *wislizeni, Tamarix ramosissima, Salix exigua*, or *Chrysothamnus linifolius*.

Globally

This is a dense to moderately dense, tallgrass wet meadow that is characterized by being composed almost entirely of *Spartina pectinata*. Other herbaceous species such as *Andropogon gerardii, Calamagrostis canadensis, Carex nebrascensis, Carex pellita, Carex praegracilis, Elymus canadensis, Equisetum hyemale* var. *affine, Glycyrrhiza lepidota, Panicum virgatum, Pascopyrum smithii*, and *Verbena hastata* may be present but contribute low cover (Hansen et al. 1995, Jones and Walford 1995, Kittel et al. 1999b, Carsey et al. 2003a). However, *Eleocharis palustris* or *Schoenoplectus pungens* may codominate some stands (Hansen et al. 1995, Jones and Walford 1995). Scattered woody species may also be present such as *Amorpha fruticosa, Chrysothamnus linifolius, Populus deltoides* ssp. *wislizeni, Salix exigua*, and the invasive exotic *Tamarix ramosissima*. The invasive thistle *Cirsium arvense* or introduced forage species *Agrostis stolonifera* may be abundant in some stands.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Herb (field)	*Carex pellita, Pascopyrum smithii, Spartina pectinata*
Herb (field)	*Equisetum hyemale* var. *affine*

Globally

Stratum	Species
Herb (field)	*Spartina pectinata*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Tamarix ramosissima

Globally
Cirsium arvense, Tamarix ramosissima

CONSERVATION STATUS RANK

Global Rank & Reasons: G3? (1-Feb-1996).

CLASSIFICATION COMMENTS

Dinosaur National Monument
Data are not available.

Globally
Compare this association with *Spartina pectinata - Carex* spp. Herbaceous Vegetation (CEGL001477).

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Dinosaur National Monument Inventory Notes: This community is easily recognized because of its overwhelming dominance of *Spartina pectinata*.
Dinosaur National Monument Data Sources: This association is described from field data collected in the 1990s,

2002, and 2003 (8 plots: DINO.0021, GR019, GR045, GR049, GR083, GR099, GR101, GR102, and 2 observation points: DINO.8011, DINO.9020).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Carsey et al. 2003a, Driscoll et al. 1984, Evans 1989a, Hansen and Hoffman 1988, Hansen et al. 1989, Hansen et al. 1991, Hansen et al. 1995, Johnston 1987, Jones 1992b, Jones and Walford 1995, Kagan et al. 2004, Keim 1932, Kittel et al. 1996, Kittel et al. 1997a, Kittel et al. 1999b, MTNHP 2002b, Weaver 1965, Western Ecology Working Group n.d.

Carex pellita Herbaceous Vegetation
Woolly Sedge Herbaceous Vegetation

CODE	CEGL001809
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
FORMATION	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k.)
ALLIANCE	*CAREX PELLITA* SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1414) Woolly Sedge Seasonally Flooded Herbaceous Alliance
ECOLOGICAL SYSTEM(S):	North Pacific Dry and Mesic Alpine Dwarf-Shrubland, Fell-field and Meadow (CES204.862) Rocky Mountain Alpine-Montane Wet Meadow (CES306.812) Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)
USFWS WETLAND SYSTEM:	Palustrine

CONCEPT SUMMARY
Globally
This groundwater-supported plant association occurs in small patches along stream channels and in seasonally wet depressions and swales at low to moderate elevations in the western U.S. from Washington to Montana south to Oregon, Utah, Wyoming and Colorado. It has also been reported from British Columbia, Canada. These wetlands form small to medium-sized meadows. *Carex pellita*, a distinctive wetland-indicator species, clearly dominates stands with 30-80% cover. Low species diversity, with few associates having high constancy, is characteristic. *Deschampsia caespitosa, Carex microptera, Carex nebrascensis, Carex simulata, Carex praegracilis, Elymus glaucus, Juncus balticus, Schoenoplectus pungens, Equisetum arvense,* and *Equisetum hyemale* are sometimes present with low cover. Scattered shrubs and small trees may also be present . On the eastern plains of Colorado, it can occur under a canopy of cottonwood trees forming *Populus deltoides / Carex pellita* Woodland (CEGL002649).

DISTRIBUTION
Dinosaur National Monument
This association is uncommon but is most likely to occur in very small patches in permanently wet habitats adjacent to the Green and Yampa rivers.

Globally
This plant association is a minor wetland type in Colorado, Utah, Idaho, Montana, Washington, Oregon, and British Columbia, Canada. Carex pellita is a common sedge that occurs throughout the northern and western United States. It is likely that this or a closely related association occurs in Wyoming, California, and New Mexico.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This rare wetland association occurs within the floodplain of the Green River at elevations below 2500 m.

Globally
This groundwater-supported plant association occurs in small patches along stream channels and in seasonally wet

depressions and swales at low to moderate elevations in the western U.S. from Washington to Montana south to Oregon, Utah, Wyoming and Colorado. It has also been reported from British Columbia, Canada. These wetlands form small to medium-sized meadows on valley bottoms. Soils are alluvial and remain saturated through at least part of the growing season.

VEGETATION DESCRIPTION

Dinosaur National Monument

Carex pellita clearly dominates this association with moderately dense to dense cover. Other herbaceous species are few and inconsistent. Shrub and tree seedlings may be present with low cover, including *Salix exigua, Tamarix ramosissima, Chrysothamnus linifolius, Populus deltoides*, and *Salix amygdaloides*.

Globally

Carex pellita, a distinctive wetland-indicator species, clearly dominates stands of this association with 30-80% cover. Low species diversity is characteristic. *Deschampsia caespitosa, Carex microptera, Carex nebrascensis, Carex simulata, Carex praegracilis, Carex utriculata, Elymus glaucus, Juncus balticus, Schoenoplectus pungens, Equisetum arvense*, and *Equisetum hyemale* are sometimes present with low cover. Stands that have been degraded by grazing may have high cover by the exotic species *Agrostis stolonifera* or *Poa pratensis* or the native rush *Juncus balticus* (Jankovsky-Jones et al. 2001). Scattered shrubs and small trees may be present, including *Salix exigua, Chrysothamnus linifolius, Salix amygdaloides, Populus deltoides*, and exotic *Tamarix* spp.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Herb (field)	*Carex pellita*

Globally

Stratum	**Species**
Herb (field)	*Carex pellita*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Tamarix ramosissima

Globally

Phleum pratense, Poa pratensis

CONSERVATION STATUS RANK

Global Rank & Reasons: G3 (17-Oct-2000). This association has been documented in small stands throughout much of the western United States and Canada. High-quality stands are uncommon due to improper grazing by livestock, hydrologic alterations, and ground-disturbing activities. The diagnostic species in this association is very palatable to livestock when young. Stands may be dry at the surface as early as July allowing season-long livestock utilization. Overuse by livestock can result in introduction of non-native species such as Poa pratensis and *Taraxacum officinale* or an increase in less palatable species such as *Carex nebrascensis* and *Juncus balticus*. Overuse by livestock can also result in stream downcutting that may permanently change the site potential from a wet to a dry meadow. *Phalaris arundinacea*, an additional non-native species, may become established due to alteration of hydrology or sediment inputs. Meadows that support stands of *Carex pellita* are often used for hay pasture and may be drained, ditched and flood irrigated, or seeded with pasture grasses to increase hay production.

CLASSIFICATION COMMENTS

Dinosaur National Monument

Data are not available.

Globally

This plant association has been described in recent classifications throughout its range (Kovalchik 1987, Padgett et al. 1989, Evenden 1990, Crowe and Clausnitzer 1997, Manning and Padgett 1995, Kittel et al. 1999a). Hansen et al. (1995) included all combinations of *Carex pellita, Carex lasiocarpa*, and *Carex buxbaumii* in the *Carex lasiocarpa* habitat type. There may be some similarities between sites supporting *Carex pellita, Carex lasiocarpa*, and *Carex buxbaumii* plant associations. However, *Carex pellita* stands typically occur on mineral soils in seasonally saturated

floodplains along runoff-dominated stream channels or headwater basins, while *Carex lasiocarpa* and *Carex buxbaumii* occur on organic soils in association with semipermanently saturated spring-fed or groundwater-driven wetlands. From a biodiversity conservation standpoint, the three associations should be recognized as distinct types. Identification of this association is complicated when shrubs are present and when *Carex pellita* is not clearly dominant.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Data are not available.
Dinosaur National Monument Data Sources: This association is described from field data plots collected in the 1990s (1 plot: GR020).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: M. Jankovsky-Jones, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Carsey et al. 2003a, Crowe and Clausnitzer 1997, Driscoll et al. 1984, Evenden 1990, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, IDCDC 2005, Jankovsky-Jones et al. 2001, Kagan et al. 2000, Kittel et al. 1995, Kittel et al. 1997a, Kittel et al. 1999a, Kittel et al. 1999b, Kovalchik 1987, MTNHP 2002b, Manning and Padgett 1995, Muthukumar et al. 2004, Padgett et al. 1988b, Padgett et al. 1989, WNHP unpubl. data, Western Ecology Working Group n.d., Young 1982

Carex praegracilis Herbaceous Vegetation
Clustered Field Sedge Herbaceous Vegetation

CODE	CEGL002660
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
FORMATION	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k.)
ALLIANCE	*CAREX PRAEGRACILIS* SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1419) Clustered Field Sedge Seasonally Flooded Herbaceous Alliance
ECOLOGICAL SYSTEM(S):	Rocky Mountain Alpine-Montane Wet Meadow (CES306.812) Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821) North American Arid West Emergent Marsh (CES300.729)
USFWS WETLAND SYSTEM:	Palustrine

CONCEPT SUMMARY
Globally
This plant association forms meadows in swales and along stream channels in the prairies of several western states on both sides of the Continental Divide. In Montana it is found at elevations as low as 610 m (2000 feet). It is also found in southern Arizona basin wetlands at 1100 m (3615 feet). The association occurs along small, shallow streams, usually no more than 2-5 m (7-17 feet) wide, with little sinuosity, low gradient and little to no floodplain development. Soils are deep, ranging from heavy clays to sandy clay loams. Often the only vegetation type along small streams, it completely covers the ground in narrow bands following the streambed and dominated by Carex praegracilis (20-40% cover), *Eleocharis palustris*, and *Equisetum laevigatum*. Alternatively, it can occur in patches within a mosaic of monotypic stands of wet meadow graminoid species including *Juncus balticus, Carex nebrascensis, Carex pellita*, and *Schoenoplectus pungens*. No shrubs or trees are present. In Arizona, the stand is codominated by *Ambrosia confertiflora*.

DISTRIBUTION
Dinosaur National Monument
This association is uncommon with one stand found below a seep in a ravine below the Island Park Road at Stone Bridge Draw in Utah.

Globally
This association occurs in appropriate habitat across the Rocky Mountain and northern Great Basin states and

southern Arizona.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This rare wetland association occurs below a seep on the midslope of a ravine. The site is saturated and occurs on a 22-degree, south-facing slope at 1677 m elevation. Substrate parent material is Morrison Formation.

Globally

This plant association forms meadows in swales and along stream channels in the prairies of several western states (Montana, Idaho, Wyoming, Colorado and Arizona) on both sides of the Continental Divide. In Montana it is found at elevations as low as 610 m (2000 feet). It is also found in southern Arizona basin wetlands at 1100 m (3615 feet). The association occurs along small, shallow streams, usually no more than 2-5 m (7-17 feet) wide, with little sinuosity, low gradient and little to no floodplain development. Soils are deep, ranging from heavy clays to sandy clay loams.

VEGETATION DESCRIPTION

Dinosaur National Monument

The single sampled plot of this wetland has a moderately dense (40% cover) herbaceous layer dominated by *Carex praegracilis* with *Juncus balticus* codominant. Other herbaceous species include low cover of graminoids such as *Agrostis scabra, Distichlis spicata, Eleocharis palustris, Pascopyrum smithii, Schoenoplectus maritimus*, and a few forbs such as *Grindelia squarrosa, Ranunculus cymbalaria*, and *Vicia* sp. Scattered shrubs *Ericameria nauseosa* and *Sarcobatus vermiculatus* are present. Introduced species include *Melilotus officinalis, Polygonum aviculare*, and *Taraxacum officinale*.

Globally

Often the only vegetation type along small streams, it completely covers the ground in narrow bands following the streambed and dominated by *Carex praegracilis* (20-40% cover), *Eleocharis palustris*, and *Equisetum laevigatum*. Alternatively, it can occur in patches within a mosaic of monotypic stands of wet meadow graminoid species including *Juncus balticus, Carex nebrascensis, Carex pellita*, and *Schoenoplectus pungens*. No shrubs or trees are present. In Arizona, the stand is codominated by *Ambrosia confertiflora*.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Herb (field)	*Carex praegracilis*

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G4 (5-Feb-2001). This association is known from several western states, although few stands have been well-documented. Stands are small meadows in Colorado (1-20 acres), but it is known to form large meadows in southwestern Montana. Occurrences on federal lands are often in a degraded condition. The highest conditions exist on unprotected private lands. Soil compaction and compositional shifts from grazing and heavy recreational use are the greatest threats. The global rank was changed from G2 to G3G4 to reflect the wide distribution of the type as well as its apparent abundance in several states (Montana and Wyoming).

CLASSIFICATION COMMENTS

Dinosaur National Monument

Globally

This association is known from several western states (MT, ID, WY, CO and AZ), although few stands have been

documented. This type needs to be compared with *Carex praegracilis* - *Carex aquatilis* Herbaceous Vegetation (CEGL001821), as they may be the same. A single plot in southern Arizona is codominated by *Ambrosia confertiflora*. More research is needed to verify that southern stands should be included in this association.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Data are not available.
Dinosaur National Monument Data Sources: This association is described from field data plots collected in the 1990s (1 plot: DINO.9001).
Local Description Authors: K.A. Schulz
Global Description Authors: R.J. Rondeau, mod. M.S. Reid and K.A. Schulz

REFERENCES: CONHP Ecology Team 2001, Carsey et al. 2003a, Culver and Sanderson 1997, Durkin et al. 1994b, Hansen et al. 1988b, Hansen et al. 1995, IDCDC 2005, Jones and Walford 1995, Kagan et al. 2004, Kittel et al. 1997a, Kittel et al. 1999a, Kittel et al. 1999b, MTNHP 2002b, Western Ecology Working Group n.d.

Eleocharis palustris Herbaceous Vegetation
Marsh Spikerush Herbaceous Vegetation

Marsh Spikerush Wet Meadow

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	*ELEOCHARIS (PALUSTRIS, MACROSTACHYA)* 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) Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821) North American Arid West Emergent Marsh (CES300.729)
USFWS WETLAND SYSTEM:	Palustrine

CONCEPT SUMMARY
Globally
This 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 feet). 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 under 1 m tall that is 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
Dinosaur National Monument
This association is known fromthe Yampa and Green rivers, mostly in riparian or backchannel habitats.

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
Dinosaur National Monument
This wetland association occurs along saturated edges of low-gradient perennial streams and rivers. It may also occupy intermittent stream bottoms, seeps and springs from low to high elevations. Hydrologic regime ranges from seasonally to permanently flooded. Soil texture ranges from organic to fine-textured silty clays.

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 feet). 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
Dinosaur National Monument
This wetland association is dominated by *Eleocharis palustris*, with 5 to 40% cover. *Eleocharis palustris* may occur alone but is usually associated with other herbaceous species. These species commonly include *Equisetum hyemale* var. *affine*, *Polygonum amphibium* var. *emersum*, and *Helenium autumnale* var. *montanum*. The shrubs Salix exigua and *Tamarix ramosissima* may be present with minimal cover; however, trees and shrubs are generally absent.

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, stands are dominated by *Eleocharis acicularis* and *Eleocharis palustris* which commonly cover the bottoms of the pools and emerge above the water as the pools dry out. 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 which was ringed by *Eleocharis palustris*. Communities in Utah include *Eleocharis acicularis* and *Alopecurus aequalis* as likely associates (Padgett et al. 1989).

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	Species
Herb (field)	*Eleocharis palustris*

Globally

Stratum	Species
Herb (field)	*Eleocharis palustris*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Tamarix ramosissima

Globally
Data are not available.

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association typically occurs in patches too small for the standard plot size used in NPS-VegMap data collection. It was only recorded during an inventory project that used 10x10-m plots. It tends to occur as inclusions occupying the wettest sites within larger riparian complexes.
Dinosaur National Monument Data Sources: This association is described from field data plots collected in the 1990s (14 plots: GR016, GR028, GR042, GR046, GR047, GR052, GR061, GR064, GR084, GR088, GR091, GR096, GR097, GR111).
Local Description Authors: J. Thompson, mod. J. Coles
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 Rolfsmeier 2000, Stewart 1940, Titus and Christy 1996a, Titus and Christy 1999, Von Loh 2000, WNHP unpubl. data, Western Ecology Working Group n.d., Youngblood et al. 1985a

Juncus balticus Herbaceous Vegetation
Baltic Rush Herbaceous Vegetation

Baltic Rush Wet Meadow

CODE	CEGL001838
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
FORMATION	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k.)
ALLIANCE	*JUNCUS BALTICUS* SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1374) Baltic Rush Seasonally Flooded Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Interdunal Swale Wetland (CES304.059)
Boreal Wet Meadow (CES103.873)
North American Arid West Emergent Marsh (CES300.729)
Northern Columbia Plateau Basalt Pothole Ponds (CES304.058)
Western Great Plains Open Freshwater Depression Wetland (CES303.675)
Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)
Temperate Pacific Subalpine-Montane Wet Meadow (CES200.998)
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This Baltic rush community is found widely throughout the western United States and into western Canada. This 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

Dinosaur National Monument

This association is known from Twelve Mile Gulch and is likely to occur in small patches throughout the monument wherever alkaline groundwater is available, including the McKee Springs area, Lily and Deerlodge parks and the Yampa Bench.

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

Dinosaur National Monument

This association occupies seeps, springs and stream edges over a broad range of elevations. Soil texture ranges from loamy sand to clay loam. Organic litter and occasionally gravel comprise the nonvegetated ground cover.

Globally
This widespread herbaceous wetland community is found throughout western North America. Elevation ranges from 138 to 3500 m (454-11,475 feet). Far northern stands in the Boreal Plains are at about 800 m (2625 feet). Stands usually occur as small, dense patches on flat to gently sloping sites near seeps and streams. Stream channels are highly variable in size and type, ranging from narrow to moderately wide, and from deeply entrenched to very sinuous (Kittel et al. 1999b). In the boreal regions, this community occurs more commonly on gradual sandy shorelines. Soils are also variable and range from sandy and well-drained to poorly drained silty clay loam or silty clay alluvium to organic; however, soils tend to be finer-textured, alkaline and may be saline (Brotherson and Barnes 1984, Padgett et al. 1989, Kittel et al. 1999b). 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
Dinosaur National Monument
A dense stand of *Juncus balticus* characterizes this association. Mesic grasses, including *Muhlenbergia asperifolia, Distichlis spicata, Leymus cinereus, Hordeum brachyantherum,* and *Agrostis stolonifera*, commonly occur with *Juncus balticus*. Forbs may be present but none with significant cover. Shrubs occasionally occur and may include *Artemisia tridentata* ssp. *tridentata* and *Chrysothamnus linifolius*.

Globally
This 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 jubatum, Muhlenbergia asperifolia, Pascopyrum smithii, Poa nemoralis* ssp. *interior, Phleum alpinum,* and *Sporobolus airoides*. Forb cover is generally low but may include *Caltha leptosepala, Glaux maritima, Maianthemum stellatum, Rumex aquaticus, Cirsium scariosum, Achillea millefolium, Artemisia ludoviciana, Potentilla plattensis, Polygonum bistortoides, Dodecatheon pulchellum,* and *Iris missouriensis*. Shrubs and dwarf-shrubs are not common; however, *Artemisia frigida* cover may be significant in some stands, and occasional *Artemisia tridentata* ssp. *tridentata, Ericameria nauseosa, Dasiphora fruticosa* ssp. *floribunda*, *Populus* spp., *Salix* spp., or *Sarcobatus vermiculatus* shrubs may occur. Some stands may be codominated by the introduced perennial sod grasses *Poa pratensis* or *Agrostis stolonifera*. Other introduced species, such as *Cirsium arvense, Erodium cicutarium, Iva axillaris, Lactuca serriola, Phleum pratense, Taraxacum officinale, Thinopyrum intermedium, Trifolium* spp., *Tragopogon dubius*, and *Xanthium strumarium*, may occur in disturbed stands.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Herb (field)	*Distichlis spicata, Juncus balticus, Muhlenbergia asperifolia*

Globally

Stratum	**Species**
Herb (field)	*Juncus balticus*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Agrostis stolonifera, Cirsium arvense, Cirsium vulgare, Melilotus officinalis

Globally
Data are not available.

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
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
Dinosaur National Monument Inventory Notes: Many wetland types at Dinosaur National Monument include *Juncus balticus*. This association is recognizable in that *Juncus balticus* is a clear dominant, although it rarely occurs in pure stands. All stands are small.
Dinosaur National Monument Data Sources: This association is described from 2002 field data (1 plot: DINO.0610).
Local Description Authors: J. Thompson, mod. 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 1992, Muldavin et al. 2000a, Murray 2000, Mutel 1973, Mutz and Graham 1982, NVNHP 2003, Olson and Gerhart 1982, Padgett 1981, Padgett 1982, Padgett et al. 1989, Rector 1979, Richard et al. 1996, 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, WNHP unpubl. data, Wasser and Hess 1982, Western Ecology Working Group n.d., Youngblood et al. 1985a

Spartina gracilis Herbaceous Vegetation
Alkali Cordgrass Herbaceous Vegetation

CODE	CEGL001588
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	*SPARTINA GRACILIS* SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1407) Alkali Cordgrass Seasonally Flooded Herbaceous Alliance
ECOLOGICAL SYSTEM(S):	Inter-Mountain Basins Playa (CES304.786) North American Arid West Emergent Marsh (CES300.729) Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY
Globally
This association has only been described from plots in northern Colorado, Utah and Oregon, but it is likely to occur throughout the western U.S. In Colorado, these wetland meadows occur in small patches in swales and on banks, terraces and overflow channels of gentle-gradient streams and rivers at low to middle elevations. Soils are alkaline, fine-textured silt loams and clay loams. The vegetation is a sparse to thick herbaceous layer of grasses and grasslike plants that is dominated by *Spartina gracilis*. Other herbaceous species that are known to occur include *Equisetum hyemale*, *Distichlis spicata*, *Triglochin maritima*, and *Asclepias speciosa*. Deciduous trees and shrubs occur with minimal cover and are usually restricted to the margins of stands. This association requires a seasonally high water table and alkaline soils in order to persist. Information on stands that occur outside Colorado will be added later as it becomes available.

DISTRIBUTION
Dinosaur National Monument
This association was documented from the banks of the Green River.

Globally
This association has been described from plots in northern Colorado, Utah and Oregon. It is likely to occur throughout the western U.S.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This wetland association occurs on the banks of gentle-gradient streams and rivers at low to middle elevations. The soils are finer-textured and hold water better than the sandy soils that dominate these low riparian terraces.

Globally
This wet meadow association occurs in small patches in swales and on banks, terraces and overflow channels of gentle-gradient streams and rivers at low to middle elevations in northern Colorado. Soils are alkaline, fine-textured silt loams and clay loams.

VEGETATION DESCRIPTION
Dinosaur National Monument
This herbaceous association is characterized by sparse to dense cover of Spartina gracilis. Other herbaceous species that are known to occur include *Equisetum hyemale* and *Asclepias speciosa*. Deciduous trees and shrubs occur with minimal cover.

Globally
This herbaceous association is characterized by sparse to dense cover of *Spartina gracilis* with few other species. Other herbaceous species that are known to occur include *Equisetum hyemale, Distichlis spicata, Triglochin maritima,* and *Asclepias speciosa*. Deciduous trees and shrubs occur with minimal cover and are usually restricted to the margins of stands.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Herb (field)	*Spartina gracilis*

Globally

Stratum	**Species**
Herb (field)	*Spartina gracilis*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Dinosaur National Monument Inventory Notes: The available data for this association lack environmental information. This association occurs in slight depressions on streambanks.
Dinosaur National Monument Data Sources: This description is derived from field data collected in the 1990s (1 plot: GR121).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Baker 1984b, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Carsey et al. 2003a, Driscoll et al. 1984, Hanson 1929, IDCDC 2005, Jones 1992b, Kagan et al. 2004, MTNHP 2002b, NVNHP 2003, Sawyer and Keeler-Wolf 1995, Ungar 1972, Ungar 1974c, Western Ecology Working Group n.d.

Phragmites australis Western North America Temperate Semi-natural Herbaceous Vegetation
Common Reed Western North America Temperate Semi-natural Herbaceous Vegetation

Western Reed Marsh

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.l.)
ALLIANCE	*PHRAGMITES AUSTRALIS* 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) Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)
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 semipermanently 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
Dinosaur National Monument
This association occurs throughout the monument near springs, stream edges, and overflow channels.

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
Dinosaur National Monument
This wetland association occupies seeps, ditches, pond margins, stream banks and overflow channels of streams at elevations below 2000 m. The fine-textured, mucky soil is saturated in the spring and usually dries out by late summer. The nonvegetated soil surface is covered with a dense mat of organic litter and moss.

Globally
This association is widespread in the western U.S. and Canada. Elevation ranges from 640-1980 m. Stands occur in temporarily to semipermanently 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 type often occurs in small 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
Dinosaur National Monument
This tall, dense herbaceous association is strongly dominated by *Phragmites australis*. Some species that are commonly associated include *Typha latifolia, Glyceria striata, Equisetum laevigatum, Juncus balticus,* and *Solidago canadensis*. Shrubs may contribute less than 5% total cover and include *Salix exigua, Rhus trilobata*, and *Rosa woodsii*.

Globally
The vegetation is variable, as *Phragmites australis* will invade existing natural or semi-natural communities. Once established, this community is usually strongly dominated by *Phragmites australis* with few or no other vascular plants present. Stands have a 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*, and *Solidago canadensis*. Introduced species such as *Lepidium latifolium* and *Cirsium arvense* may be present and compete well against *Phragmites australis* in disturbed sites.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Herb (field)	*Solidago canadensis*
Herb (field)	*Glyceria striata, Phragmites australis, Typha latifolia*

Globally

Stratum	**Species**
Herb (field)	*Phragmites australis*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Cirsium arvense

Globally
Cirsium arvense

CONSERVATION STATUS RANK
Global Rank & Reasons: G5 (20-Sep-2000).

CLASSIFICATION COMMENTS
Dinosaur National Monument
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 conceptually and nomenclaturally.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Dinosaur National Monument Inventory Notes: Data are not available.
Dinosaur National Monument Data Sources: This association is described from 2002 and 2003 field data (1 plot: DINO.1410, and 4 observation points: DINO.8400, DINO.8402, DINO.9102, DINO.9154).
Local Description Authors: J. Thompson, mod. J. Coles
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 acutus Herbaceous Vegetation
Hardstem Bulrush Herbaceous Vegetation

Bulrush Marsh

CODE	CEGL001840
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.l.)
ALLIANCE	*SCHOENOPLECTUS ACUTUS - (SCHOENOPLECTUS TABERNAEMONTANI)* SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1443) Hardstem Bulrush - (Softstem Bulrush) Semipermanently Flooded Herbaceous Alliance

ECOLOGICAL SYSTEM(S):
Inter-Mountain Basins Interdunal Swale Wetland (CES304.059)
North American Arid West Emergent Marsh (CES300.729)
Northern Columbia Plateau Basalt Pothole Ponds (CES304.058)
Temperate Pacific Freshwater Emergent Marsh (CES200.877)
North Pacific Coastal Interdunal Wetland (CES204.062)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY
Globally
This association is a common emergent wetland type ranging from the Puget Sound of Washington to Montana south to California, Nevada and Utah. Stands occur along low-gradient, meandering, usually perennial streams, river floodplain basins, and around the margins of ponds and shallow lakes especially in backwater areas. Some sites are flooded most of the year with about 1 m of fresh to somewhat saline or alkaline water. Other sites, however, dry up enough in late summer to where the water table drops below the ground surface, though the soils are still partially saturated. Soils are generally deep, organic, alkaline, poorly drained and fine-textured, but range in soil textures from sand to clay to organic muck. The soils may be normal or saline. Vegetation is characterized by a dense tall herbaceous vegetation layer 1-3 m tall that is dominated by *Schoenoplectus acutus*, often occurring as a near monoculture. Associated species include low cover of *Mentha arvensis*, *Polygonum amphibium*, *Sagittaria latifolia*, and species of *Carex*, *Eleocharis*, *Rumex*, and *Typha*. Early in the growing season or at permanently flooded sites, aquatic species such as *Potamogeton* spp. and *Lemna minor* may be present to abundant. Stands of this association contain no tree or shrub layer, but a few sites have been invaded by the introduced shrub *Tamarix* spp.

DISTRIBUTION
Dinosaur National Monument
This association is known from the Gates of Lodore Canyon on the Green River. It may also occur in similar environments along the Yampa River.

Globally
This association is a common emergent wetland found mostly in the interior western U.S. from Washington to Montana south to California, Nevada and Utah.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument
This association occurs along low-gradient streams and overflow channels within floodplains. Soils are poorly drained, and texture ranges from muck to sandy clay. The soil surface is matted with organic litter. Elevation is below 2000 m.

Globally
This association is a common emergent herbaceous wetland found mostly in the interior western U.S. Elevations range from near sea level to 2030 m. Stands occur along low-gradient, meandering, usually perennial streams, river floodplain basins, in overflow channels and around the margins of ponds and shallow lakes especially in backwater areas. Some sites are flooded most of the year with about 1 m of fresh to somewhat saline or alkaline water. Other sites, however, dry up enough in late summer to where the water table drops below the ground surface, though the soils are still partially saturated. Soils are generally deep, organic, alkaline, poorly drained and fine-textured, but range in soil textures from sand to clay to organic muck. The soils may be normal or saline.

VEGETATION DESCRIPTION
Dinosaur National Monument
This tall, dense herbaceous vegetation association is dominated by *Schoenoplectus acutus*. Other herbaceous species present are variable in composition and percent cover. Some species known to occur in the monument with significant cover are *Hordeum jubatum* and *Asclepias speciosa*. Shrubs and trees are absent.

Globally
This wetland association is characterized by a dense tall herbaceous vegetation layer 1-3 m tall that is dominated by *Schoenoplectus acutus*, often occurring as a near monoculture. Associated species include low cover of *Mentha arvensis*, *Hordeum jubatum*, *Asclepias speciosa*, *Polygonum amphibium*, *Sagittaria latifolia*, and species of *Carex*, *Eleocharis*, *Rumex*, and *Typha*. Early in the growing season or at the more permanently flooded sites, aquatic species such as *Potamogeton* spp. and *Lemna minor* may be present to abundant. Stands of this association contain no tree or shrub layer, but a few sites have been invaded by the introduced shrub *Tamarix* spp.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Herb (field)	*Asclepias speciosa*
Herb (field)	*Hordeum jubatum, Schoenoplectus acutus*

Globally

Stratum	**Species**
Herb (field)	*Schoenoplectus acutus*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

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

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
This association appears to be somewhat variable in flood regime. It is flooded less time than some of the other *Schoenoplectus acutus* associations in this semipermanently flooded alliance with some stands included in this association occurring in a seasonally flooded hydrologic regime. However, stands described by Kunze (1994) from western Washington were permanently flooded with shallow water (about 1 m deep). Additional research is needed to determine if the different hydrological regimes indicate a need to split out new associations.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association occurs in very small patches and is uncommon.
Dinosaur National Monument Data Sources: This association is described from 2002 field data (1 plot: DINO.0312).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: K.A. Schulz, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, Bundy et al. 1996, Christy 2004, Christy and Cornelius 1980, Christy et al. 1998, Crowe et al. 2004, Dethier 1990, Driscoll et al. 1984, Evans 1989a, Evans 1989b, Griffiths 1902, Hansen et al. 1991, Hansen et al. 1995, IDCDC 2005, Jankovsky-Jones et al. 1999, Jefferson 1975, Kagan et al. 2000, Kierstead and Pogson 1976, Kunze 1994, MTNHP 2002b, Macdonald 1977, Moseley 1998, NVNHP 2003, Padgett et al. 1989, Sawyer and Keeler-Wolf 1995, Thomas 1980, Youngblood et al. 1985a

Schoenoplectus pungens Herbaceous Vegetation
Common Threesquare Herbaceous Vegetation

Bulrush Wet Meadow

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.l.)
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
Dinosaur National Monument
This association was sampled at Lower Disaster Falls on the Green River and in Red Rock Canyon, a tributary of the Yampa River. It may also occur on level sites around springs, small streams and abandoned river channels throughout the monument, wherever there is relatively non-saline groundwater available throughout the growing season.

Globally
This community is found in the western United States in the intermountain basins, as well as in western parts of the Great Plains, from east-central Alberta, Canada, and Montana south to Colorado, and west into Nevada, Utah, and Wyoming.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument

This wetland association occurs along gentle-gradient streams and overflow channels within river floodplains. Soils are poorly drained, and texture ranges from muck to sandy clay. The soil surface is matted with organic litter. Elevation is below 2000 m.

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
Dinosaur National Monument
This is a tall, dense herbaceous vegetation association codominated by *Schoenoplectus pungens. Juncus balticus* or *Agrostis gigantea* may have as high cover as *Schoenoplectus pungens*. Other herbaceous species present are variable in composition and percent cover but are not as abundant as those mentioned above. Minor co-occurring species include *Equisetum* spp., *Hordeum jubatum, Phleum pratense, Muhlenbergia asperifolia, Carex* spp., and *Melilotus officinalis*. The federally listed (Threatened) orchid *Spiranthes diluvialis* is also known to occur in this habitat. Shrubs and trees are absent from this association.

Globally
This widespread wetland association is characterized by a dense, 0.3- to 0.6-m tall herbaceous vegetation layer that is 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*. The more northern stands are dominantly *Schoenoplectus pungens* with 50% cover or greater with no other constant or significant species.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Herb (field)	*Schoenoplectus pungens*

Globally

Stratum	**Species**
Herb (field)	*Schoenoplectus pungens*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Agrostis stolonifera, Melilotus officinalis, Spiranthes diluvialis

Globally
Agrostis stolonifera, Melilotus officinalis, Spiranthes diluvialis

CONSERVATION STATUS RANK
Global Rank & Reasons: G3G4 (9-Apr-1998).

CLASSIFICATION COMMENTS
Dinosaur National Monument
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
Dinosaur National Monument Inventory Notes: One plot assigned to this association was fenced, excluding cattle grazing. The other plot was in a location inaccessible to cattle. Schoenoplectus pungens may not always be dominant but is at least codominant with other graminoids.
Dinosaur National Monument Data Sources: This association is described from 2002 field data (2 plots: DINO.0019, DINO.0198).
Local Description Authors: J. Thompson, mod. J. Coles
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.

Calamagrostis scopulorum Hanging Garden Herbaceous Vegetation
Ditch Reedgrass Hanging Garden Herbaceous Vegetation

CODE	CEGL002751
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
FORMATION	Saturated temperate or subpolar grassland (V.A.5.N.m.)
ALLIANCE	*CALAMAGROSTIS SCOPULORUM* SATURATED HANGING GARDEN HERBACEOUS ALLIANCE (A.2655) Ditch Reedgrass Saturated Hanging Garden Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Hanging Garden (CES304.764)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This wetland seep community usually occurs in alcoves and in horizontal fractures in limestone or sandstone canyon walls in northwestern Colorado and eastern Utah. Many stands are inaccessible, but one documented site is on the bank of an intermittent wash where groundwater rises to the surface. Elevation ranges from 1400 to 1675 m (4600-5500 feet). Soil collects on ledges fed by dripping groundwater and becomes the substrate for small patches of wetland vegetation. Soils are poorly developed, sandy and moist throughout the growing season. This is a lush herbaceous association dominated by *Calamagrostis scopulorum*. Other herbaceous species common to this association include *Comandra umbellata, Solidago missouriensis, and Juncus balticus*. Although a shrub layer is lacking, scattered *Tamarix ramosissima, Rosa woodsii, Rhus trilobata,* and *Salix exigua* are known to occur on the margins of the community. Typical hanging garden forb species such as *Mimulus eastwoodiae, Aquilegia micrantha* or *Adiantum capillus-veneris* are absent or have very low cover.

DISTRIBUTION

Dinosaur National Monument
This association is known from Starvation Canyon and may occur in alcoves and canyon wall crevices throughout the monument where groundwater exits limestone substrates.

Globally
This association has been documented from canyons in northwestern Colorado and eastern Utah.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This wetland seep association occurs in horizontal crevices of limestone walls and alcoves at elevations below 2000 m. Soil collects on ledges fed by dripping groundwater and becomes the substrate for this small patch of wetland vegetation. The soils are moist throughout the growing season.

Globally
This wetland seep association usually occurs in alcoves and in horizontal fractures in limestone or sandstone canyon walls in northwestern Colorado and eastern Utah. One site is on the bank of an intermittent wash where groundwater is close to the surface. Elevation ranges from 1400 to 1675 m (4600-5500 feet). Soil collects on ledges fed by dripping groundwater and becomes the substrate for this small patch of wetland vegetation. The soils are poorly developed, sandy and moist throughout the growing season.

VEGETATION DESCRIPTION
Dinosaur National Monument
This is a lush herbaceous vegetation association dominated by *Calamagrostis scopulorum*. Other herbaceous species common to this association include *Clematis ligusticifolia*, *Carex* spp., *Solidago missouriensis*, and *Juncus balticus*. Although a shrub layer is lacking, scattered *Tamarix ramosissima, Rosa woodsii, Rhus trilobata*, and *Salix exigua* are known to occur with sparse cover within or just below the alcove containing the seep.

Globally
This is a lush herbaceous association dominated by *Calamagrostis scopulorum*. Other herbaceous species common to this association include *Comandra umbellata, Solidago missouriensis*, and *Juncus balticus*. Although a shrub layer is lacking, scattered *Tamarix ramosissima, Rosa woodsii, Rhus trilobata*, and *Salix exigua* are known to occur with sparse cover within or just below the alcove containing the seep. Typical hanging garden forb species such as Mimulus eastwoodiae, *Aquilegia micrantha*, or *Adiantum capillus-veneris* are absent or have very low cover.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Herb (field)	*Clematis ligusticifolia*
Herb (field)	*Calamagrostis scopulorum*

Globally

Stratum	**Species**
Herb (field)	*Calamagrostis scopulorum*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Agrostis stolonifera, Tamarix ramosissima

Globally
Primula specuicola

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

CLASSIFICATION COMMENTS
Globally
This association is part of a complex of groundwater-dependent 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 (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).

This association is relatively rare among hanging gardens. It can be distinguished from other hanging garden types by the overwhelming dominance of *Calamagrostis scopulorum* and a lack of other typical hanging garden species such as *Aquilegia micrantha, Adiantum capillus-veneris,* or *Mimulus eastwoodiae.*

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is relatively rare among hanging gardens within the monument. It is likely to occur more often in limestone (as opposed to the more common sandstone) seeps, but the sites are usually inaccessible by field crews. The association can be distinguished from other hanging garden types by the overwhelming dominance of *Calamagrostis scopulorum* and a lack of other typical hanging garden species such as *Aquilegia micrantha*.
Dinosaur National Monument Data Sources: This association is described from 2002 field data (1 plot: DINO.0690, 1 observation point: DINO.9019).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Evenden pers. comm., Fowler 1995, Spence pers. comm., Welsh 1989, Welsh and Toft 1981

Artemisia tridentata ssp. *wyomingensis / Pascopyrum smithii* Shrub Herbaceous Vegetation
Wyoming Big Sagebrush / Western Wheatgrass Shrub Herbaceous Vegetation

CODE	CEGL001047
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	*ARTEMISIA TRIDENTATA* SSP. *WYOMINGENSIS* SHRUB HERBACEOUS ALLIANCE (A.1527) Wyoming Big Sagebrush Shrub Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)
Inter-Mountain Basins Big Sagebrush Steppe (CES304.778)
Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This Wyoming big sagebrush type is found throughout the northern Great Plains and adjacent basins, Black Hills, and Rocky Mountains of the United States. Stands occur on gently rolling uplands or upper parts of stream terraces and drainageways. Drier examples may be found on more exposed slope positions. Soils are moderately deep clay, clay loam, silt loam and loam. Soil moisture conditions are relatively mesic. Soil pH ranges from 5.8 to 7.8. The vegetation contains an open short-shrub layer, approximately 0.5 m tall, dominated by microphyllous-leaved shrubs, and a dense herbaceous layer dominated by medium-tall graminoids. Shrub cover averages between 15 and 30% but may range as high as 55%. *Artemisia tridentata* ssp. *wyomingensis* dominates the shrub layer. Other shrubs may be present, including *Symphoricarpos oreophilus, Ericameria nauseosa, Amelanchier utahensis,* or *Purshia tridentata*. The dense herbaceous layer has a canopy cover of 10% in dry, heavily grazed stands to more than 75% in protected, mesic stands. Pascopyrum smithii is the leading dominant. Important associates include *Koeleria macrantha, Poa secunda,* and *Nassella viridula*. In drier or more heavily grazed phases, *Bouteloua gracilis, Hesperostipa comata,* and *Carex filifolia* may be more common, along with the succulent *Opuntia polyacantha*. Forbs contribute low cover, often less than 10%, and are typically of low constancy. More constant species (>50%) include Artemisia frigida, *Sphaeralcea coccinea,* and *Vicia americana*. Grassy leaf litter covers over 75% of the ground; stones and bare soil comprise the remainder.

Nonvascular plants are rare.

DISTRIBUTION

Dinosaur National Monument

This association is known from Iron Mine Ridge on Douglas Mountain.

Globally

This Wyoming big sagebrush type is found throughout the northern Great Plains and adjacent basins, Black Hills, and Rocky Mountains of the United States, particularly in Colorado and Wyoming.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occupies gentle slopes and swales of the high plateau country of the monument. Elevations range from 2200 to 2300 m. Litter covers most of the unvegetated ground surface, and soils are deep, sandy or silty loams.

Globally

Stands occur on gently rolling uplands, swales or upper parts of stream terraces and drainageways. Drier examples may be found on more exposed slope positions or steeper slopes. Soils are moderately deep to deep clay, clay loam, silt loam or sandy loam. Soil moisture conditions are relatively mesic. Soil pH ranges from 5.8 to 7.8 (Hirsch 1985, Hansen and Hoffman 1988, Thilenius et al. 1995).

VEGETATION DESCRIPTION

Dinosaur National Monument

This shrub association has between 35 and 55% cover of *Artemisia tridentata* ssp. *wyomingensis* in the shrub stratum. Other shrubs with low cover include *Symphoricarpos oreophilus, Ericameria nauseosa, Amelanchier utahensis*, or *Purshia tridentata*. *Pascopyrum smithii* dominates the herbaceous layer with at least 5% cover and higher cover than any other grass species. Total herbaceous vegetation cover is 10 to 30%.

Globally

The vegetation contains an open short-shrub layer, approximately 0.5 m tall, dominated by microphyllous-leaved shrubs, and a dense herbaceous layer dominated by medium-tall graminoids. Shrub cover averages between 15 and 30% (Hirsch 1985, Hansen and Hoffman 1988, Thilenius et al. 1995) but may range as high as 55%. *Artemisia tridentata* ssp. *wyomingensis* dominates the shrub layer. Other shrubs present may include *Symphoricarpos oreophilus, Ericameria nauseosa, Amelanchier utahensis*, or *Purshia tridentata*. The dense herbaceous layer has a canopy cover ranging between 10% in heavily grazed sites to over 75% in protected, mesic sites. *Pascopyrum smithii* is the leading dominant. Important associates include *Koeleria macrantha, Poa secunda*, and *Nassella viridula*. In drier or more heavily grazed phases, *Bouteloua gracilis, Hesperostipa comata*, and *Carex filifolia* may be more common, along with the succulent *Opuntia polyacantha*. Forbs contribute low cover, often less than 10%, and are typically of low constancy. More constant species (>50%) include *Artemisia frigida, Sphaeralcea coccinea*, and *Vicia americana*. Grassy leaf litter covers over 75% of the ground; stones and bare soil comprise the remainder. Nonvascular plants are rare (Hirsch 1985, Hansen and Hoffman 1988, Thilenius et al. 1995).

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Pascopyrum smithii*

Globally

Stratum	**Species**
Short shrub/sapling	*Artemisia tridentata* ssp. *wyomingensis*
Herb (field)	*Pascopyrum smithii*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Data are not available.

Globally

Hesperostipa comata, Koeleria macrantha, Opuntia polyacantha, Poa secunda

CONSERVATION STATUS RANK
Global Rank & Reasons: G4 (23-Feb-1994).
CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Data are not available.
Dinosaur National Monument Data Sources: This description is based on 2002 field data (2 plots: DINO.0155, DINO.0252).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: D. Faber-Langendoen, mod. J. Coles

REFERENCES: Baker 1982b, Baker 1983c, Baker and Kennedy 1985, Bear Creek Uranium Mine Application n.d., Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Cotter-Ferguson Project n.d., Driscoll et al. 1984, Earth Resource Technology n.d., Ellis and Hackney 1981, Francis 1983, Hansen and Hoffman 1988, Hansen et al. 1980, Hansen et al. 1984, Heidel and Jean 2002, Hirsch 1985, Keammerer 1987, MTNHP 2002b, NDNHI n.d., Skull Point Mine Application n.d., Skull Point Mine Permit Renewal n.d., Strong 1980, Sweetwater Uranium Project 1978, Thilenius et al. 1995, Tiedemann et al. 1987, Von Loh et al. 2000, 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	*MUHLENBERGIA PUNGENS* 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 feet), 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

Dinosaur National Monument

This association is restricted to sandy outcrops of Browns Park Formation near the Gates of Lodore. It was sampled near Conway Draw and is not likely to occur elsewhere in the mapping area.

Globally

This association has been documented from southern Utah and northwestern Colorado.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occupies eolian sand dunes and blowouts on flat to gentle slopes at elevations below 1800 m. Soils are course, rapidly drained loamy sands and lack significant ground cover.

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 feet), 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

Dinosaur National Monument

This herbaceous vegetation association is characterized by ring-like patches of *Muhlenbergia pungens* (10-20% cover) distributed across sand dunes and blowouts. The community typically occurs in small patches within stands of sagebrush shrublands and juniper woodlands. Other vegetation is high in species diversity but sparse in total percent cover. Some commonly associated species include *Aristida purpurea, Sporobolus cryptandrus, Cryptantha* spp., *Gutierrezia sarothrae*, and *Chrysothamnus* spp.

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

Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Gutierrezia sarothrae*
Herb (field)	*Muhlenbergia pungens*

Globally

Stratum	**Species**
Herb (field)	*Muhlenbergia pungens*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Data are not available.

Globally

Yucca elata var. *utahensis*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (22-Mar-2005).

CLASSIFICATION COMMENTS
Dinosaur National Monument
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
Dinosaur National Monument Inventory Notes: This association is uncommon within the monument. However, when it does occur, it likely only occupies very small patches and could be overlooked in field sampling and mapping.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (2 plots: DINO.0819, DINO.0830).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

Equisetum hyemale Herbaceous Vegetation
Common Scouring-rush Herbaceous Vegetation

CODE	CEGL002760
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	Semipermanently flooded temperate perennial forb vegetation (V.B.2.N.e.)
ALLIANCE	*EQUISETUM (ARVENSE, VARIEGATUM, HYEMALE)* SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.3539) (Field Horsetail, Variegated Scouring-rush, Common Scouring-rush) Semipermanently Flooded Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This wetland association has only been described from the Green and Yampa river drainages in northwestern Colorado and probably in adjacent eastern Utah, and it is expected to occur adjacent to perennial or intermittent streams or springs throughout the Colorado Plateau. This association occurs in small patches around seeps and ponds, on streambanks, and within floodplains. Soils are typically saturated during the growing season. The vegetation is characterized by moderate to dense cover of *Equisetum hyemale* var. *affine* and typically associated with forb species *Apocynum cannabinum* and *Helenium autumnale* var. *montanum*. Other forbs occur with low cover, but graminoids are largely absent. Seedlings of *Populus deltoides* ssp. *wislizeni* are often present, as are the shrubs *Chrysothamnus linifolius* and *Salix exigua*.

DISTRIBUTION
Dinosaur National Monument
This association is rare in the park, because of the scarcity of perennial streams with a relatively low gradient and a flashy flow regime. It was sampled along the lower reaches of Pot Creek and near Jack Springs in the northern part of the monument.

Globally

This association occurs along the Green River and some of its tributaries in northwestern Colorado and probably in adjacent eastern Utah.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs in narrow belts along the margins of low-gradient tributary streams between 1580 and 1600 m elevation. Litter covers most of the unvegetated surface, with a little cover by bare ground and rocks fallen from the cliffs above. Soils are derived from alluvium and include sands and silts.

Globally

This plant association occurs in small stands on level to moderately sloping sandbars and terraces adjacent to rivers and perennial streams in northwestern Colorado. Stands may also occur adjacent to springs and seeps. Elevations of documented sites range between 1580 and 2070 m (5180-6800 feet). Soils are generally saturated, sandy or silty in texture, and derived from alluvium or sedimentary rock.

VEGETATION DESCRIPTION

Dinosaur National Monument

Total vegetation cover is between 50% and more than 100% in this riparian wetland type. Scattered *Acer negundo* trees may provide sparse shade, but the vegetation is clearly dominated by *Equisetum hyemale* with between 40 and 90% cover. *Salix exigua* and *Tamarix ramosissima* shrubs may also occur along the edges of stands. Graminoids and forbs present are variable and tend to be of species that are rhizomatous or otherwise tolerate annual scouring-type floods; they include *Agrostis stolonifera, Asclepias speciosa, Glycyrrhiza lepidota,* and *Phragmites australis*.

Globally

This community is characteristic of sites with periodic scouring floods or other disturbance. It generally occurs in small patches composed mainly of *Equisetum hyemale* with minor cover of associated species, including *Heterotheca villosa* and *Rorippa palustris* ssp. *hispida*. Total vegetation cover ranges from 25% to more than 100% depending on degree of soil saturation and how long the vegetation has had to develop since the latest flood. Native shrubs such as *Chrysothamnus linifolius* and *Salix exigua* may be minor elements of the community. Exotic species are often present, including *Tamarix ramosissima, Bromus tectorum, Agrostis stolonifera,* and *Phragmites australis*.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Acer negundo*
Tall shrub/sapling	*Salix exigua*
Herb (field)	*Equisetum hyemale*

Globally

Stratum	**Species**
Herb (field)	*Equisetum hyemale*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Agrostis stolonifera, Phragmites australis, Tamarix ramosissima

Globally

Agrostis stolonifera, Bromus tectorum, Phragmites australis, Tamarix ramosissima

CONSERVATION STATUS RANK

Global Rank & Reasons: G3 (6-Jun-2006). This association is restricted to a small range (northwestern Colorado) and is limited to a small number of occurrences (fewer than 20), although more stands are likely to exist. Stands themselves tend to be small and temporary, as they depend on frequent scouring floods to keep succession by more competitive species at bay.

CLASSIFICATION COMMENTS

Dinosaur National Monument

Data are not available.

Globally
This association occurs in very small patches and was probably overlooked during fieldwork for the Dinosaur Vegetation Mapping Project because the patches did not meet the size criterion for sampling. It is described here from data collected during previous studies along the Green River.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is restricted to the margins of low-gradient tributary streams that experience periodic flash flooding.
Dinosaur National Monument Data Sources: This association is described from accuracy assessment data collected in 2005 (2 plots: DINO_AA.A1402, DINO_AA.A1476).
Local Description Authors: J. Coles
Global Description Authors: J. Coles

REFERENCES: CONHP unpubl. data 2003, Carsey et al. 2003a, Western Ecology Working Group n.d.

Equisetum laevigatum Herbaceous Vegetation
Smooth Horsetail Herbaceous Vegetation

CODE	CEGL002241
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	Semipermanently flooded temperate perennial forb vegetation (V.B.2.N.e.)
ALLIANCE	*EQUISETUM LAEVIGATUM* SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.2648) Smooth Horsetail Semipermanently Flooded Herbaceous Alliance
ECOLOGICAL SYSTEM(S):	Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821) Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)
USFWS WETLAND SYSTEM:	Not applicable

CONCEPT SUMMARY
Globally
This rare association occurs on the narrow valley floors and low alluvial terraces of small perennial streams of the Colorado Plateau of Colorado and Utah that are subject to periodic scouring from flooding. Elevations range from 1603 to 1785 m (5260-5855 feet), and slopes do not exceed 8%. The alluvial soils vary in texture from clay or silt to sand, and the soil surface may be bare if flooding has occurred recently, or covered by a mat of older *Equisetum* stems. Total vegetation cover in this association may exceed 100%, but it is dominated by the fern ally *Equisetum laevigatum* with between 20 and 75% cover. Graminoids may provide up to 25% cover and include *Agrostis gigantea, Juncus balticus*, or *Muhlenbergia asperifolia*. Forbs are generally also present and are variable, but usually indicate disturbance. Riparian trees and shrubs, such as *Tamarix ramosissima, Populus* spp., and *Salix* spp., may occur at the margins of the association. Deep rhizome growth allows *Equisetum* plants to survive environmental disturbances such as burial, flooding, fire and drought. As riparian terraces become isolated from flooding and the water table, *Equisetum laevigatum* will persist thanks to its system of rhizomes, but other herbaceous and woody species will tend to become dominant.

DISTRIBUTION
Dinosaur National Monument
This association is known from the Yampa Bench and is likely to occur in very small stands on the banks of the Green and Yampa rivers, on the margins of tributary streams prone to flash flooding, and near cow ponds or reservoirs.

Globally
This type is restricted to small streams in the Colorado Plateau of Colorado and Utah that are subject to flooding and scouring from flooding.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association typically occurs below 1800 m elevation on streambanks, pond edges, and below springs. Soils are sandy, and much of the substrate surface is matted with organic litter.

Globally

This association occurs on the narrow valley floors and low alluvial terraces of small perennial streams that are subject to periodic scouring from flooding. Elevations range from 1603 to 1785 m (5260-5855 feet), slopes do not exceed 8%, and aspect varies. Soils are alluvium derived from shales, sandstones or igneous rocks. The soil surface may be bare if flooding has occurred recently, or covered by a mat of older *Equisetum* stems.

VEGETATION DESCRIPTION

Dinosaur National Monument

Moderate to dense cover of *Equisetum laevigatum* characterizes this herbaceous vegetation association, with between 20 and 50% cover. Woody species such as *Tamarix ramosissima, Ericameria nauseosa*, and *Artemisia tridentata* ssp. *tridentata* may be present with low cover. Associated forbs and grasses are typically weedy or non-native species, including *Iva axillaris, Bromus tectorum,* and *Muhlenbergia asperifolia*.

Globally

This herbaceous association is dominated by the fern ally *Equisetum laevigatum* with between 20 and 75% cover. Graminoids may provide up to 25% cover and include *Agrostis gigantea, Juncus balticus,* or *Muhlenbergia asperifolia*. Forbs are generally also present and are variable, but usually indicate disturbance and include *Cirsium arvense, Tragopogon dubius,* and *Plantago lanceolata*. Riparian trees and shrubs, such as *Tamarix ramosissima, Populus* spp., and *Salix* spp., may occur at the margins of the association.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Herb (field)	*Iva axillaris*
Herb (field)	*Bromus tectorum, Muhlenbergia asperifolia*
Herb (field)	*Equisetum laevigatum*

Globally

Stratum	Species
Herb (field)	*Equisetum laevigatum*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Bromus tectorum, Tamarix ramosissima

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (10-Jan-2005).

CLASSIFICATION COMMENTS

Dinosaur National Monument

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Dinosaur National Monument Inventory Notes: The only sampled site is on Pool Creek, a tributary of the Yampa River.

Dinosaur National Monument Data Sources: This association is described from 2002 field data (1 plot: DINO.0203).

Local Description Authors: J. Thompson, mod. J. Coles

Global Description Authors: J. Coles

REFERENCES: Hauke 1993, Page 1977, Western Ecology Working Group n.d.

Aquilegia micrantha - Calamagrostis scopulorum Herbaceous Vegetation
Mancos Columbine - Ditch Reedgrass Herbaceous Vegetation

CODE	CEGL002592
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	*AQUILEGIA MICRANTHA* 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: Not applicable

CONCEPT SUMMARY

Globally

This association is confined to seeps emerging from sandstone cliffs in the Colorado Plateau and lower elevation canyons in adjacent southern Rocky Mountains where it may occur on metamorphic substrates. Elevations are below 2000 m. Aspect is not important in determining the distribution of this association. Instead, seeps will tend to occur on the side of the canyon where gravity and hydrology combine to force groundwater out. The unvegetated surface often has high cover of bare soil, sometimes coated with a white calcareous crust or bedrock. For the most part, soils are derived from dissolution of sandstone grains and fragments from adjacent slopes and ledges and are saturated year-round from water seeping between sedimentary rock layers. In the case of a stand in the Black Canyon of the Gunnison, a north-facing alcove with a seep and overhanging ledge is cut into Black Canyon schist and gneiss. Total vegetation cover ranges from 20 to 75% and is characterized by clumps of *Calamagrostis scopulorum* and *Aquilegia micrantha*. In drier gardens, *Schizachyrium scoparium* may be dominant. Other herbaceous species occurring frequently in this association include *Zigadenus vaginatus, Epipactis gigantea, Platanthera zothecina, Cirsium ownbeyi, Petrophyton caespitosum, Dodecatheon pulchellum, Clematis ligusticifolia, Solidago nana, Pellaea glabella, Zigadenus elegans,* and *Solidago velutina*. There is no developed shrub or tree layer, but most occurrences include scattered woody plants such as *Pinus edulis, Amelanchier utahensis, Prunus virginiana, Paxistima myrsinites, Cercocarpus intricatus, Glossopetalon spinescens* var. *meionandrum, Betula occidentalis, Brickellia* sp., *Ericameria* sp., *Symphoricarpos rotundifolius, Holodiscus dumosus*, and *Rhus trilobata*.

DISTRIBUTION

Dinosaur National Monument

This association is known from the labyrinth canyons cut into Weber sandstone near Ely Creek and similar narrow side canyons near Cleopatra's Couch on the Yampa River.

Globally

This association has been documented from the Colorado Plateau and Uinta Basin of western Colorado and eastern Utah. It may also occur at Zion National Park (Malanson 1980, 1982), although it was not documented there during a recent (2003) NPS vegetation mapping effort.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This hanging garden association occurs on horizontal ledges and crevices of sandstone cliff walls and canyon alcoves at elevations below 2000 m. Sandy soils that accumulate in the cliff crevices or at the bases of canyon alcoves are saturated year-round from water seeping between sedimentary rock layers. Samples taken of this association all occur on southwesterly aspects and moderate to very steep slopes (cliffs).

Globally

This hanging garden association occurs on ledges and in crevices and alcoves in near-vertical sandstone canyon

walls in southeastern Utah and northwestern Colorado and in Black Canyon on the Gunnison metamorphic substrate in west-central Colorado. Elevations are below 2000 m. Sandy soils that accumulate in the cliff crevices or at the bases of canyon alcoves are saturated year-round from water seeping between sedimentary rock layers or in the case of Black Canyon, a north-facing alcove with a seep and overhanging ledge is cut into Black Canyon schist and gneiss. Aspect is not important in determining the distribution of this association. Instead, seeps will tend to occur on the side of the canyon where gravity and hydrology combine to force water out. The unvegetated surface often has high cover of bare soil, sometimes coated with a white calcareous crust or bedrock. For the most part, soils are derived from dissolution of sandstone grains and fragments from adjacent slopes and ledges.

VEGETATION DESCRIPTION

Dinosaur National Monument

This association is characterized by the co-occurrence of *Aquilegia micrantha* and *Calamagrostis scopulorum* within canyon seeps and alcoves. Together these two species contribute 20 to 50% cover and are typically associated with a high diversity of forbs and grasses, including several rare and endemic species. Some of the commonly associated species include *Zigadenus vaginatus, Epipactis gigantea, Cirsium ownbeyi, Petrophyton caespitosum, Dodecatheon pulchellum, Clematis ligusticifolia, Solidago nana, Pellaea glabella,* and *Carex* spp. *Pinus edulis, Juniperus* spp., *Cercocarpus intricatus, Glossopetalon spinescens* var. *meionandrum, Betula occidentalis*, and *Rhus trilobata*, each with low percent cover, are common tree and shrub species in the hanging gardens and their immediate vicinity.

Globally

This association is confined to seeps emerging from sandstone cliffs in the Colorado Plateau. Total vegetation cover ranges from 20 to 75% and is characterized by clumps of *Calamagrostis scopulorum* and *Aquilegia micrantha*. In drier gardens, *Schizachyrium scoparium* may be dominant. Other herbaceous species occurring frequently in this association include *Zigadenus vaginatus, Epipactis gigantea, Platanthera zothecina, Cirsium ownbeyi, Petrophyton caespitosum, Dodecatheon pulchellum, Clematis ligusticifolia, Solidago nana, Pellaea glabella, Zigadenus elegans,* and *Solidago velutina*. There is no developed shrub or tree layer, but most occurrences include scattered woody plants such as *Pinus edulis, Amelanchier utahensis, Prunus virginiana, Paxistima myrsinites, Cercocarpus intricatus, Glossopetalon spinescens* var. *meionandrum, Betula occidentalis, Brickellia* sp., *Ericameria* sp., *Symphoricarpos rotundifolius, Holodiscus dumosus,* and *Rhus trilobata*.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Herb (field)	*Aquilegia micrantha, Clematis ligusticifolia, Dodecatheon pulchellum, Solidago nana*
Herb (field)	*Aquilegia micrantha*

Globally

Stratum	**Species**
Herb (field)	*Equisetum laevigatum*
Herb (field)	*Calamagrostis scopulorum*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Carex curatorum, Cirsium ownbeyi, Epipactis gigantea, Zigadenus vaginatus

Globally

Carex curatorum, Cirsium ownbeyi, Epipactis gigantea, Platanthera zothecina, Zigadenus vaginatus

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (7-Apr-2005).

CLASSIFICATION COMMENTS

Dinosaur National Monument

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 (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: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Mimulus eastwoodiae is missing from the plots at Dinosaur National Monument. *Carex curatorum* has been found only in gardens west of the Colorado-Utah border.
Dinosaur National Monument Data Sources: The description is based on 2002 and 2003 field data (6 plots: DINO.0030, DINO.0031, DINO.0032, DINO.1021, DINO.1411, DINO.1412, and 2 observation points: DINO.8406, DINO.8407).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Evenden pers. comm., Fowler 1995, Malanson 1980, Malanson 1982, 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

Cheatgrass Annual Grassland

CODE	CEGL003109
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, subpolar annual grasslands or forb vegetation (V.D.2.N.)
FORMATION	Short temperate annual grassland (V.D.2.N.d.)
ALLIANCE	*BROMUS TECTORUM* 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
Dinosaur National Monument
This association is known from throughout the monument and specifically from Round Top Mountain, Yampa Bench, Jack Springs Draw, Massey Cabin and the Yampa River corridor.

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

Dinosaur National Monument

This association occurs as a result of fire or heavy livestock grazing within woodland, shrubland or herbaceous communities. It occupies variable aspects, slope angles, and substrates at elevations ranging from 1500 to 2100 m. Soils are typically rapidly drained sandy loams.

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

Dinosaur National Monument

The dominant species in this association is the exotic annual grass *Bromus tectorum*. Grasses that may also occur with low cover include *Elymus lanceolatus, Poa fendleriana, Achnatherum hymenoides, Pseudoroegneria spicata, Hesperostipa comata*, and *Pleuraphis jamesii*. These species were likely dominant or at least present prior to disturbance. Forb species vary but typically include scattered plants of *Sisymbrium altissimum* and *Sphaeralcea coccinea*. Shrubs and dwarf-shrubs are commonly present with minimal cover and include *Sarcobatus vermiculatus, Ephedra viridis, Gutierrezia sarothrae*, and *Opuntia polyacantha*.

Globally

This vegetation type is characterized by a sparse to dense, short, annual graminoid layer that is typically dominated by *Bromus tectorum* with over 80-90% of the total vegetation cover. Other *Eurasian* introduced annual species of *Bromus* which may alternatively dominate or codominate are *Bromus carinatus, Bromus hordeaceus, Bromus madritensis, Bromus japonicus, Bromus rigidus*, or *Bromus 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

Dinosaur National Monument

Stratum	Species
Herb (field)	*Bromus tectorum*

Globally

Stratum	Species
Herb (field)	*Bromus hordeaceus, Bromus japonicus, Bromus madritensis, Bromus rigidus, Bromus rubens, Bromus tectorum*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Bromus tectorum, Sisymbrium altissimum

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (invasive) (1-Dec-1997).

CLASSIFICATION COMMENTS

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
Dinosaur National Monument Inventory Notes: Data are not available.
Dinosaur National Monument Data Sources: The description is based on 2002 and 2003 field data (4 plots: DINO.0367, DINO.0481, DINO.0823, DINO.1416, and 6 observation points: DINO.8004, DINO.9110, DINO.9111, DINO.9130, DINO.9409, DINO.9415).
Local Description Authors: J. Thompson, mod. J. Coles
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

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	*EPHEDRA TORREYANA* 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-degree slopes), occur between 1280 and 1845 m (4200-6050 feet) 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. 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
Dinosaur National Monument
This association is known from the low-elevation hills of the Sage Creek and Red Wash drainages in the northwestern part of the monument.

Globally

This association is known from gypsum outcrops and soils in eastern Utah and western Colorado.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occupies the arid Moenkopi shale badlands of the monument at elevations below 1800 m. Aspect and slope angle vary among sites. Soils are fine-textured, highly erosive, loose and clayey. The ground cover is largely exposed soil and cryptobiotic crusts.

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-degree slopes), occur between 1280 and 1845 m (4200 - 6050 feet) 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

Dinosaur National Monument

A sparse dwarf-shrub canopy of *Ephedra torreyana* and *Atriplex confertifolia* combined with significant cover of gypsophilic cryptobiotic crusts characterize this association. Total shrub cover averages about 10%, and nonvascular species cover ranges from 5 to 50%. Herbaceous species vary among sites and contribute minimal cover. Those that most consistently occur are the bunch grasses *Poa fendleriana* and *Achnatherum hymenoides*.

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

Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Atriplex confertifolia*
Short shrub/sapling	*Ephedra torreyana*

Globally

Stratum	**Species**
Short shrub/sapling	*Ephedra torreyana*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Data are not available.

Globally

Bromus tectorum, Descurainia pinnata, Salsola tragus

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (21-Mar-2005).

CLASSIFICATION COMMENTS

Dinosaur National Monument

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association was restricted to outcrops of red Moenkopi shales near Sage Creek.
Dinosaur National Monument Data Sources: The description is based on 2003 field data (2 plots: DINO.0726, DINO.1023).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

Leymus salinus Shale Sparse Vegetation
Salinas Lyme Grass Shale Sparse Vegetation

Salinas Lyme Grass Tableland

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	*LEYMUS SALINUS* 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 feet), 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
Dinosaur National Monument
This association is known from Twelvemile Gulch and Bill White Draw located south of the Yampa River at the east end of the monument.

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
Dinosaur National Monument
This association occupies steep, north-facing slopes of Mancos or Morrison shales in the monument's valleys below 1900 m in elevation. Soils are fine-textured silty clays that are naturally very erosive. Bunch grasses concentrate eroding soils, creating a terracing effect on the steep slopes, helping to stabilize the soil.

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 feet). 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
Dinosaur National Monument
This herbaceous vegetation association is sparse in total cover. *Leymus salinus* is the dominant, both visually and in terms of cover, with trace cover by the grasses *Bromus tectorum, Poa secunda*, and *Elymus elymoides*. Some shrubs may occur, but with even lower cover, including *Atriplex confertifolia, Atriplex gardneri*, and *Tetradymia spinosa*.

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
Dinosaur National Monument

Stratum	**Species**
Herb (field)	*Leymus salinus*

Globally

Stratum	**Species**
Short shrub/sapling	*Atriplex confertifolia*
Herb (field)	*Leymus salinus*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (26-Jun-2001).

CLASSIFICATION COMMENTS
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Leymus salinus was misidentified as *Psathyrostachys juncea* in one sampled plot. This association may be expected on any steep, eroding gray shale slope.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (1 plot: DINO.0616, 1 observation point: DINO.9043).
Local Description Authors: J. Thompson, mod. J. Coles

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Comer pers. comm., Western Ecology Working Group n.d.

Achnatherum lettermanii Herbaceous Alliance
Letterman's Needlegrass Herbaceous Alliance

CODE	A.2524
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
FORMATION	Medium-tall bunch temperate or subpolar grassland (V.A.5.N.d.)
ALLIANCE	*ACHNATHERUM LETTERMANII* HERBACEOUS ALLIANCE (A.2524) Letterman's Needlegrass Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This alliance is currently only known from the subalpine meadows in the Spring Mountains in southern Nevada and from Dinosuar NM in northwestern Colorado. Stands occur at high elevations on gentle to moderate slopes with no specific aspect. Soils are moderately deep, sandy, and rapidly drained. Vegetation is characterized by dominance or codominance of the perennial bunchgrass *Achnatherum lettermanii*. Associated species vary locally. In Nevada, Elymus trachycaulus or *Oxytropis oreophila* are reported as codominants with high diversity of other herbaceous species. In Colorado, associated species include *Achillea millefolium, Achnatherum hymenoides Danthonia unispicata* and *Heterotheca villosa* in the herbaceous layer and scattered shrubs *Amelanchier utahensis, Ceanothus velutinus, Symphoricarpos oreophilus,* and *Mahonia repens*.

DISTRIBUTION

Dinosaur National Monument

This alliance is known from Douglas Mountain.

Globally

This alliance is currently known only from the Spring Mountains in Nevada and from Dinosuar NM in Colorado. It likely is more widespread as the diagnostic species may occur in montane and subalpine habitats across much of the western US.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This alliance is currently known from the subalpine meadows in the Spring Mountains in southern Nevada and Dinosuar NM in Colorado. In Colorado this alliance occurs at high elevations on gentle to moderate slopes with no specific aspect. Soils are moderately deep, sandy, and rapidly drained. Within the monument, examples of this herbaceous alliance are likely to have been burned in the recent past. The plot sampled for this alliance was in a burned area that was formerly a *Cercocarpus ledifolius* woodland.

Globally

This alliance is currently known from the subalpine meadows in the Spring Mountains in southern Nevada and from Dinosuar NM in northwestern Colorado. Stand in Nevada occur on gentle to moderate slopes at 3245-3290 m elevation. In Colorado stands occur at high elevations (~2573 m) on gentle to moderate slopes with no specific aspect. Soils are moderately deep, sandy, and rapidly drained. No other data is environmental data is available at this time.

VEGETATION DESCRIPTION

Dinosaur National Monument

This herbaceous alliance is dominated within the monument by the perennial bunchgrass *Achnatherum lettermanii* with moderate cover. Other species present are typical of post-burn woodland communities. These species include

traces of the shrubs *Amelanchier utahensis, Ceanothus velutinus, Symphoricarpos oreophilus,* and *Mahonia repens,* the forbs *Achillea millefolium* and *Heterotheca villosa*, and the grasses *Achnatherum hymenoides* and *Danthonia unispicata*. Total herbaceous cover is approximately 20%.

Globally
This alliance is dominated by the perennial bunchgrass *Achnatherum lettermanii* with moderate cover. Associated species vary. In Nevada, *Elymus trachycaulus* or *Oxytropis oreophila* are reported as codominants with high diversity of other herbaceous species. In Colorado, associated species include *Achillea millefolium, Achnatherum hymenoides, Danthonia unispicata* and *Heterotheca villosa* in the herbaceous layer with scattered shrubs such as *Amelanchier utahensis, Ceanothus velutinus, Symphoricarpos oreophilus,* and *Mahonia repens*.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Herb (field)	*Achnatherum lettermanii, Achnatherum hymenoides, Danthonia unispicata*

Globally

Stratum	**Species**
Herb (field)	*Achnatherum lettermanii*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: Not applicable.

CLASSIFICATION COMMENTS
Dinosaur National Monument
Little is known about this alliance. More survey is needed to fully characterize it across its range of distribution.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: Not applicable

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This type is rare in the monument. Most occurrences of *Achnatherum lettermanii* are as the understory of a shrubland association.
Dinosaur National Monument Data Sources: This description was derived from 2002 field data (1 plot: DINO.0532).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: K.A. Schulz

REFERENCES: Nachlinger and Reese 1996, Western Ecology Working Group n.d.

Artemisia tridentata (ssp. *tridentata*, ssp. *xericensis*) Shrubland Alliance
(Basin Big Sagebrush, Foothill Big Sagebrush) Shrubland Alliance

CODE	A.830
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. *TRIDENTATA*, SSP. *XERICENSIS*)

ALLIANCE (A.830)
(Basin Big Sagebrush, Foothill Big Sagebrush) Shrub Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

These shrublands occur throughout the Intermountain West from the western Great Basin to the northern Rocky Mountains and Colorado Plateau. Sites supporting this alliance include sloping fans, footslopes, rolling hills, and deep, well-drained alluvial bottomlands. Soils are deep, fine- to medium-textured alluvial soils with some source of subirrigation during the summer season, but moderately deep upland soils with ample moisture storage also support these shrublands. Some stands occur on deep, sandy soils, or soils that are highly calcareous. The vegetation included in this alliance is characterized by a somewhat sparse to moderately dense (10-70% cover) shrub layer of Artemisia tridentata ssp. tridentata or *Artemisia tridentata* ssp. *xericensis*. Shrub associates include Ericameria nauseosa or *Chrysothamnus viscidiflorus* which increase with disturbance. Other shrubs occasionally present include *Purshia tridentata, Ephedra viridis, Gutierrezia sarothrae, Tetradymia canescens, Sarcobatus vermiculatus*, and *Atriplex* spp. Occasionally individual trees are present in some stands. The relatively sparse herbaceous layer is dominated by bunch grasses (<20% cover) that occupy patches in the shrub matrix. The most widespread species is *Pseudoroegneria spicata*, which occurs from the Columbia Basin to the northern Rockies. Other locally dominant or important species include *Leymus cinereus, Festuca idahoensis, Pascopyrum smithii, Elymus lanceolatus, Elymus elymoides, Pleuraphis jamesii, Koeleria macrantha, Muhlenbergia richardsonis, Hesperostipa comata*, and *Poa secunda*. Forbs are generally of low importance and are highly variable across the range. Mosses and lichens are important ground cover in some stands. Diagnostic of this alliance is the *Artemisia tridentata* ssp. *tridentata*- or *Artemisia tridentata* ssp. *xericensis* dominated shrub layer that lacks a significant graminoid layer (<20% cover perennial graminoids) or has over 40% total cover of shrubs.

DISTRIBUTION

Dinosaur National Monument

This alliance is known from Bear Hollow in the Yampa Plateau region of the monument.

Globally

This alliance has been documented from every state in the western United States, except Arizona and New Mexico. Undoubtedly, it occurs in these two states but has not yet been documented there.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This vegetation occupies higher elevation valley bottoms. Elevations are around 2300 m. Soils are typically deep sandy loams. It is often impacted by livestock grazing.

Globally

This alliance occurs throughout the Intermountain West from the western Great Basin to the northern Rocky Mountains and Colorado Plateau at elevations ranging from 240 m in the Columbia Basin up to 2500 m. The climate where this alliance occurs is semi-arid with annual precipitation ranging from 18-40 cm and high inter-annual variation. Much of the precipitation falls as snow, and growing-season drought is characteristic. Temperatures are continental with large annual and diurnal variation. In drier regions, these shrublands are usually associated with perennial or ephemeral stream drainages with water tables less than 3 m from the soil surface. Sites supporting this alliance include sloping fans, footslopes, rolling hills, swales, draws, and deep, well-drained alluvial bottomlands. Soils are deep, fine- to medium-textured alluvial soils with some source of subirrigation during the summer season, but moderately deep upland soils with ample moisture storage also support these shrublands. Some stands occur on deep, sandy soils, or soils that are highly calcareous (Hironaka et al. 1983). Although this alliance may grade into sites with alkaline soils at the edge of internally drained basins, *Artemisia tridentata* is a non-halophyte and requires low salinity for optimum growth. The importance of perennial bunch grasses, the most typical herbaceous associates, is favored with greater spring and summer rain, which increases northward and eastward. Because of the deep alluvial soils, stands have been converted to agriculture in much of the range of the alliance. Adjacent vegetation is highly variable, but some common adjacents include *Juniperus occidentalis*-, *Pinus ponderosa*-, and *Cercocarpus ledifolius*-dominated woodlands, as well as shrublands dominated by *Artemisia tridentata* ssp. *vaseyana*.

VEGETATION DESCRIPTION

Dinosaur National Monument

Artemisia tridentata ssp. *tridentata* characterizes this alliance with sparse to moderately dense shrub cover. Shrubs are 1-3 m tall. The understory has up to 45% cover of *Poa fendleriana* in the understory.

Globally

The plant associations in this widespread western shrubland alliance are characterized by a somewhat sparse to moderately dense (10-70% cover) shrub layer of *Artemisia tridentata* ssp. *tridentata or Artemisia tridentata* ssp. *xericensis*. The height of the shrub layer ranges from about 0.5 m to close to 2 m. *Ericameria nauseosa* and/or *Chrysothamnus viscidiflorus* are almost always present and increase with disturbance. Other shrubs occasionally present include *Artemisia tridentata* ssp. *wyomingensis, Artemisia tridentata* ssp. *vaseyana, Grayia spinosa, Tetradymia canescens, Purshia tridentata, Ephedra viridis, Gutierrezia sarothrae, Sarcobatus vermiculatus, Artemisia frigida,* and *Atriplex* spp. Trees are very rarely present in this alliance, but scattered individuals of *Pinus ponderosa, Juniperus scopulorum, Juniperus occidentalis* or *Cercocarpus ledifolius* may occur. The herbaceous layer is relatively sparse and typically dominated by bunch grasses which occupy patches in the shrub matrix, or may form a matrix surrounding the shrubs. There is typically less than 20% cover of perennial graminoids, although the cover of exotic annual grasses, such as *Bromus tectorum,* may be very high (>20% in some cases). The most widespread species is *Pseudoroegneria spicata,* which occurs from the Columbia Basin to the northern Rockies. Other locally dominant or important species include *Leymus cinereus, Festuca idahoensis, Pascopyrum smithii, Elymus lanceolatus, Elymus elymoides, Hesperostipa comata, Koeleria macrantha, Muhlenbergia richardsonis, Pleuraphis jamesii, Bouteloua gracilis,* and *Poa secunda*. Forbs are generally of low importance and are highly variable across the range, but may be diverse in some stands. Species that often occur are *Symphyotrichum falcatum* var. *crassulum* and *Collinsia parviflora* in Nevada, *Penstemon caespitosus* in north-central Colorado, *Achillea millefolium, Erigeron compositus, Packera cana,* and *Taraxacum officinale* in southwestern Montana, and *Cordylanthus ramosus* in southwestern Wyoming. Other important genera include *Astragalus, Oenothera, Eriogonum,* and *Balsamorhiza*. Mosses and lichens may be important ground cover, and a cryptogamic soil crust is present and will cover the ground surface in undisturbed stands. Diagnostic of this alliance is the *Artemisia tridentata* ssp. *tridentata*- or *Artemisia tridentata* ssp. *xericensis*-dominated shrub layer that lacks a significant graminoid layer (<20% cover perennial graminoids) or has over 40% total cover of shrubs.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Short shrub/sapling	*Artemisia tridentata* ssp. *tridentata*
Herb (field)	*Poa fendleriana*

Globally

Stratum	Species
Short shrub/sapling	*Artemisia tridentata* ssp. *tridentata, Artemisia tridentata* ssp. *xericensis*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: Not applicable.

CLASSIFICATION COMMENTS

Dinosaur National Monument

Globally

Stands included in this alliance occur in environments (climate or substrates) that limited the growth of perennial graminoids or may be the result heavy livestock grazing depleting the perennial graminoid layer of stands of *Artemisia tridentata* (ssp. *tridentata*, ssp. *xericensis*) Shrub Herbaceous Alliance (A.1522).

CLASSIFICATION CONFIDENCE: Not applicable

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: The plot sampled for this vegetation has high cover of *Poa fendleriana* in the understory and no other species present, which is probably not a typical occurrence
Dinosaur National Monument Data Sources: This description is based on 2002 field data (1 plot: DINO.0500).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: D. Sarr, mod. K.A. Schulz

REFERENCES: Baker 1982b, Baker 1983b, Baker 1984a, Barbour and Major 1988, Barrows et al. 1977, Blackburn 1967, Blackburn et al. 1968c, Branson et al. 1976, Caicco and Wellner 1983f, Caicco and Wellner 1983k, Chappell et al. 1997, Daubenmire 1970, DeVelice and Lesica 1993, Donart et al. 1978b, Francis 1983, Francis 1986, Francis and Aldon 1983, Hess 1981, Hironaka 1978, Hironaka et al. 1983, Holland 1986b, Jensen et al. 1988a, Keammerer 1977, Kittel et al. 1994, Kittel et al. 1999a, Kuchler 1964, McArthur and Welch 1986, McLean 1970, Mooney 1985, Mueggler and Stewart 1980, Northcutt 1978, ORNHP unpubl. data, Poulton 1955, Ralston 1969, Sawyer and Keeler-Wolf 1995, Shiflet 1994, Strong 1980, Tiedemann et al. 1987, Tueller and Blackburn 1974, Tueller et al. 1966, Tweit and Houston 1980, West 1983a, West 1983c,

Cercocarpus ledifolius Woodland Alliance
Curl-leaf Mountain-mahogany Woodland Alliance

CODE	A.586
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Extremely xeromorphic evergreen woodland (II.A.5.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural extremely xeromorphic evergreen woodland (II.A.5.N.)
FORMATION	Sclerophyllous extremely xeromorphic evergreen woodland (II.A.5.N.a.)
ALLIANCE	*CERCOCARPUS LEDIFOLIUS* WOODLAND ALLIANCE (A.586) Curl-leaf Mountain-mahogany Woodland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland (CES304.772)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
Plant associations in this alliance occur in semi-arid, mountainous habitats of the interior western United States. Annual precipitation averages 25-45 cm, with a significant proportion falling as winter snow. These woodlands often form small patchy stands on rocky outcrops or escarpments in forested areas, or may form the only tree cover in steppe regions. Elevations where the alliance is found range from 600 m to over 2650 m. Soils are typically rocky and immature, and are always of coarser texture than soils of adjacent coniferous woodlands or forests. The vegetation in this alliance is characterized by an open canopy of *Cercocarpus ledifolius*. These woodlands may occur as scattered communities in arid steppe or on rocky outcrops or steep escarpments within forests. Steppe woodlands typically have only *Cercocarpus ledifolius* in the overstory canopy, but *Juniperus occidentalis, Juniperus osteosperma, Juniperus scopulorum, Pinus edulis*, or *Pinus monophylla* occur in local areas. Evergreen or cold-deciduous shrubs often grow in these woodlands and include *Artemisia tridentata* ssp. *vaseyana, Purshia tridentata, Artemisia tridentata, Amelanchier alnifolia, Holodiscus dumosus, Ericameria nauseosa, Ribes* spp., *Prunus virginiana*, and *Symphoricarpos* spp. The understory is typically dominated by bunch grasses, including *Festuca idahoensis, Leymus ambiguus, Pseudoroegneria spicata, Elymus elymoides, Calamagrostis rubescens*, and *Achnatherum* spp. Adjacent vegetation is usually *Pinus ponderosa* forest, *Artemisia* shrubland, or *Festuca - Achnatherum* grassland.

DISTRIBUTION
Dinosaur National Monument
Stands of this alliance are known from high ridges of Uinta Mountain Group quartzite and were sampled near Pot Creek in the northwestern region of the monument. It may have been more extensive before the northern part of the park burned in the 1970s.

Globally

This alliance occurs in the northern Great Basin, from northeastern California north across Nevada, into southeastern Oregon, southern Idaho, western Montana, and southern Utah. It has not been reported from Wyoming or Colorado, or further south in the western U.S., but may occur there.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

Stands placed in this woodland alliance occur on rimrock ledges or protected enclaves on the leeward side of ridges. Elevations range between 2100 and 2700 m. Soils are shallow, skeletal sandy loams derived from Uinta Mountain Group quartzite.

Globally

Plant associations in this alliance occur in semi-arid, mountainous habitats of the interior west. Annual precipitation averages 25-45 cm, with a significant proportion falling as winter snow. These woodlands often form small patchy stands on rocky outcrops or escarpments in forested areas, or may form the only tree cover in steppe regions. Elevations where the alliance is found range from 600 m to over 2650 m. Soils are typically rocky and immature, and are always of coarser texture than soils of adjacent coniferous woodlands or forests. Adjacent vegetation is usually *Pinus ponderosa* forest, *Artemisia* shrublands, or *Festuca - Achnatherum* grassland.

VEGETATION DESCRIPTION

Dinosaur National Monument

This alliance is characterized by an open canopy (20% cover) of *Cercocarpus ledifolius* in tree form. The understory is sparse but includes a scattering of mesic shrubs such as *Amelanchier alnifolia, Prunus virginiana, Ribes cereum, Artemisia tridentata, Purshia tridentata, Mahonia repens*, and *Paxistima myrsinites*. The herbaceous layer consists primarily of grasses with moderate cover, especially *Melica bulbosa*. The example of this alliance is mature and not likely to change much in the near future, unless disturbed by wildfire.

Globally

The vegetation in this alliance is characterized by an open canopy of *Cercocarpus ledifolius*. These woodlands may occur as scattered communities in arid steppe or on rocky outcrops or steep escarpments within forests. Steppe woodlands typically have only *Cercocarpus ledifolius* in the overstory canopy, but *Juniperus occidentalis, Juniperus osteosperma, Juniperus scopulorum, Pinus edulis*, or *Pinus monophylla* occur in local areas. Evergreen or cold-deciduous shrubs often grow in these woodlands and include *Artemisia tridentata* ssp. *vaseyana, Purshia tridentata, Amelanchier alnifolia, Holodiscus dumosus, Ericameria nauseosa, Ribes* spp., *Prunus virginiana*, and *Symphoricarpos* spp. The understory is typically dominated by bunch grasses, including *Festuca idahoensis, Leymus ambiguus, Pseudoroegneria spicata, Elymus elymoides, Calamagrostis rubescens*, and *Hesperostipa* spp.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Tall shrub/sapling	*Cercocarpus ledifolius*
Herb (field)	*Melica bulbosa, Poa fendleriana*

Globally

Stratum	**Species**
Tree canopy	*Cercocarpus ledifolius*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Data are not available.

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: Not applicable.

CLASSIFICATION COMMENTS

Dinosaur National Monument

This plot was classified to the alliance level because its understory did not resemble that of any association within the *Cercocarpus ledifolius* Shrubland Alliance (A.828).

Globally
The *Cercocarpus ledifolius* woodland and shrubland alliances are poorly distinguished in the literature, as most authors describe the species as having either a tall-shrub or small-tree growth form within a single association. Some associations may have shrub-dominated stands in one area and also have a woodland physiognomy in another. The woodland physiognomy appears to be more typical, based on available literature. Near the northern edge of its range in Montana and Idaho, *Cercocarpus ledifolius* is described as occurring primarily in the shrub form (Mueggler and Stewart 1980, Tisdale 1986). These northern variants are the only described stands which appear to be clearly distinct from the woodland alliance.

The woodland stands may have a different subspecies (or variety) as a dominant than the shrubland. In Wyoming, the heritage program is proposing to recognize two *Cercocarpus ledifolius* alliances, based upon varieties of *Cercocarpus ledifolius*. The most widespread proposed alliance (in Wyoming) is dominated by *Cercocarpus ledifolius* var. *ledifolius*, which grows up to about 1.5 m tall. The other proposed alliance, dominated by *Cercocarpus ledifolius* var. *intercedens*, is found only along the western border of the state, and the growth form is as small trees 4-5 m tall. The two taxa are obviously different in Wyoming, in stature and leaf characteristics, and are easily separated. Further review of the two current *Cercocarpus ledifolius* alliances may warrant treatment as proposed for Wyoming.

CLASSIFICATION CONFIDENCE: Not applicable

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes:
Dinosaur National Monument Data Sources: The description is based on 2002 field data (1 plot: DINO.0213).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: M.S. Reid/D. Sarr

REFERENCES: Beatley 1976, Blackburn et al. 1969d, Cooper et al. 1995, DeVelice 1992, Dealy 1975, Gruell et al. 1985, Hall 1973, Heinze et al. 1962, Moseley 1987b, Mozingo 1987, Mueggler and Stewart 1980, Sawyer and Keeler-Wolf 1995, Tisdale 1986, Western Ecology Working Group n.d.

Eriogonum (corymbosum, leptocladon) Dwarf-shrubland Alliance
(Crispleaf Wild Buckwheat, Sand Wild Buckwheat) Dwarf-shrubland Alliance

CODE	A.1126
PHYSIOGNOMIC CLASS	Dwarf-shrubland (IV)
PHYSIOGNOMIC SUBCLASS	Deciduous dwarf-shrubland (IV.B.)
PHYSIOGNOMIC GROUP	Extremely xeromorphic deciduous dwarf-shrubland (IV.B.3.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural extremely xeromorphic deciduous dwarf-shrubland (IV.B.3.N.)
FORMATION	Extremely xeromorphic deciduous subdesert dwarf-shrubland without succulents (IV.B.3.N.a.)
ALLIANCE	*ERIOGONUM (CORYMBOSUM, LEPTOCLADON)* DWARF-SHRUBLAND ALLIANCE (A.1126) (Crispleaf Wild Buckwheat, Sand Wild Buckwheat) Dwarf-shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Shale Badland (CES304.789)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This semi-arid dwarf-shrubland alliance has been described from shale breaks in Utah, and is likely to occur elsewhere on the Colorado Plateau and in southwestern Wyoming. Stands are located on eroded shale outcrops on gentle to moderately steep slopes typically with southwesterly aspects. Substrate is a shallow, sandy clay loam to clay soil. Vegetation included in this alliance is characterized by a sparse to moderately sparse dwarf-shrub layer that is dominated or codominated by the dwarf-shrub *Eriogonum corymbosum* or *Eriogonum leptocladon*. Codominant dwarf-shrubs may include *Eriogonum effusum* and *Krascheninnikovia lanata*. Occasional shrubs and

small trees to 3 m tall, such as *Atriplex canescens, Atriplex confertifolia, Amelanchier utahensis, Artemisia tridentata*, and *Juniperus osteosperma*, may be present. The herbaceous layer has typically sparse cover of perennial, cool-season bunch grasses such as *Leymus salinus, Elymus elymoides, Elymus lanceolatus, Achnatherum hymenoides, Pascopyrum smithii, Poa secunda, Pseudoroegneria spicata*, or *Hesperostipa comata*. Annual forbs, such as *Chenopodium leptophyllum, Gilia leptomeria*, and grasses may be present seasonally. The exotic annual grass *Bromus tectorum* was present in some stands. Diagnostic of this shrubland alliance is total vegetation cover over 25% that is dominated by *Eriogonum corymbosum*.

DISTRIBUTION

Dinosaur National Monument

This alliance is known from Baker Cabin on the Yampa Plateau.

Globally

Vegetation included in this alliance has been described from eroded shale breaks on the Colorado Plateau in the Uinta Basin in northeastern and southern Utah, and from northwestern Colorado. It also is likely to occur in southwestern Wyoming and northern Arizona.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

The sampled plot placed in this alliance occupies a talus slope. Elevation is around 1950 m. The soil is a sandy clay. Stand size is generally very small. Eriogonum corymbosum often occurs on rocky slopes.

Globally

Dwarf-shrublands included in this alliance have been described from the Uinta Basin in northeastern Utah and in southern Utah, and likely occur elsewhere on the Colorado Plateau and southwestern Wyoming. Elevations range from 1450-2120 m. Climate is semi-arid, cold temperate. Summers are hot and winters are cold with a freezing temperatures and snow. The mean annual precipitation ranges from 24-43 cm. The precipitation is distributed bimodally with over half falling during the late summer monsoon often as high-intensity convection storms and the rest during the winter. The May-June period is typically droughty. Stands are located on eroded shale outcrops on gentle to moderately steep slopes typically with southwesterly aspects. Substrate is a shallow, sandy clay loam to clay soil with either high or low pH, and high or low salinity. These soils are derived from Mowry, Moenkopi or Tropic shales, or Green River Formation parent materials.

VEGETATION DESCRIPTION

Dinosaur National Monument

The stand placed in this dwarf-shrub alliance is characterized by sparse to moderate cover of *Eriogonum corymbosum. Gutierrezia sarothrae* is associated with equal or lesser cover. Forbs present with minimal cover include *Sphaeralcea coccinea, Phlox hoodii, Leptodactylon pungens, Cryptantha* spp., and *Penstemon* spp. Grasses are more abundant and include *Pseudoroegneria spicata, Hesperostipa comata*, and *Koeleria macrantha*.

Globally

This dwarf-shrubland alliance has a sparse to moderately sparse dwarf-shrub layer that is less than 0.5 m tall and is dominated or codominated by the diagnostic species, *Eriogonum corymbosum* or *Eriogonum leptocladon*. Codominant dwarf-shrubs may include *Eriogonum effusum* and *Krascheninnikovia lanata*. Occasional shrubs and small trees to 3 m tall, such as *Atriplex canescens, Atriplex confertifolia, Amelanchier utahensis, Artemisia tridentata*, and *Juniperus osteosperma*, may be present. The herbaceous layer has typically sparse cover of perennial, cool-season bunch grasses like *Leymus salinus, Elymus elymoides, Elymus lanceolatus, Achnatherum hymenoides, Pascopyrum smithii, Poa secunda, Pseudoroegneria spicata* or *Hesperostipa comata*. Annual forbs such as *Chenopodium leptophyllum, Gilia leptomeria*, and grasses may be present seasonally. The exotic annual grass Bromus tectorum was present in some stands. Cover data from stands at Bryce Canyon National Park for *Eriogonum corymbosum, Krascheninnikovia lanata, Atriplex canescens, Elymus* spp. were 3%, 15%, 2%, and 3%, respectively (Roberts et al. 1992). Stands from the Uinta Basin had up to 30% cover of *Eriogonum corymbosum* with a total vegetation cover of 40% (Brotherson and Brotherson 1979).

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**

Short shrub/sapling	*Eriogonum corymbosum, Gutierrezia sarothrae*
Herb (field)	*Penstemon* sp., *Phlox hoodii*
Herb (field)	*Pseudoroegneria spicata, Hesperostipa comata, Koeleria macrantha*

Globally

Stratum	**Species**
Short shrub/sapling	*Eriogonum corymbosum*
Herb (field)	*Achnatherum hymenoides, Hesperostipa comata, Leymus salinus, Poa secunda, Pseudoroegneria spicata*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: Not applicable.

CLASSIFICATION COMMENTS
Dinosaur National Monument

Globally
Brotherson and Brotherson (1979) studied *Eriogonum corymbosum* on sites of 10 different soils within the Uinta Basin. There is more variation in habitats than recorded in this description, but it is not clear where the boundaries should be. Also, *Eriogonum corymbosum* has 10 varieties that occur in Utah. It is not clear if any of the varieties other than the typical variety are diagnostic of the plant association where they occur. In addition, some stands in this alliance lacked the vegetation cover to be classified as a dwarf-shrubland and would be better classified as sparsely vegetated. More taxonomic, survey and description work in stands are necessary to clarify the classification of vegetation in this alliance.

Taxonomically *Eriogonum corymbosum* Benth is a huge and complex species group involving numerous variants and putative hybrids with *E. longchophyllum, 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 *E. longchophyllum, E. leptocladon*, and *E. brevicaule*.

CLASSIFICATION CONFIDENCE: Not applicable

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Look for this alliance on north-facing colluvial slopes.
Dinosaur National Monument Data Sources: This description was derived from 2002 field data (1 plot: DINO.0376).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: K. Schulz

REFERENCES: Brotherson and Brotherson 1979, Roberts et al. 1992, Welsh 1957, Welsh et al. 1987

Juniperus scopulorum Temporarily Flooded Woodland Alliance
Rocky Mountain Juniper Temporarily Flooded Woodland Alliance

CODE	A.563
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	*JUNIPERUS SCOPULORUM* TEMPORARILY FLOODED WOODLAND ALLIANCE

(A.563)
Rocky Mountain Juniper Temporarily Flooded Woodland Alliance

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

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This riparian woodland alliance has been reported from low to mid-montane areas in Colorado and Montana. Stands occur on a wide range of landforms, from rocky V-shaped canyons to fertile alluvium. Stands are intolerant of frequent and prolonged flooding. However, this vegetation is tolerant of periodic flooding and high water tables. Typically, the soils are shallow, derived from coarse alluvial substrates. Vegetation included in this alliance is characterized by an open tree canopy that is dominated by *Juniperus scopulorum*. Scattered emergent deciduous trees may be present, such as *Populus angustifolia, Populus deltoides,* or *Populus balsamifera* ssp. *trichocarpa*. Typically shrub cover ranges from 10-25%. Shrub composition can include any of the following: *Amelanchier alnifolia, Cornus sericea, Rhus aromatica, Rosa woodsii,* or *Solanum dulcamara*. Herbaceous undergrowth occurs beneath the tree canopy as well as on exposed point bars. The understory consists of native graminoids, including *Piptatherum micranthum, Panicum virgatum,* and the fern ally *Equisetum arvense*. Forb cover is sparse and can include *Glycyrrhiza lepidota, Apocynum androsaemifolium* or *Maianthemum stellatum*. Both the forb and graminoid strata can be dominated by adventive, weedy species. Diagnostic of this woodland alliance is the *Juniperus scopulorum*-dominated open tree canopy and the riparian habitats.

DISTRIBUTION

Dinosaur National Monument

This alliance is known from Jack Springs Draw. It may occur at the toes of alluvial fans that feed into the Green and Yampa rivers.

Globally

This alliance has been described from the Colorado River basin in Colorado and the Yellowstone and Madison rivers in Montana. The alliance likely occurs in the Great Basin and possibly occurs elsewhere in the western, intermountain U.S.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This alliance occurs at the base of moderately angled slopes of arroyos, dry washes, and low stream terraces. Soils are sandy loam, moist, and covered with leaf litter. Elevation is around 1600 m.

Globally

Vegetation types within this alliance may occur throughout low to mid-montane areas in the western United States. Stands in Colorado typically are limited to a distinct band at the high-water mark of gently meandering, moderate-gradient stream channels having little to moderate floodplain development. In Montana, communities form either a narrow band along streams of V-shaped canyons, or relatively broad stands on older alluvial terraces of floodplains of major streams or rivers such as along the upper Yellowstone River and lower Madison River. Elevation ranges from 1170 m in Montana to 2800 m in Utah. These woodlands are intolerant of frequent and prolonged flooding; however, they are tolerant of periodic flooding and high water tables. Typically, the soils are shallow, derived from coarse alluvial substrates. Soil textures are sandy clay loams to sandy loams with a high percentage of coarse fragments.

VEGETATION DESCRIPTION

Dinosaur National Monument

This alliance has a moderate to dense tree canopy. *Juniperus scopulorum* is dominant and may be accompanied by single trees of *Juniperus osteosperma* or *Acer negundo*. Shrubs are tall, over 2 m high, and include *Cornus sericea, Rhus trilobata, Artemisia tridentata* ssp. *tridentata,* and *Sarcobatus vermiculatus*. *Cornus sericea* is always present but may not always be dominant. The herbaceous species present are indicative of moist environments and include *Equisetum laevigatum, Phragmites australis,* and *Glycyrrhiza lepidota,* totaling 20% cover. *Juniperus scopulorum* and mesic shrubs will continue to dominate and remain stable if moist conditions persist.

Globally

Vegetation in this woodland alliance has a tree canopy dominated by *Juniperus scopulorum* with typically 25-60%

canopy cover. A sparse to moderately dense emergent-tree stratum (0-60% cover) is usually present, and is composed of *Populus angustifolia, Populus deltoides*, or *Populus balsamifera* ssp. *trichocarpa*. Shrub species that may be present include up to 60% cover of Cornus sericea. Typically shrub cover ranges from 10-25%. Shrub composition can include any of the following: *Amelanchier alnifolia, Rhus aromatica, Rosa woodsii*, or *Solanum dulcamara*. Herbaceous undergrowth occurs beneath the tree canopy as well as on exposed point bars. The understory consists of native graminoids, including 10-25% cover each of *Piptatherum micranthum, Panicum virgatum*, and the fern ally *Equisetum arvense*. Forb cover is sparse (10-25%) and can include *Glycyrrhiza lepidota, Apocynum androsaemifolium* or *Maianthemum stellatum*. In some stands, both the forb and graminoid strata may be dominated by adventive, weedy species (Hansen et al. 1995, Kittel et al. 1999).

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Juniperus scopulorum*
Tall shrub/sapling	*Rhus trilobata*
Herb (field)	*Equisetum laevigatum*

Globally

Stratum	**Species**
Tree canopy	*Juniperus scopulorum*
Tall shrub/sapling	*Cornus sericea*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum

Globally
Agrostis stolonifera, Bromus inermis, Bromus tectorum, Dactylis glomerata, Elymus repens, Poa pratensis

CONSERVATION STATUS RANK
Global Rank & Reasons: Not applicable.

CLASSIFICATION COMMENTS
Dinosaur National Monument

Globally
From Ed Skudlarek (NVNHP): Regarding this woodland alliance in Nevada, we have a National Natural Landmark file on 'Spring Valley Swamp Cedar' that references Cronquist et al. (1972), Billings (1954), Simpson (1876), and Maxey and Eakin (1949) in a field investigation report about a small number of stands of Rocky Mountain juniper in Spring Valley that were being considered for registration by the National Park Service in 1980. Citation from Cronquist: "An interesting ecotype of this species [rocky mountain juniper, *Juniperus scopulorum*] is found in the valley bottom of Spring Valley, which lies between the Snake and the Schell Creek ranges in White Pine Co., Nevada. The habitat in which these trees grow is unusual in its high water table and saline soils. It is an area in which greasewood thrives." Apparently this alliance in Nevada is ranked prospectively as G1 and S1.

CLASSIFICATION CONFIDENCE: Not applicable

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes:
Dinosaur National Monument Data Sources: This association is described from 2002 field data (1 plot: DINO.0317).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: D. Culver, mod. K.A. Schulz

REFERENCES: Billings 1954, Cronquist et al. 1972, Hansen et al. 1991, Hansen et al. 1995, Kittel et al. 1994, Kittel et al. 1996, Kittel et al. 1999a, Maxey and Eakin 1949, Simpson 1876, Welsh et al. 1987

Pinus edulis - (*Juniperus* spp.) Woodland Alliance

Two-needle Pinyon - (Juniper species) Woodland Alliance

CODE	A.516
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

Pinus edulis-dominated woodlands occur in the mountains, plateaus and canyons of Colorado, Utah, Arizona and New Mexico, in the westernmost tip of the Oklahoma panhandle, and possibly in western Texas. The climate of the region is semi-arid with drought not uncommon. Stands typically occur on nearly level to steep (to 80%), rocky slopes on hillsides and ridgetops. Aspect does not seem important except in elevational extremes for a given latitude where low-elevation stands are restricted to the more mesic north slopes; canyons and high-elevation stands occur on south aspects. Sites are typically dry with shallow, rocky, calcareous and alkaline soils. Other sites include eroded "badlands," lava flows, scree slopes, and deep sands. The understory ranges from a relatively rich mixture of evergreen and/or deciduous shrubs, to a sparse to moderately dense herbaceous layer dominated by perennial grasses (with or without shrubs), to no vegetation at all. Most commonly the understory is sparse and has a patchy distribution in the openings between tree crowns. Associated species can include *Juniperus monosperma, Juniperus osteosperma, Juniperus deppeana, Juniperus coahuilensis, Quercus arizonica, Cercocarpus montanus, Cercocarpus ledifolius, Arctostaphylos pungens, Artemisia tridentata, Rhus trilobata, Bouteloua gracilis, Andropogon hallii, Festuca arizonica, Muhlenbergia dubia*, and others.

DISTRIBUTION

Dinosaur National Monument

This alliance is known from Pot Creek on Wild Mountain.

Globally

Stands included in this woodland alliance are common on the Colorado Plateau and extend north into the Uinta Mountains, south in the northern mountains of the Sonoran and Chihuahuan deserts and east to lower montane zone of the southern Rocky Mountains. The alliance is also found on mesas and breaks of the southern Great Plains as far as the Panhandle of Oklahoma and into western Texas.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This alliance occurs throughout the monument on hills, plateaus, alluvial fans, terraces, canyons and ridges. The site assigned to this alliance occurs at 2160 m elevation on level ground on the summit of a plateau. The soil is a loamy sand.

Globally

Stands included in this woodland alliance occur in the foothills and the lower montane zone in the southern Rocky Mountains; mountains, mesas, piedmonts and canyons in the Chihuahuan and Sonoran deserts and the Colorado Plateau; and breaks and escarpments in the southern Great Plains. Elevations range from 1500-2440 m. Climate is semiarid and droughts are not uncommon. Summers are generally hot, and winters range from mild with cold periods and occasional snows in southern New Mexico and Arizona to the more typical extended periods of freezing temperatures. The seasonality of precipitation varies from east to west with summer rain more common in the southern and eastern portion of the alliance's range and winter precipitation more common in the western portion of the range. Mean annual precipitation ranges from 30-46 cm. Stands typically occur on nearly level to steep (to 80%), rocky slopes on hillsides and ridgetops. Aspect does not seem important except in elevational extremes for a given latitude where low-elevation stands are restricted to the more mesic north slopes, and canyons and high-elevation

stands occur on south aspects. Sites are typically dry with shallow, rocky, calcareous and alkaline soils. Other sites include eroded 'badlands', lava flows, scree slopes, and deep sands. Soil textures range from sandy loam to clay and are typically derived from limestone, sandstone or shale. Other parent materials include andesite, basalt, granite, quartzite, monzonite, rhyolite and mixed alluvium. Adjacent vegetation at higher elevations is typically woodland or forest dominated by *Pinus ponderosa*. Adjacent vegetation at lower elevations is often *Juniperus* spp.-dominated woodland and savanna, *Artemisia* spp.dominated shrubland, or grassland.

VEGETATION DESCRIPTION

Dinosaur National Monument

This alliance is strongly dominated by *Pinus edulis* and *Juniperus osteosperma*, with canopy cover ranging from 20 to 40%. Seedlings of both species of tree are likely to be present. The sampled site has an understory dominated by *Elymus lanceolatus* with 5-15% cover, *Poa fendleriana* with 1-5% cover, and *Artemisia tridentata* ssp. *wyomingensis* with 1-5% cover.

Globally

Woodlands included in this alliance occur on dry sites in the lower montane zone in the southern Rocky Mountains; mountains, mesas and canyons in the Chihuahuan and Sonoran Deserts, and the Colorado Plateau; and breaks in the southern Great Plains. Stands have a moderately sparse to moderately dense tree canopy typically 3-12 m tall. Mature individuals range from 2-3 m tall 'scrub' to large trees up to 21 m tall. Moderately sparse stands have an open canopy with trees distributed in patches, whereas the tree crowns touch in the moderately dense stands. The upper canopy may be solely dominated by the evergreen needle-leaved tree *Pinus edulis*, but more commonly is codominated by one of several species of *Juniperus* or *Quercus* depending on geography. On the Colorado Plateau, *Juniperus osteosperma* may codominate, whereas *Juniperus monosperma* codominates in the eastern part of the woodland's range. At higher elevations, *Juniperus scopulorum* may be present and in the far southern extent, Madrean evergreen woodland species co-occur. These species include Juniperus deppeana, *Juniperus coahuilensis* and the encinals, *Quercus arizonica, Quercus grisea, Quercus X pauciloba.*

The understory ranges from a relatively rich mixture of evergreen and/or deciduous shrubs, to a sparse to moderately dense herbaceous layer dominated by perennial grasses (with or without shrubs), to no vegetation at all. Most commonly the understory is sparse and has a patchy distribution. Characteristic shrubs and dwarf-shrubs include *Artemisia tridentata, Cercocarpus montanus, Cercocarpus ledifolius, Coleogyne ramosissima, Ephedra viridis, Gutierrezia sarothrae, Lycium pallidum, Opuntia* spp., *Purshia mexicana, Purshia tridentata, Rhus trilobata*, and *Quercus gambelii*. Shrubs restricted to warmer southern latitudes include *Agave* spp., *Arctostaphylos pungens, Dasylirion wheeleri, Garrya* spp., *Nolina microcarpa, Quercus turbinella*, and *Yucca baccata*. The herbaceous layer is sparse to moderately dense, ranging from 1-30% cover. Perennial graminoids are the most abundant species, particularly *Bouteloua curtipendula, Bouteloua gracilis, Bouteloua hirsuta, Aristida* spp., *Festuca arizonica, Koeleria macrantha, Muhlenbergia* spp., *Achnatherum hymenoides, Piptatherum micranthum, Poa fendleriana, Pseudoroegneria spicata*, and *Hesperostipa* spp. *Andropogon hallii* occurs as an understory species in rare, deep sands habitats. Many forb species occur, but few have much cover. Commonly present forbs include species of *Artemisia, Eriogonum, Heterotheca, Mirabilis, Penstemon, Phlox, Senecio*, and *Zinnia*. Annual grasses and forbs are seasonally present.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Juniperus osteosperma, Pinus edulis*

Globally

Stratum	**Species**
Tree canopy	*Juniperus osteosperma, Juniperus monosperma, Pinus edulis*
Herb (field)	*Bouteloua gracilis*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Bromus tectorum.

Globally

Bromus tectorum. Salsola kali

CONSERVATION STATUS RANK
Global Rank & Reasons: Not applicable.

CLASSIFICATION COMMENTS
Dinosaur National Monument

Globally
Pinus edulis forest stands are not well differentiated from woodland stands. They occur on less xeric sites within woodlands such as on north aspects and at higher elevation sites. Only one association currently exists, and more work is needed to clarify the differences between these two alliances.

The literature often describes *Pinus edulis* and *Juniperus* spp. vegetation types as one woodland type (P/J woodland). Both *Pinus edulis*-dominated associations and those codominated with *Juniperus* spp. are included in this alliance. More work is needed to clarify boundaries between this alliance and the *Juniperus* spp. alliances that may have scattered *Pinus edulis* trees. Also, a sparsely vegetated alliance may need to be developed because some *Pinus edulis* stands do not have enough cover to be classified as woodlands. See Francis (1986) for examples.

CLASSIFICATION CONFIDENCE: Not applicable

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: The sample used to describe this alliance has significant cover of *Elymus lanceolatus* in the understory. A single plot is insufficient to create a new association, so this plot was placed into the Alliance. If additional plots are found, a new *Pinus edulis - Juniperus osteosperma / Elymus lanceolatus* Woodland will be created.
Dinosaur National Monument Data Sources: This description was derived from 2002 field data (1 plot: DINO.0206).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: K. Schulz, mod. J. Coles

REFERENCES: Anhold 2005, BIA 1979, Baker 1980a, Baker 1982b, Baker 1983b, Baker 1983c, Baker 1984a, Baker and Kennedy 1985, Barnes 1987, Bassett et al. 1987, Brown 1982, Burns and Honkala 1990a, Clements 1904, DeLeuw, Cather & Company 1977, Dick-Peddie 1986, Dick-Peddie 1993, Donart et al. 1978a, Dwyer and Pieper 1967, Erdman 1962, Erdman 1969, Erdman 1970, Erdman et al. 1969, Everett 1986, Eyre 1980, Francis 1986, Galatowitsch and Bourgeron 1985, Harmon 1980, Harrington and Cobb 1988, Heinze et al. 1962, Hess and Wasser 1982, Holm 1927, Isaacson 1967, Jameson 1962, Jameson and Reid 1965, Jameson et al. 1962, Johnston 1984, Johnston 1987, Kennedy 1983a, Ladyman and Muldavin 1996, Larson and Moir 1986, Larson and Moir 1987, Little 1987, Marr et al. 1973b, Marr et al. 1979, Mason et al. 1967, Medina 1986, Moir 1963, Moir and Carleton 1987, Moir and Ludwig 1979, Muldavin 1994, Muldavin and Mehlhop 1992, Muldavin et al. 1998c, Northcutt 1978, Pieper 1968, Powell 1988b, Rippel et al. 1998, Rogers 1953, Shantz 1906, Soil Conservation Service 1978, Steinhoff 1978, Tiedemann 1978, USFS 1981a, USFS 1981b, USFS 1982, USFS 1983a, USFS 1985a, USFS 1985b, USFS 1985c, USFS 1985d, USFS 1985e, USFS 1985g, Vories 1974, Warren et al. 1982, Wells 1970a, Western Ecology Working Group n.d., Wright et al. 1973, Wright et al. 1979, Zimmerman 1978

Pseudotsuga menziesii Woodland Alliance
Douglas-fir Woodland Alliance

CODE	A.552
PHYSIOGNOMIC CLASS	Woodland (II)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (II.A.)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Conical-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.b.)
ALLIANCE	*PSEUDOTSUGA MENZIESII* WOODLAND ALLIANCE (A.552) Douglas-fir Woodland Alliance

ECOLOGICAL SYSTEM(S): Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This widespread coniferous woodland alliance occurs across the western U.S., typically on relatively poor sites for tree growth. Environmental factors, such as harsh substrate, desiccating winds or frequent disturbances that limit the tree canopy density, vary geographically. Stands are typically restricted to hot, dry slopes with southern and western exposures at higher elevations and latitudes. At lower elevations and latitudes stands are found on relatively mesic northern aspects. Where there is adequate moisture to develop a closed tree canopy, shallow rocky soils, talus and scree have so little moisture-holding capacity that these sites are effectively very dry for plant growth. Other harsh substrates, such as serpentine, or frequent disturbance from fire may also limit tree canopy development. Substrates are typically shallow, lithic, course-textured and well-drained. Woodlands included in this alliance have a sparse to moderately dense canopy, or may occur as patchy stands that are dominated by *Pseudotsuga menziesii*. Other trees in the canopy and subcanopy may include *Pinus ponderosa, Tsuga mertensiana* or *Quercus chrysolepis* in Oregon, and *Pinus flexilis* or *Juniperus scopulorum*. Typically sparse tall-shrub/small-tree layer may include *Acer circinatum* or any of the above trees depending on the species range. Shrub cover is scattered to patchy. Common shrubs include *Cercocarpus ledifolius, Cercocarpus montanus, Holodiscus dumosus, Purshia tridentata*, or *Toxicodendron diversilobum*. The herbaceous layer is often dominated by perennial graminoids such as *Festuca campestris, Festuca idahoensis, Leucopoa kingii, Piptatherum micranthum, Pseudoroegneria spicata,* or *Schizachyrium scoparium.* Forbs important in this layer include *Aspidotis densa* and *Penstemon fruticosus*. Annual grasses and forbs may be present, especially on disturbed sites. Diagnostic of this alliance is the *Pseudotsuga menziesii*-dominated tree canopy with less than 60% cover on average.

DISTRIBUTION

Dinosaur National Monument

This alliance is known from Limestone Ridge in the northern region of the monument and from the slot canyons that dissect the south side of Split Mountain.

Globally

Woodlands included in this alliance are found on dry sites in mountains of the northwestern U.S. from California to Washington, east to the Rocky Mountains in Montana, Wyoming and Utah. The alliance also occurs in New Mexico, Arizona, Colorado, and southern British Columbia, Canada.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

One stand occurs in a narrow, shaded rocky ravine; the other on a high mountain slope. This alliance occurs at relatively high elevations, over 2400 m in exposed areas, but small stands also appear in narrow ravines at low elevations that are also cold-air drainages. Topography ranges from northerly facing slopes at the lower end of the elevation spectrum to southwesterly facing slopes at the higher elevations, to any aspect and slope in sheltered canyons. Slopes are typically steep and rocky, with shallow, coarse-textured and rapidly drained soils.

Globally

Associations included in this woodland alliance occur on dry sites in Washington and Oregon in the Cascade, Okanogan, Blue and Klamath mountains, and in the Rocky Mountains. Elevations vary with latitude from 300 m in the northern Cascades to 3000 m in New Mexico and Arizona. The climate regime is strongly influenced by the rainshadow effect of the Cascade Range or Coastal Ranges of southern Oregon. Climate is mostly temperate, continental with maritime influences in the Cascades and northwestern Rocky Mountains. Annual precipitation ranges from approximately 40 cm in drier habitats in the Blue Mountains and southern Rocky Mountains to 150-230 cm in the Cascades. There are usually environmental factors, such as harsh substrate or frequent disturbance, that limit these open (25-60% canopy cover) stands from developing closed canopies. Stands are typically restricted to hot, dry slopes with southern and western exposures and shallow soils. This is true of many stands in the Cascades and northern Rocky Mountains. However, in some stands, serpentine soils limit tree density. In more xeric habitats and the southern Rocky Mountains, stands occur on relatively mesic sites and have been described from scree slopes at high elevations or north slopes.

Stands occur on moderate to steep slopes. Substrates are typically shallow, lithic, course-textured soils derived from colluvium and residuum. Soil texture ranges from gravelly sand to loam. There is typically high surface cover of

rock, as well as coarse fragments within the soil. Soil pH varies from acidic to alkaline depending on parent material. Parent materials are extremely varied in these widespread associations and may include volcanic, sedimentary, metamorphic and igneous rocks such as lava, basalt, tuff, granite, gneiss, rhyolite, andesite, dolomite, limestone, mudstone and sandstone. These rocky, shallow soils have so little moisture-holding capacity that these sites are effectively very dry for plant growth even where there is substantial precipitation. In some cases, these sites are exposed to high winds. Wind detracts from soil moisture status by blowing off snow, directly desiccating plants, and eroding soil.

VEGETATION DESCRIPTION

Dinosaur National Monument

The two situations placed into this alliance are very different in habitat and species composition. Tree canopy cover of *Pseudotsuga menziesii* ranges from sparse to moderately dense, with the more closed stand occurring in a sheltered, low-elevation ravine, the low cover occurring in a island of unburned woodland on a high mountain slope. Canopy heights range from 10 to 20 m. One of the plot samples used to describe this alliance has 10% cover of *Ceanothus velutinus*, a shrub that responds well to fire. The ravine plot had a mix of shrubs associated with rocky areas (e.g., *Holodiscus dumosus, Amelanchier utahensis, Ribes cereum*). The perennial grass *Achnatherum lettermanii* dominates the herbaceous layer in the mountain stand with 70% cover, which is not necessarily characteristic of this alliance. More typical is the ravine stand, with a few percent cover of grasses and forbs, especially *Poa fendleriana* and *Heterotheca villosa*.

Globally

These coniferous woodlands occur in the mountains of the western U.S. They have a sparse to moderately dense, open canopy, or may occur as patchy stands, dominated by *Pseudotsuga menziesii*. Other trees in the canopy and subcanopy may include *Pinus ponderosa, Tsuga mertensiana* or *Quercus chrysolepis* in Oregon, and *Pinus flexilis* or *Juniperus scopulorum* in the Rocky Mountains. A typically sparse tall-shrub/small-tree layer may include *Acer circinatum* or any of the above trees depending on the species range. The short-shrub layer is scattered to patchy, and may be dominated by *Cercocarpus ledifolius, Cercocarpus montanus, Holodiscus dumosus, Purshia tridentata* or *Toxicodendron diversilobum*, but can include numerous other species. The herbaceous layer is sparse to moderately dense in more open stands. It is often dominated by perennial graminoids such as *Festuca campestris, Festuca idahoensis, Leucopoa kingii, Piptatherum micranthum, Pseudoroegneria spicata* or *Schizachyrium scoparium*. Forbs important in this layer include *Aspidotis densa* and *Penstemon fruticosus*. Numerous other graminoid and forb species may be present, but cover is generally sparse. Annual grasses and forbs may be present, especially on disturbed sites.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	Species
Tree canopy	*Pseudotsuga menziesii*
Tree subcanopy	*Juniperus osteosperma, Pinus edulis*
Tall shrub/sapling	*Amelanchier utahensis*
Short shrub/sapling	*Ceanothus velutinus, Ephedra viridis, Holodiscus dumosus*
Herb (field)	*Heterotheca villosa*
Herb (field)	*Achnatherum lettermanii, Poa fendleriana*

Globally

Stratum	Species
Tree canopy	*Pseudotsuga menziesii, Pinus flexilis, Pinus ponderosa, Tsuga mertensiana*
Tree subcanopy	*Acer circinatum, Juniperus scopulorum, Pinus edulis*
Tall shrub/sapling	*Cercocarpus ledifolius*
Short shrub/sapling	*Cercocarpus montanus, Holodiscus dumosus, Purshia tridentata*
Herb (field)	*Festuca idahoensis, Pseudoroegneria spicata*

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument

Data are not available.

Globally

Bromus tectorum.

CONSERVATION STATUS RANK
Global Rank & Reasons: Not applicable.

CLASSIFICATION COMMENTS
Dinosaur National Monument
Two *Pseudotsuga menziesii* plots could not be assigned with confidence to an existing or new NVC association. They were placed instead into the *Pseudotsuga menziesii* Alliance.

Globally
There are two scree associations in this alliance that appear very similar and possibly could be combined. Information from California needs to be incorporated into this alliance. Both this alliance and the *Pinus ponderosa - Pseudotsuga menziesii* Woodland Alliance (A.533) have an association with both conifers and *Penstemon fruticosus* in the herbaceous layer.

CLASSIFICATION CONFIDENCE: Not applicable

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Plots are placed into the Alliance when they have a *Pseudotsuga menziesii*-dominated canopy and lack a recognized diagnostic understory layer.
Dinosaur National Monument Data Sources: This description is derived from 2002 field data (2 plots: DINO.0168, DINO.0262).
Local Description Authors: J. Thompson, mod. J. Coles Global
Description Authors: N/A

REFERENCES: Atzet and Wheeler 1984, Atzet et al. 1996, Chappell et al. 1997, Cole 1982, Cooper 1975, Cooper et al. 1995, DeVelice 1992, DeVelice et al. 1986, DeVelice et al. 1991, DeVelice et al. 1995, Fitzhugh et al. 1987, Johnson and Clausnitzer 1992, Johnston 1987, Larson and Moir 1986, Larson and Moir 1987, MTNHP unpubl. data, Mauk and Henderson 1984, Pfister et al. 1977, Roberts et al. 1979a, Sawyer and Keeler-Wolf 1995, Steele et al. 1981, Steele et al. 1983, Western Ecology Working Group n.d., Williams and Smith 1990, Williams et al. 1990b, Youngblood and Mauk 1985

Ericameria nauseosa / Pascopyrum smithii Shrubland [Park Special]
Rubber Rabbitbrush / Western Wheatgrass Shrubland [Park Special]

CODE	Park Special
PHYSIOGNOMIC CLASS	Not Applicable
PHYSIOGNOMIC SUBCLASS	Not Applicable
PHYSIOGNOMIC GROUP	Not Applicable
PHYSIOGNOMIC SUBGROUP	Not Applicable
FORMATION	Not Applicable
ALLIANCE	Not Applicable

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally

DISTRIBUTION
Dinosaur National Monument
This association was sampled in Zenobia Basin. It may be expected to occur anywhere a mesic *Artemisia tridentata* ssp. *vaseyana / Pascopyrum smithii* stand on sandy soils has burned.

Globally
Data are not available.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument

This association occupies broad valley floors and swales of the mid-elevation plateaus of the monument. The sampled stand occurs at 2150 m elevation. The soils are comparatively deep sandy loams and partially covered with organic litter.

Globally
Data are not available.

VEGETATION DESCRIPTION
Dinosaur National Monument
This shrubland association is strongly dominated by *Ericameria nauseosa* with 40% cover. Other shrub species are sparse to absent. The perennial rhizomatous grass *Pascopyrum smithii* dominates the herbaceous layer with 20% cover. Few other grasses or forbs occur in this association.

Globally
Data are not available.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	Species
Short shrub/sapling	*Ericameria nauseosa*
Herb (field)	*Pascopyrum smithii*

Globally
Data are not available.

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: Not applicable.

CLASSIFICATION COMMENTS
Dinosaur National Monument
The site where this association occurs has experienced recent cattle use and likely has had a long history of livestock disturbance. The community also likely originated from a fire.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: Not applicable

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Homogeneous stands of *Pascopyrum smithii* similar to this one are not common in the monument.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (1 plot: DINO.0255).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: N/A

REFERENCES: Western Ecology Working Group n.d.

Glycyrrhiza lepidota Herbaceous Vegetation [Park Special]
American Licorice Herbaceous Vegetation [Park Special]

CODE Park Special

PHYSIOGNOMIC CLASS	Not Applicable
PHYSIOGNOMIC SUBCLASS	Not Applicable
PHYSIOGNOMIC GROUP	Not Applicable
PHYSIOGNOMIC SUBGROUP	Not Applicable
FORMATION	Not Applicable
ALLIANCE	Not Applicable

ECOLOGICAL SYSTEM(S): Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Dinosaur National Monument

This wetland association has only been described from the Green and Yampa river drainages in northwestern Colorado and probably in adjacent eastern Utah, and it is expected to occur adjacent to perennial or intermittent streams or springs throughout the Colorado Plateau. This association occurs in patches primarily within active floodplains, either in the stream bed or on the lowest terraces that flood annually. Soils are typically saturated during the growing season. The vegetation is characterized by moderate to dense cover of *Glycyrrhiza lepidota*. Other species present may include *Equisetum* spp, *Elymus canadensis* and *Asclepias speciosa*. Seedlings of *Populus deltoides* ssp. *wislizeni* or *Tamarix ramosissima* are often present.

Globally

Data are not available.

DISTRIBUTION

Dinosaur National Monument

This association is evident only in late summer. It was sampled along the Green River; occurrences were noted but not sampled in the bed of the Yampa River near Deerlodge Park.

Globally

Data are not available.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument

This association occurs on the active floodplains of the Green and Yampa rivers, on raw alluvial soils exposed as the river level drops in late summer. Sites are generally flat or follow the slight slope of the river, although they may be channeled. Sites are generally sandy, sometimes with a veneer of silt or river-deposited organic material.

Globally

Data are not available.

VEGETATION DESCRIPTION

Dinosaur National Monument

The vegetation is primarily herbaceous and is dominated by sparse to dense cover of *Glycyrrhiza lepidota* (5 to 60% cover). Other herbaceous species commonly present are typical of sites that experience frequent scouring and periodic flooding: *Elymus canadensis, Asclepias speciosa*, and *Equisetum* spp. Seedlings of *Populus deltoides* ssp. *wislizeni* or *Tamarix ramosissima* are often present.

Globally

Data are not available.

MOST ABUNDANT SPECIES

Dinosaur National Monument

Stratum	**Species**
Tall shrub/sapling	*Populus deltoides ssp. wislizeni, Tamarix ramosissima*
Herb (field)	*Glycyrrhiza lepidota, Equisetum hyemale*
Herb (field)	*Elymus canadensis*

Globally
Data are not available.

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
N/A

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: Not applicable.

CLASSIFICATION COMMENTS
Dinosaur National Monument
This is an ephemeral community, and often occurs in patches that are too small or too narrow to sample.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: Not applicable

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes:
Dinosaur National Monument Data: This association is described from field data collected in the 1990s (9 plots: GR017, GR030, GR039, GR044, GR050, GR54, GR75, GR60, GR63).
Local Description Authors: J. Coles
Global Description Authors: N/A

REFERENCES: Western Ecology Working Group n.d.

Heterotheca villosa Herbaceous Vegetation [Park Special]
Hairy Goldenaster Herbaceous Vegetation [Park Special]

CODE	Park Special
PHYSIOGNOMIC CLASS	Not Applicable
PHYSIOGNOMIC SUBCLASS	Not Applicable
PHYSIOGNOMIC GROUP	Not Applicable
PHYSIOGNOMIC SUBGROUP	Not Applicable
FORMATION	Not Applicable
ALLIANCE	Not Applicable

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally

DISTRIBUTION
Dinosaur National Monument
This association occurs primarily on point bars along the Green River with a few occurrences on the Yampa River near the confluence with the Green.

Globally
Data are not available.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association typically occupies banks and the heads of islands, where periodic scouring leaves a surface of large

cobbles in a matrix of sand. A few occurrences are on banks or low terraces of the Green River. Soils are rapidly drained, poorly developed and derived from sandy alluvium.

Globally
Data are not available.

VEGETATION DESCRIPTION
Dinosaur National Monument
This herbaceous association is dominated by *Heterotheca villosa*, with 10 to 40% cover, and is usually associated with herbaceous species *Sporobolus cryptandrus, Achnatherum hymenoides, Hesperostipa comata, Elymus canadensis*, and *Aristida purpurea*. Total herbaceous cover is less than 50%. *Juniperus osteosperma* may invade from upland communities but occurs with minimal cover. Other conifers, deciduous trees and shrubs may occasionally occur as scattered individuals within the community.

Globally
Data are not available.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	Species
Herb (field)	*Pascopyrum smithii, Achnatherum hymenoides, Sporobolus cryptandrus, Aristida purpurea*
Herb (field)	*Heterotheca villosa*

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum, Melilotus officinalis

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: Not applicable.

CLASSIFICATION COMMENTS
Dinosaur National Monument
This association appears to be in an early- to mid-seral stage. As the banks and pointbars collect more fine-textured sediment, this community will eventually transform itself into an *Artemisia tridentata* ssp. *tridentata or Sarcobatus vermiculatus* shrubland. Occasional scouring by floods will tend to maintain the community.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: Not applicable

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association usually occurs in small patches but is common, distinct, and easily identified in the field.
Dinosaur National Monument Data Sources: This association is described from field data collected in the 1990s (6 plots: GR062, GR065, GR085, GR094, GR100, GR108).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: N/A

REFERENCES: Western Ecology Working Group n.d.

***Juniperus osteosperma / Artemisia tridentata - Grayia spinosa* Woodland [Park Special]**
Utah Juniper / Big Sagebrush - Spiny Hopsage Woodland [Park Special]

CODE	Park Special
PHYSIOGNOMIC CLASS	Not Applicable
PHYSIOGNOMIC SUBCLASS	Not Applicable
PHYSIOGNOMIC GROUP	Not Applicable
PHYSIOGNOMIC SUBGROUP	Not Applicable
FORMATION	Not Applicable
ALLIANCE	Not Applicable

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

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally

DISTRIBUTION
Dinosaur National Monument
This association is restricted to narrow, rocky canyons along the Green River. It was sampled at Disaster Falls in Lodore Canyon and at Mitten Draw in Split Mountain Canyon.

Globally
Data are not available.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association occupies moderate to steeply sloping canyon walls and sandy toeslopes (up to 42 degrees) oriented to any aspect between 1483 and 1614 m elevation. In canyon wall stands, rock, gravel and litter cover most of the unvegetated surface, while toeslope stands have high cover of litter and bare ground. Moss provides up to 30% cover in all stands, indicating relatively mesic and stable conditions. Soils are coarse-textured and are derived from quartzite, sandstone and alluvium.

Globally
Data are not available.

VEGETATION DESCRIPTION
Dinosaur National Monument
Total vegetation cover is relatively high for a woodland, ranging from approximately 40 to 55%. *Juniperus osteosperma* and a few Pinus edulis form a canopy 2 to 5 m high with between 15 and 25% closure. The shrub layer may have up to 20% cover and is dominated by a mix of *Grayia spinosa* and either *Artemisia tridentata* ssp. *tridentata* (on sandy toeslopes) or *Artemisia tridentata* ssp. *wyomingensis* (on rocky canyon walls). Other shrubs are present with only a few percent cover; *Chrysothamnus viscidiflorus, Ephedra viridis, Philadelphus microphyllus, Opuntia polyacantha*, and *Rhus trilobata* were recorded in the sampled stands. The herbaceous layer is generally well-developed, with between 15 and 25% cover. *Bromus tectorum* is generally present and dominates the herbaceous layer; *Hesperostipa comata* and *Achnatherum hymenoides* are the most consistent native grasses. Other herbaceous species present with minor cover include *Poa secunda* and *Heterotheca villosa*.

Globally
Data are not available.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Juniperus osteosperma*
Short shrub/sapling	*Artemisia tridentata ssp. tridentata, Artemisia tridentata ssp. wyomingensis, Grayia spinosa*
Herb (field)	*Hesperostipa comata*

Globally
Data are not available.

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum, Ephedra viridis, Achnatherum hymenoides

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: Not applicable.

CLASSIFICATION COMMENTS
Dinosaur National Monument
Although this association occupies sites that would seem to be inherently unstable (colluvial canyon walls and sandy high river terraces), it appears to be stable. Thick moss cover on the ground and a well-developed grass layer is evidence of stability.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: Not applicable

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Grayia spinosa is rarely a dominant species at Dinosaur National Monument except in this community, which is restricted to rocky canyon walls and sandy high riparian terraces at the foot of canyon walls.
Dinosaur National Monument Data Sources: The description is based on 2005 accuracy assessment data (4 plots: DINO_AA.A0414, DINO_AA.A1534, DINO_AA.B0419, DINO_AA.C0091).
Local Description Authors: J. Coles
Global Description Authors: N/A

REFERENCES: Western Ecology Working Group n.d.

Juniperus osteosperma / Glossopetalon spinescens Woodland [Park Special]
Utah Juniper / Spiny Greasebush Woodland [Park Special]

CODE	Park Special
PHYSIOGNOMIC CLASS	Not Applicable
PHYSIOGNOMIC SUBCLASS	Not Applicable
PHYSIOGNOMIC GROUP	Not Applicable
PHYSIOGNOMIC SUBGROUP	Not Applicable
FORMATION	Not Applicable
ALLIANCE	Not Applicable

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

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally

DISTRIBUTION
Dinosaur National Monument
This association is restricted to Split Mountain Canyon. It was sampled on the slopes above Schoolboy Rapid, SOB Rapid and the Split Mountain Boat Ramp.

Globally
Data are not available.

ENVIRONMENTAL DESCRIPTION

Dinosaur National Monument
This association occupies steeply sloping (30 degrees) active colluvial deposits on canyon walls oriented to south or west aspects between 1537 and 1609 m elevation. Rocks, gravel, bedrock and bare ground have about equal cover in most stands. The slopes are loose and shifting, and material is constantly moving downslope. Soils are coarse-textured and derived from limestones and sandstones of the Weber, Morgan, Round Valley and Madison formations.

Globally
Data are not available.

VEGETATION DESCRIPTION
Dinosaur National Monument
Because rooting substrate is limited, this association's total vegetation cover is relatively low for a woodland, ranging from approximately 12 to 20%. Stunted *Juniperus osteosperma* and a few Pinus edulis form a dwarfed canopy 1 to 2 m high with between 5 and 10% closure. The shrub layer may have up to 10% cover and is dominated by *Glossopetalon spinescens* var. *meionandrum* and *Ephedra viridis*. Other shrubs are present with only a few percent cover*; Amelanchier utahensis, Brickellia microphylla, Gutierrezia sarothrae, Cercocarpus intricatus, Eriogonum corymbosum*, and *Fraxinus anomala* were recorded in the sampled stands. The herbaceous layer rarely has more than a trace cover and is variable from stand to stand. Species recorded in the sample plots include *Poa fendleriana, Poa secunda, Pleuraphis jamesii, Achnatherum hymenoides, Hesperostipa comata*, and *Pseudoroegneria spicata*. Forb species were not recorded.

Globally
Data are not available.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Tree canopy	*Juniperus osteosperma*
Short shrub/sapling	*Glossopetalon spinescens var. meionandrum, Ephedra viridis*

Globally
Data are not available.

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Fraxinus anomala, Gutierrezia sarothrae

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: Not applicable.

CLASSIFICATION COMMENTS
Dinosaur National Monument
This association occupies rocky sites where there is evidence the substrate is actively moving downslope. Woody plants root in cracks in the bedrock and are pounded by falling rocks from above. The colluvial substrate is shallow over bedrock, and the herbaceous layer is sparse and poorly developed.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: Not applicable

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Glossopetalon spinescens var. *meionandrum* is rarely a dominant species at Dinosaur National Monument except in this community, which is restricted to limestone and sandstone colluvium on steep canyon walls.
Dinosaur National Monument Data Sources: The description is based on 2005 accuracy assessment field data (5

plots: DINO_AA.A0183, DINO_AA.A0192, DINO_AA.A0201, DINO_AA.A0948, DINO_AA.B0197).
Local Description Authors: J. Coles
Global Description Authors: N/A

REFERENCES: Western Ecology Working Group n.d.

Philadelphus microphyllus - Ephedra viridis Shrubland [Park Special]
Littleleaf Mock Orange - Mormon-tea Shrubland [Park Special]

CODE	Park Special
PHYSIOGNOMIC CLASS	Not Applicable
PHYSIOGNOMIC SUBCLASS	Not Applicable
PHYSIOGNOMIC GROUP	Not Applicable
PHYSIOGNOMIC SUBGROUP	Not Applicable
FORMATION	Not Applicable
ALLIANCE	Not Applicable

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally

DISTRIBUTION
Dinosaur National Monument
This association is known from Thanksgiving Gorge.

Globally
Data are not available.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association occurs in a small stand on a steep, southeast-facing colluvial canyon slope. Elevation is 1700 m, and the soil texture is sandy loam.

Globally
Data are not available.

VEGETATION DESCRIPTION
Dinosaur National Monument
This association is unique because of the dominance of the shrub *Philadelphus microphyllus* with between 35 and 45% cover. *Ephedra viridis* occurs with up to 25% cover. Other shrubs present include *Artemisia tridentata* ssp. *wyomingensis, Ribes inerme, Chrysothamnus viscidiflorus,* and *Rhus trilobata*. The dense shrub cover and presence of large rock leave little space for herbaceous vegetation. The exotic annual grass Bromus tectorum is the most prevalent herbaceous species with up to 15% cover in a drought year. Mosses contribute significant ground cover.

Globally
Data are not available.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Philadelphus microphyllus, Ephedra viridis*

Globally
Data are not available.

OTHER NOTEWORTHY SPECIES

Dinosaur National Monument
Bromus tectorum

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: Not applicable.

CLASSIFICATION COMMENTS
Dinosaur National Monument
This association is more mesic than normally occurs at this elevation and exposure, primarily because of the mulch effect of colluvium.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: Not applicable

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: Philadelphus microphyllus occurs occasionally as a minor community component on rock outcrops and colluvial slopes but is not likely to be found occurring as densely as described in this park special.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (1 plot: DINO.1006).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: N/A

REFERENCES: Western Ecology Working Group n.d.

Post-fire Herbaceous Vegetation [Park Special]
Post-fire Herbaceous Vegetation [Park Special]

CODE	Park Special
PHYSIOGNOMIC CLASS	Not Applicable
PHYSIOGNOMIC SUBCLASS	Not Applicable
PHYSIOGNOMIC GROUP	Not Applicable
PHYSIOGNOMIC SUBGROUP	Not Applicable
FORMATION	Not Applicable
ALLIANCE	Not Applicable

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally

DISTRIBUTION
Dinosaur National Monument
This association is known to occur at Garden Creek, Massey Cabin and Zenobia Basin in northwestern and northern regions of the monument.

Globally
Data are not available.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association can occur in most physical environments that have been impacted by wildfire. Elevation ranges from 1600 to 2300 m on gentle to steep slopes of all aspects. Soils are typically sandy, rapidly drained, and have

little development or structure.

Globally
Data are not available.

VEGETATION DESCRIPTION
Dinosaur National Monument
This herbaceous association is characterized by a diversity of forbs and grasses that become established soon after a fire. Some shrubs may reseed or sprout after the fire but do not contribute significant cover; species vary by site and depend on the previous community but include *Ephedra viridis, Cercocarpus montanus, Amelanchier utahensis, Purshia tridentata,* and *Eriogonum corymbosum*. For whatever reason, *Ericameria nauseosa* is absent. Tree snags and stumps remain standing. Total vegetation cover tends to be somewhat sparse, between 10 and 35%. The herbaceous layer is also variable, but the species that best characterize the type include *Achnatherum hymenoides, Poa fendleriana, Bromus tectorum,* and *Elymus elymoides.* Annual and perennial forbs are abundant and variable and may have as much or more cover as the grasses. Typical species include *Heterotheca villosa, Penstemon* sp, and *Machaeranthera* sp.

Globally
Data are not available.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Ephedra viridis*
Herb (field)	*Achnatherum hymenoides, Poa fendleriana, Elymus elymoides*
Herb (field)	*Heterotheca villosa, Ipomopsis congesta, Machaeranthera canescens*

Globally
Data are not available.

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Bromus tectorum, Achnatherum hymenoides, Penstemon sp.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: Not applicable.

CLASSIFICATION COMMENTS
Dinosaur National Monument
This association is in the early-seral stages of succession after fire burned pinyon-juniper woodlands or sagebrush shrubland. All but the largest burn areas will succeed within 20 years to sagebrush shrublands or pinyon-juniper woodlands.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: Not applicable

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: The plots sampled to describe this association were all burned pinyon-juniper woodlands. This type is intended to describe burned sites in which there is no clear diagnostic species.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (3 plots: DINO.0226, DINO.0242, DINO.0451).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: N/A

REFERENCES: Western Ecology Working Group n.d.

Pseudoroegneria spicata - Leymus salinus Herbaceous Vegetation [Park Special]
Bluebunch Wheatgrass - Salinas Lyme Grass Herbaceous Vegetation [Park Special]

CODE	Park Special
PHYSIOGNOMIC CLASS	Not Applicable
PHYSIOGNOMIC SUBCLASS	Not Applicable
PHYSIOGNOMIC GROUP	Not Applicable
PHYSIOGNOMIC SUBGROUP	Not Applicable
FORMATION	Not Applicable
ALLIANCE	Not Applicable

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally

DISTRIBUTION
Dinosaur National Monument
This association is known from Anderson Hole on the Yampa River at the east end of the monument.

Globally
Data are not available.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association occurs on a steep colluvial canyon slope with a northeasterly aspect. Elevation is 1800 m, and soil texture is clay loam. The mesic nature of the site is reflected by the fact that moss has 70% ground cover.

Globally
Data are not available.

VEGETATION DESCRIPTION
Dinosaur National Monument
This association is codominated by the perennial bunch grasses *Pseudoroegneria spicata* and *Leymus salinus*. Total cover is 70%. Shrubs have less than 10% total cover and include *Symphoricarpos oreophilus, Artemisia tridentata* ssp. *wyomingensis, Rhus trilobata, Ephedra viridis,* and *Eriogonum corymbosum*. Forb species are numerous, although they contribute very low cover.

Globally
Data are not available.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	Species
Herb (field)	*Pseudoroegneria spicata, Leymus salinus*

Globally
Data are not available.

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: Not applicable.

CLASSIFICATION COMMENTS
Dinosaur National Monument
This association is now a robust stand of bunch grasses with low potential for increasing shrub cover, unless conditions dry considerably. The current stand has few niches available for woody plants to become established.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: Not applicable

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This bunchgrass association is rare in the monument, occurring only on colluvial north-facing slopes protected from the sun by high cliffs.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (1 plot: DINO.1403).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: N/A

REFERENCES: Western Ecology Working Group n.d.

Shale Annual Herbaceous Vegetation [Park Special]
Shale Annual Herbaceous Vegetation [Park Special]

CODE	Park Special
PHYSIOGNOMIC CLASS	Not Applicable
PHYSIOGNOMIC SUBCLASS	Not Applicable
PHYSIOGNOMIC GROUP	Not Applicable
PHYSIOGNOMIC SUBGROUP	Not Applicable
FORMATION	Not Applicable
ALLIANCE	Not Applicable

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Shale Badland (CES304.789)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally

DISTRIBUTION
Dinosaur National Monument
This association is known from the western entrance of the monument.

Globally
Data are not available.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association occupies highly disturbed sites on shale badlands or low, arid, barren hills and alluvial flats of the monument that are derived from shale. Elevation is below 1500 m. Soils are typically clayey in texture but can be sandy because of the superposition of eolian sands.

Globally
Data are not available.

VEGETATION DESCRIPTION
Dinosaur National Monument
This association is characterized by its sparse to dense (depending on time of year and annual precipitation) cover by

annual, usually weedy forbs and grasses. Total herbaceous cover is less than 20% in a drought year. Typical herbaceous species present include *Salsola tragus, Alyssum desertorum, Cleome lutea,* and *Bromus tectorum*.

Globally
Data are not available.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	Species
Herb (field)	*Bromus tectorum*
Herb (field)	*Salsola tragus*

Globally
Data are not available.

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Alyssum desertorum, Cleome lutea, Halogeton glomeratus

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: Not applicable.

CLASSIFICATION COMMENTS
Dinosaur National Monument
This association reflects a degraded shale community. Grazing and off-road vehicle use have particularly affected these areas because of their low elevation and easy access. The disturbance is likely to persist because of the soil's poor water-holding capacity and the constant wind desiccation and sheet erosion that is characteristic of these sites.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: Not applicable

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This type has been reported from Mancos shale sites and alluvial flats adjacent to hills of Mancos shale.
Dinosaur National Monument Data Sources: The description is based on 2002 field data (1 plot: DINO.0654).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: N/A

REFERENCES: Western Ecology Working Group n.d.

Tetradymia canescens Shrubland [Park Special]
Gray Horsebrush Shrubland [Park Special]

CODE	Park Special
PHYSIOGNOMIC CLASS	Not Applicable
PHYSIOGNOMIC SUBCLASS	Not Applicable
PHYSIOGNOMIC GROUP	Not Applicable
PHYSIOGNOMIC SUBGROUP	Not Applicable
FORMATION	Not Applicable
ALLIANCE	Not Applicable

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally

DISTRIBUTION
Dinosaur National Monument
This association is known from south of the Dinosaur Quarry at the western end of the monument.

Globally
Data are not available.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association was sampled once at 1475 m elevation on older terraces in the valley of the Green River below Split Mountain. Soils are deep loamy sands derived from alluvium. Cryptobiotic crust is present on the soil surface with moderate cover.

Globally
Data are not available.

VEGETATION DESCRIPTION
Dinosaur National Monument
This open shrub association is dominated by *Tetradymia canescens* with 20% cover. *Artemisia tridentata* ssp. *wyomingensis* is present with less than 5% cover. Dwarf-shrubs *Opuntia fragilis* and *Gutierrezia sarothrae* occur with 10% total cover. Herbaceous species are sparse.

Globally
Data are not available.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	**Species**
Short shrub/sapling	*Tetradymia canescens*

Globally
Data are not available.

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: Not applicable.

CLASSIFICATION COMMENTS
Dinosaur National Monument
Past or recent disturbance to this site is not apparent. It is unclear whether edaphic factors or land-use history control the existence of this anomalous community. The *Tetradymia canescens* shrubland is surrounded by sagebrush stands to form a mosaic of shrubland communities. The two communities have few species in common.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: Not applicable

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association has a very limited distribution in the monument.

Dinosaur National Monument Data Sources: The description is based on 2002 field data (1 plot: DINO.0658).
Local Description Authors: J. Thompson, mod. J. Coles
Global Description Authors: N/A

REFERENCES: Western Ecology Working Group n.d.

Xanthium strumarium Herbaceous Vegetation [Park Special]
Rough Cocklebur Herbaceous Vegetation [Park Special]

CODE	Park Special
PHYSIOGNOMIC CLASS	Not Applicable
PHYSIOGNOMIC SUBCLASS	Not Applicable
PHYSIOGNOMIC GROUP	Not Applicable
PHYSIOGNOMIC SUBGROUP	Not Applicable
FORMATION	Not Applicable
ALLIANCE	Not Applicable

ECOLOGICAL SYSTEM(S): Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY
Dinosaur National Monument
This wetland association has only been described from the Green and Yampa river drainages in northwestern Colorado and probably in adjacent eastern Utah, and it is expected to occur adjacent to perennial or intermittent streams or springs throughout the Colorado Plateau. This association occurs in patches primarily within active floodplains, either in the stream bed or on the lowest terraces that flood annually. Soils are typically saturated during the growing season. The vegetation is characterized by a virtual monoculture of *Xanthium strumarium*.

Globally
Data are not available

DISTRIBUTION
Dinosaur National Monument
This association occurs infrequently in small patches along the Yampa and Green rivers.

Globally
Data are not available.

ENVIRONMENTAL DESCRIPTION
Dinosaur National Monument
This association occurs in the active channel and scoured banks of the Yampa and Green rivers. Flooding and scouring occur annually and sometimes seasonally. Soils are alluvial sands and cobbles with a high water table.

VEGETATION DESCRIPTION
Dinosaur National Monument
This association is characterized by dense stands of the exotic annual forb *Xanthium strumarium*. No other species were recorded in the sampled plot.

Globally
Data are not available.

MOST ABUNDANT SPECIES
Dinosaur National Monument

Stratum	Species
Herb (field)	*Xanthium strumarium*

Globally
Data are not available.

OTHER NOTEWORTHY SPECIES
Dinosaur National Monument
Data are not available.

Globally
Data are not available.

CONSERVATION STATUS RANK
Global Rank & Reasons: Not applicable.

CLASSIFICATION COMMENTS
Dinosaur National Monument
This association becomes established on fresh alluvium in the active floodplain of the major rivers within the monument following high flows in the spring and early summer. *Xanthium strumarium* is considered exotic in Colorado but probably not invasive along stream sites that are dynamic due to flooding.

Globally
Data are not available.

CLASSIFICATION CONFIDENCE: Not applicable

ELEMENT SOURCES
Dinosaur National Monument Inventory Notes: This association is only evident in the late summer and early fall, as it occurs primarily in habitats that are flooded in the spring and early summer.
Dinosaur National Monument Data Sources: This association is described from 1990s field data (1 plot: GR021).
Local Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

Bibliography for Dinosaur National Monument

Alberta Natural Heritage Information Centre. 2005. Community database files. Alberta Natural Heritage Information Centre, Parks and Protected Areas Division, Alberta Community Development, Edmonton.

Achuff, P.L., R.L. McNeil, M.L. Coleman, C. Wallis and C. Wershler. 2002a. Ecological land classification of Waterton Lakes National Park, Alberta. Volume I: Integrated resource description. Parks Canada, Waterton Lakes National Park, Alberta. 226 pp.

Achuff, P.L., R L. McNeil, and M.L. Coleman. 1997. Chapter III-Vegetation. Pages 28-93 in: P.L. Achuff, R.L. McNeil, and M.L. Coleman. Ecological land classification of Waterton Lakes National Park, Alberta. Parks Canada, Waterton Lakes National Park. 250 pp. plus maps.

Agee, J.K., and J.Kertis. 1987. Forest types of the north Cascades National Park Service complex. Canadian Journal of Botany 65:1520-1530.

Agee, J.K., and R.Wasem. 1987. Stetattle Creek Research Natural Area. Federal Research Natural Areas in Oregon and Washington. Supplement No. 25. 25 pp.

Aldous, A.E., and H.L. Shantz. 1924. Types of vegetation in the semiarid portion of the United States and their economic significance. Journal of Agricultural Research 28(2):99-128.

Alexander, B.G., Jr., E.L. Fitzhugh, F. Ronco, Jr., and J.A. Ludwig. 1987. A classification of forest habitat types of the northern portion of the Cibola National Forest, NM. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. General Technical Report RM-143. Fort Collins, CO. 35 pp.

Alexander, B.G., Jr., F. Ronco, Jr., A.S. White, and J.A. Ludwig. 1984b. Douglas-fir habitat types of northern Arizona. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. General Technical Report RM-108. Fort Collins, CO. 13 pp.

Alexander, B.G., Jr., F. Ronco, Jr., E.L. Fitzhugh, and J.A. Ludwig. 1984a. A classification of forest habitat types of the Lincoln National Forest, New Mexico. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. General Technical Report RM-104. Fort Collins, CO. 29 pp.

Alexander, R.M. 1986. Classification of the forest vegetation of Wyoming. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Research Note RM-466. Fort Collins, CO. 10 pp.

Alexander, R.R. 1985. Major habitat types, community types, and plant communities in the Rocky Mountains. USDA Forest Service General Technical Report RM-123. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 105 pp.

Alexander, R.R., and F. Ronco, Jr. 1987. Classification of the forest vegetation on the national forests of Arizona and New Mexico. USDA Forest Service Research Note RM-469. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

Allard, D.J. 1990. Southeastern United States ecological community classification. Interim report, Version 1.2. The Nature Conservancy, Southeast Regional Office, Chapel Hill, NC. 96 pp.

Anderson, M.D. 2001a. Ceanothus velutinus. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer).[Available: http://www.fs.fed.us/database/feis/] (accessed August 2005).

Anderson, M.D. 2001b. *Ephedra viridis*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [Available: http://www.fs.fed.us/database/feis/] (accessed 15 October 2007).

Anderson, W.E. 1956. Some soil-plant relationships in eastern Oregon. Journal of Range Management 9:171-175.

Anhold, J. 2005. Piñon pine mortality event in the Southwest: An update for 2005. Poster abstract. Ecological Restoration of Southwest Ponderosa Pine and Pinyon-Juniper Ecosystems, May 11-12, 2005, St. George, UT.

Annable, C.R. 1985. Vegetation and flora of the Funeral Mountains, Death Valley National Monument. California-Nevada Cooperative National Park Resources Studies Unit, National Park Service/University of Nevada Contribution 016/07. Las Vegas, NV. 188 pp.

Arno, S. F. 1980. Forest fire history in the northern Rockies. Journal of Forestry 78(8):460-465.

Atzet, T.A., D.E. White, L.A. McCrimmon, P.A. Martinez, P.R. Fong, and V.D. Randall. 1996. Field guide to the forested plant associations of southwestern Oregon. USDA Forest Service, Pacific Northwest Region. Technical Paper R6-NR-ECOL-TP-17-96. Portland, OR.

Atzet, T., and D.L. Wheeler. 1984. Preliminary plant associations of the Siskiyou Mountains Province, Siskiyou National Forest. USDA Forest Service, Pacific Northwest Region, Portland, OR.

Bureau of Indian Affairs. 1979. The secretarial land use plan for the addition to the Havasupai Indian Reservation. Unpublished draft Environmental Statement INT DES 79-42. Prepared by USDI Bureau of Indian Affairs,

Phoenix Area Office with the assistance of Office of Arid Land Studies, University of Arizona, Tucson.
Bureau of Land Management. 1979a. Pages 2-6 to 2-15 in: Grand Junction Resource Area grazing management-draft environmental statement.
Bureau of Land Management. 1979b. Final environmental impact statement, proposed development of coal resources in Eastern Powder River, WY. 67 pp.
Baalman, R J. 1965. Vegetation of the Salt Plains National Wildlife Refuge, Jet, Oklahoma. Unpublished Ph.D. dissertation, University of Oklahoma, Norman.
Bachrach, J.H. 1951. The plant communities of a valley in the montane forest of the Colorado Front Range. Unpublished thesis, University of Colorado, Boulder. 68 pp.
Badaracco, R J. 1971. An interpretive resource analysis of Pawnee Buttes, Colorado. Unpublished dissertation, Colorado State University, Fort Collins. 341 pp.
Bader, E.H. 1932. The vegetation of the Mesa Verde National Park, Colorado. Unpublished thesis, University of Colorado, Boulder. 64 pp.
Bailey, R. 1997. Map: Ecoregions of North America (rev.). Washington, DC: USDA Forest Service in cooperation with The Nature Conservancy and the U.S. Geological Survey. 1:15,000,000.
Bailey, R.G. 1998. Ecoregion map of North America: Explanatory note. Miscellaneous Publication Number 1548, USDA Forest Service. 10 pp.
Baker, W.L. 1980a. Alpine vegetation of the Sangre De Cristo Mountains, New Mexico: Gradient analysis and classification. Unpublished thesis, University of North Carolina, Chapel Hill. 55 pp.
Baker, W.L. 1982a. Vegetation description in Colorado-where are the gaps? Journal of the Colorado-Wyoming Academy of Science 14(1):39 (Abstract).
Baker, W.L. 1982b. Natural vegetation of the Piceance Basin, Colorado. Appendix D, pages 1-113 in: J.S. Peterson and W.L. Baker, editors. Inventory of the Piceance Basin, Colorado. Unpublished report for the Bureau Land Management, Craig, CO.
Baker, W.L. 1983b. Some aspects of the presettlement vegetation of the Piceance Basin, Colorado. Great Basin Naturalist 43(4):687-699.
Baker, W.L. 1983c. Natural vegetation of part of northwestern Moffat County, Colorado. Unpublished report prepared for the State of Colorado Natural Areas Program, Department of Natural Resources, Denver by Colorado Natural Heritage Inventory, Denver.
Baker, W.L. 1983d. A preliminary classification of the natural vegetation of Colorado. Unpublished report prepared for the Colorado Natural Heritage Inventory, Denver. 17 pp.
Baker, W.L. 1984a. A preliminary classification of the natural vegetation of Colorado. Great Basin Naturalist 44(4):647-676.
Baker, W.L. 1984b. Additions to a bibliography of Colorado vegetation description. Great Basin Naturalist 44(4):677-680.
Baker, W.L. 1986. Riparian vegetation of the montane and subalpine zones in west-central and southwestern Colorado: Final report prepared for The Nature Conservancy and Colorado Natural Areas Program, Boulder.
Baker, W.L. 1989b. Classification of the riparian vegetation of the montane and subalpine zones in western Colorado. Great Basin Naturalist 49(2):214-228.
Baker, W.L., and S.C. Kennedy. 1985. Presettlement vegetation of part of northwestern Moffat County, Colorado, described from remnants. Great Basin Naturalist 45(4):747-777.
Barbour, M.G., and J. Major, editors. 1977. Terrestrial vegetation of California. John Wiley and Sons, New York. 1002 pp.
Barbour, M.G., and J. Major, editors. 1988. Terrestrial vegetation of California: New expanded edition. California Native Plant Society, Special Publication 9, Sacramento. 1030 pp.
Barnes, F.J. 1987. Carbon and water relations across a pinyon-juniper habitat gradient. Unpublished dissertation, New Mexico State University, Las Cruces.
Barney, M.A., and N.C. Frischknecht. 1974. Vegetation changes following fire in the pinyon-juniper types of west-central Utah. Journal of Range Management 27(2):91-96.
Barrows, J.S., E.W. Mogren, K. Rowdabaugh, and R. Yancik. 1977. The role of fire in ponderosa pine and mixed conifer ecosystems. Final report, Cooperative report between the National Park Service and Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 101 pp.
Bassett, D., M. Larson, and W. Moir. 1987. Forest and woodland habitat types of Arizona south of the Mogollon Rim and southwestern New Mexico. Edition 2. USDA Forest Service, SW, Albuquerque, NM.
Bear Creek Uranium Mine Application. No date. Unpublished report No. 399 prepared for Wyoming Department of

Environmental Quality, Land Quality Division, Cheyenne, WY.
Beatley, J.C. 1975. Climates and vegetation pattern across the Mojave/Great Basin desert transition of southern Nevada. The American Midland Naturalist 93:53-70.
Beatley, J.C. 1976. Vascular plants of the Nevada Test Site and central-southern Nevada: Ecological and geographic distributions. Technical Information Center, Energy Research and Development Administration. TID-26881. Prepared for Division of Biomedical and Environmental Research. 297 pp.
Beatley, J.C. 1993. Climatic and vegetation pattern across the Mojave / Great Basin Desert Transition of southern Nevada. The American Midland Naturalist 93:53-70.
Beetle, A.A. 1955. Wheatgrasses of Wyoming. Bulletin 336. Wyoming Agricultural Experiment Station, Laramie, WY. 24 pp.
Beetle, A. ., and K.L. Johnson. 1982. Sagebrush in Wyoming. Wyoming Agricultural Experiment Station Bulletin 779. University of Wyoming, Laramie.
Beidleman, R.G. 1954. The cottonwood river-bottom community as a vertebrate habitat. Unpublished dissertation, University of Colorado, Boulder. 358 pp.
Betancourt, J.L., and T.R. Van Devender. 1981. Holocene vegetation in Chaco Canyon, New Mexico. Science 214:656-658.
Bighorn Coal Mine. No date. Application No. 213-T2, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.
Billings, W.D. 1945. The plant associations of the Carson Desert region, western Nevada. Butler University Botanical Studies 7:89-123.
Billings, W.D. 1949. The shadscale vegetation zone of Nevada and eastern California in relation to climate and soils. The American Midland Naturalist 42(1):87-109.
Blackburn, W.H. 1967. Plant succession on selected habitat types in Nevada. Unpublished thesis, University of Nevada, Reno. 162 pp.
Blackburn, W.H., P.T. Tueller, and R.E. Eckert, Jr. 1968a. Vegetation and soils of the Mill Creek Watershed. Nevada Agricultural Experiment Station Bulletin R-43. Reno. 69 pp.
Blackburn, W.H., P.T. Tueller, and R.E. Eckert, Jr. 1968b. Vegetation and soils of the Crowley Creek Watershed. Nevada Agricultural Experiment Station Bulletin R-42. Reno. 60 pp.
Blackburn, W.H., P.T. Tueller, and R.E. Eckert, Jr. 1968c. Vegetation and soils of the Duckwater Watershed. Nevada Agricultural Experiment Station Bulletin R-40. Reno. 76 pp.
Blackburn, W.H., P.T. Tueller, and R.E. Eckert, Jr. 1969a. Vegetation and soils of the Cow Creek Watershed. Nevada Agricultural Experiment Station Bulletin R-49. Reno. 80 pp.
Blackburn, W.H., P.T. Tueller, and R.E. Eckert, Jr. 1969b. Vegetation and soils of the Coils Creek Watershed. Nevada Agricultural Experiment Station Bulletin R-48. Reno. 81 pp.
Blackburn, W.H., P.T. Tueller, and R.E. Eckert, Jr. 1969c. Vegetation and soils of the Churchill Canyon Watershed. Nevada Agricultural Experiment Station Bulletin R-45. Reno. 157 pp.
Blackburn, W.H., P.T. Tueller, and R.E. Eckert, Jr. 1969d. Vegetation and soils of the Pine and Mathews Canyon Watersheds. Nevada Agricultural Experiment Station Bulletin R-46. Reno. 111 pp.
Blackburn, W.H., P.T. Tueller, and R.E. Eckert, Jr. 1971. Vegetation and soils of the Rock Springs Watershed. Nevada Agricultural Experiment Station Bulletin R-83. Reno. 116 pp.
Blackburn, W H., R.E. Eckert, Jr., and P.T. Tueller. 1969e. Vegetation and soils of the Crane Springs Watershed. Nevada Agricultural Experiment Station Bulletin R-55. Reno. 63 pp.
Blackburn, W.H., and P.T. Tueller. 1970. Pinyon and juniper invasion in black sagebrush communities in east-central Nevada. Ecology 51:841-848.
Blackhawk Coal Company. 1981. Vegetation resources. Chapter 9 Section 9.2, pages 9-1 through 9-27 in: Mining and Reclamation Plan for Willow Creek Mine, Blackhawk Coal Company. Utah Division of Oil, Gas & Mining Number ACT/007/002. Salt Lake City, UT.
Boggs, K. 2000. Classification of community types, successional sequences and landscapes of the Copper River Delta, Alaska. USDA Forest Service, Pacific Northwest Research Station, General Technical Report PNW-GTR-469. Portland, OR. March 2000. 244 pp.
Boles, P.H., and W.A. Dick-Peddie. 1983. Woody riparian vegetation patterns on a segment of the Mimbres River in southwestern New Mexico. Southwestern Naturalist 28:81-87.
Bond, H.E. 1959. Revegetation and disintegration of pocket gopher mounds on Black Mesa, Colorado. Unpublished thesis, Colorado State University, Fort Collins.
Borchert, M., A. Lopez, C. Bauer, and T. Knowd. 2004. Field guide to coastal sage scrub and chaparral series of Los

Padres National Forest. USDA Forest Service.
Bork, J.L. 1978. A survey of the vascular plants and vertebrates of Upper Table Rock. M.S. thesis, Southern Oregon State College, Ashland. 91 pp.
Boss, T.R. 1983. Vegetation ecology and net primary productivity of selected freshwater wetlands in Oregon. Ph.D. dissertation, Oregon State University, Corvallis. 236 pp.
Bourgeron, P.S., L.D. Engelking, H.C. Humphries, E. Muldavin, and W.H. Moir. 1993b. Assessing the conservation value of the Gray Ranch: Rarity, diversity and representativeness. Unpublished report prepared for The Nature Conservancy by the Western Heritage Task Force, Boulder, CO. (Volume I and II).
Bourgeron, P S., L.D. Engelking, H.C. Humphries, E. Muldavin, and W.H. Moir. 1995. Assessing the conservation value of the Gray Ranch: Rarity, diversity and representativeness. Desert Plants 11:2-3.
Bourgeron, P.S., and L.D. Engelking, editors. 1994. A preliminary vegetation classification of the western United States. Unpub.report. The Nature Conservancy, Western Heritage Task Force, Boulder, CO. 175 pp. + app.
Boutton, T.W., A.T. Harrison, and B.N. Smith. 1980. Distribution of biomass of species differing in photosynthetic pathway along an altitudinal transect in southwestern Wyoming grasslands. Oecologia 45:287-298.
Bowers, J.E. 1982. The plant ecology of inland dunes in western North America. Journal of Arid Environments 5:199-220.
Bowers, J.E. 1984. Plant geography of southwestern sand dunes. Desert Plants 6(1):31-42, 51-54.
Boyce, D.A. 1977. Vegetation of the South Fork of the White River Valley, Colorado. Unpublished dissertation, University of Colorado, Boulder. 312 pp.
Bradley, A.F., N.V. Noste, and W.C. Fischer. 1992. Fire ecology of forests and woodlands in Utah. USDA Forest Service, Intermountain Research Station. General Technical Report INT-287. Ogden, UT. 128 pp.
Bradley, W.G. 1964. The vegetation of the desert game range with special reference to the desert bighorn. Pages 43-67 in: Transcripts of the Desert Bighorn Council. Las Vegas, NV.
Bragg, T.B., and L.C. Hulbert. 1976. Woody plant invasion of unburned Kansas bluestem prairie. Journal of Range Management 29(1):19-24.
Bramble-Brodahl, M.K. 1978. Classification of *Artemisia vegetation* in the Gros Ventre area, Wyoming. M.S. thesis, University of Idaho, Moscow.
Branson, F.A. 1966. Geographic distribution and factors affecting the distribution of salt desert shrubs in the U.S. Pages 13-43 in Proceedings from the Salt Desert Shrub Symposium, 1-4 August 1966. USDI Bureau of Land Management, Cedar City, Utah.
Branson, F.A., R.F. Miller, and I.S. McQueen. 1961. Soil-water availability and use by grasslands on adjacent stony and shale-derived soils in Colorado. Short papers in geologic and hydrologic sciences. U.S. Geological Survey Professional Paper 424C:251-253.
Branson, F.A., R.F. Miller, and I.S. McQueen. 1964. Effects of two kinds of geologic materials on plant communities and soil moisture. American Society of Agronomy Special Publication 5:165-175.
Branson, F.A., R.F. Miller, and I.S. McQueen. 1965. Plant communities and soil moisture relationships near Denver, Colorado. Ecology 46(3):311-319.
Branson, F.A., R.F. Miller, and I.S. McQueen. 1967. Geographic distribution and factors affecting the distribution of salt desert shrubs in the United States. Journal of Range Management 29(5):287-296.
Branson, F.A., R.F. Miller, and I.S. McQueen. 1976. Moisture relationships in twelve northern desert shrub communities near Grand Junction, Colorado. Ecology 57:1104-1124.
Branson, F.A., and J.B. Owen. 1970. Plant cover, runoff, and sediment yield relationships on Mancos shale in western Colorado. Water Resources Research 6:783-790.
Brayshaw, T.C. 1965. The dry forest of southern British Columbia. Pages 65-75 in: V.J. Krajina, editor. Ecology of western North America. Volume I, illustrated. University of British Columbia, Department of Botany.
Brooks, R.E., and S.E. Clemants. Juncaceae. Pages 211-267 in: Flora of North America Editorial Committee, editors. Flora of North America. Volume 22. Oxford University Press, New York, NY.
Brotherson, J.D. 1987. Plant community zonation in response to soil gradients in a saline meadow near Utah Lake, Utah County, Utah. Great Basin Naturalist 47(2):322-333.
Brotherson, J.D., D.L. Anderson, and L.A. Szyska. 1984. Habitat relations of *Cercocarpus montanus* (true mountain mahogany) in central Utah. Journal of Range Management 37:321-324.
Brotherson, J.D., L.L. Rasmussen, and R.D. Black. 1986. Comparative habitat and community relationships of *Atriplex confertifolia* and *Sarcobatus vermiculatus* in central Utah. Great Basin Naturalist 46(2):348-357.
Brotherson, J.D., and K.J. Brotherson. 1979. Ecological and community relationships of *Eriogonum corymbosum* (Polygonaceae) in the Uinta Basin, Utah. Great Basin Naturalist 39:177-191.

Brotherson, J.D., and S.J. Barnes. 1984. Habitat relationships of *Glaux maritima* in central Utah. Great Basin Naturalist 44(2):299-309.

Brotherson, J.D., and W.E. Evenson. 1982. Vegetation communities surrounding Utah Lake and its bays. Utah Lake Vegetation Studies. Unpublished report done for the Utah Division of Wildlife Resources and USDI Bureau of Reclamation, Provo, UT. 401 pp.

Brotherson, J D., and W.T. Brotherson. 1981. Grazing impacts on the sagebrush communities of central Utah. Great Basin Naturalist 41(3):335-340.

Brown, D.E., C.H. Lowe, and C.P. Pase. 1979. A digitized classification system for the biotic communities of North America with community (series) and association examples for the Southwest. Journal of the Arizona-Nevada Academy of Science 14:1-16.

Brown, D.E., editor. 1982. Biotic communities of the American Southwest-United States and Mexico. Desert Plants Special Issue 4(1-4):1-342.

Brown, R.W. 1971. Distribution of plant communities in southeastern Montana badlands. The American Midland Naturalist 85(2):458-477.

Bujakiewicz, A. 1975. Vegetational zonation in the Front Range of the Rocky Mountains, Colorado. USA. Fragmenta Floristica et Geobotanica 21:99-142.

Bundy, R.M., J.V. Baumgartner, M.S. Reid, P.S. Bourgeron, H.C. Humphries, and B.L. Donohue. 1996. Ecological classification of wetland plant associations in the Lahontan Valley, Nevada. Prepared for Stillwater National Wildlife Refuge and USDI Fish & Wildlife Service. 53 pp. not including inventories, tables and graphs.

Bunin, J.E. 1975a. Aspen forests of the west slope of the Park Range, north-central Colorado. Unpublished paper presented at the 1975 AIBS/ESA Meetings, 17-22 August 1975, Oregon State University, Corvallis. 22 pp.

Bunin, J.E. 1975c. The vegetation of the west slope of the Park Range, Colorado. Unpublished dissertation, University of Colorado, Boulder. 235 pp.

Bunin, J.E. 1985. Vegetation of the City of Boulder, Colorado open space lands. Report prepared for the City of Boulder, Real Estate/Open Space, Boulder, CO. 114 pp.

Bunting, S.C. 1987. Use of prescribed burning in juniper and pinyon-juniper woodlands. Pages 141-144 in: R.L. Everett, compiler. Proceedings--pinyon-juniper conference; 1986 January 13-16; Reno, NV. Department of Agriculture, Forest Service, Intermountain Research Station. General Technical Report INT-215. Ogden, UT.

Burgess, T.L., and D.K. Northington. 1977. Desert vegetation of the Guadalupe Mountains region. Pages 229-243 in: R.H. Wauer and D.H. Riskind, editors. Transactions of the symposium on the biological resources of the Chihuahuan Desert region, United States and Mexico. USDI National Park Service. Transaction Proceedings Series No. 3. Washington, DC.

Burns, R.M., and B.H. Honkala, technical coordinators. 1990a. Silvics of North America: Volume 1. Conifers. USDA Forest Service. Agriculture Handbook 654. Washington, DC. 675 pp.

Butler, J., D. Crawford, S. Menard, and T. Meyer. 2002. Lacreek National Wildlife Refuge, South Dakota. USGS USFWS Vegetation Mapping Program. Final report. Technical Memorandum 8260-02-02, Remote Sensing and GIS Group, Technical Service Center, Bureau of Reclamation, Denver, CO.

Colorado Natural Heritage Program. 2003. Unpublished data. List of Elements and Elcodes converted and entered into Biotics Tracker 4.0. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

Colorado Natural Heritage Program. No date. Biological and Conservation Data (BCD) System. Unpublished data from field surveys. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

Colorado Natural Heritage Program. Personal communication. Colorado Natural Heritage Program, Colorado State University, Fort Collins.

Cacek, T.L. 1973. An ecological interpretation of north central Colorado. Unpublished dissertation, Colorado State University, Fort Collins. 261 pp.

Caicco, S.L., and C.A. Wellner. 1983a. Research Natural Area recommendation for City of Rocks. Unpublished report prepared for USDI Bureau of Land Management, Burley District, Idaho by Idaho Natural Areas Coordinating Committee. On file at Idaho Conservation Data Center, Boise, ID. 12 pp.

Caicco, S.L., and C.A. Wellner. 1983c. Research Natural Area recommendation for Southwest Lemhi Range. Unpublished report prepared for USDI Bureau of Land Management, Idaho Falls District, Idaho by Idaho Natural Areas Coordinating Committee. On file at Idaho Conservation Data Center, Boise, ID.

Caicco, S.L., and C.A. Wellner. 1983f. Research Natural Area recommendation for Menan Buttes. Unpublished report prepared for USDI Bureau of Land Management, Idaho Falls District, Idaho by Idaho Natural Areas Coordinating Committee. 10 pp.

Caicco, S.L., and C.A. Wellner. 1983g. Research Natural Area recommendation for Middle Canyon Alluvial Fan.

Unpublished report prepared for USDI Bureau of Land Management, Idaho Falls District, Idaho by Idaho Natural Areas Coordinating Committee.

Caicco, S.L., and C.A. Wellner. 1983i. Research Natural Area recommendation for Substation Tract. Unpublished report prepared for USDI Bureau of Land Management, Shoshone District, Idaho by Idaho Natural Areas Coordinating Committee. 11 pp.

Caicco, S.L., and C.A. Wellner. 1983j. Research Natural Area recommendation for Big Juniper Kipuka. Unpublished report prepared for USDI Bureau of Land Management, Shoshone District, Idaho by Idaho Natural Areas Coordinating Committee.

Caicco, S.L., and C.A. Wellner. 1983k. Research Natural Area recommendation for East Fork Salmon River Bench. Unpublished report prepared for USDI Bureau of Land Management, Salmon District, Idaho by Idaho Natural Areas Coordinating Committee. 14 pp.

Caicco, S.L., and C.A. Wellner. 1983l. Research Natural Area recommendation for Antelope Flat. Unpublished report prepared for USDI, Bureau of Land Management, Salmon District, Idaho by Idaho Natural Areas Coordinating Committee. 12 pp.

Caicco, S.L., and C.A. Wellner. 1983n. Research Natural Area recommendation for Little Jacks Creek. Unpublished report prepared for USDI Bureau of Land Management, Boise District, Idaho by Idaho Natural Areas Coordinating Committee. 14 pp.

Campbell, C.J., and W.A. Dick-Peddie. 1964. Comparison of phreatophyte communities on the Rio Grande in New Mexico. Ecology 45:492-501.

Campbell, V.O. 1977. Certain edaphic and biotic factors affecting vegetation in the shadscale community of the Kaiparowitz area. Unpublished thesis, Brigham Young University, Provo, UT. 59 pp.

Cannon, H.L. 1960. The development of botanical methods of prospecting for uranium on the Colorado Plateau. USDI Geological Survey Bulletin 1085-A. Washington, DC. 50 pp.

Carmichael, R.S., O.D. Knipe, C.P. Pase, and W.W. Brady. 1978. Arizona chaparral: Plant associations and ecology. USDA Forest Service Research Paper RM-202. 16 pp.

Carsey, K., D. Cooper, K. Decker, D. Culver, and G. Kittel. 2003b. Statewide wetlands classification and characterization: Wetland plant associations of Colorado. Prepared for Colorado Department of Natural Resources, Denver, by Colorado Natural Heritage Program, College of Natural Resources, Colorado State University, Fort Collins. 79 pp.

Carsey, K., G. Kittel, K. Decker, D. J. Cooper, and D. Culver. 2003a. Field guide to the wetland and riparian plant associations of Colorado. Colorado Natural Heritage Program, Fort Collins, CO.

Castle, E. S. 1954. The vegetation and its relationship to the dune soils of Kane County, Utah. Unpublished thesis, Brigham Young University, Provo, UT.

Chadde, S., P. Hansen, and R. Pfister. 1988. Wetland plant communities of the northern range, Yellowstone National Park. Final contract report June 10, 1988 (revised September 9, 1988). School of Forestry, University of Montana, Missoula. 81 pp.

Chadwick, H.W. and P. Dalke. 1965. Plant succession on dune sands in Fremont County, ID. Ecology 46:765-780.

Chapman, K.A. 1984. An ecological investigation of native grassland in southern Lower Michigan. Unpublished Master's thesis, Western Michigan University, Kalamazoo. 235 pp.

Chappell, C. 1994. Natural forests of the Puget Lowland, Washington. Northwest Science Abstract.

Chappell, C., R. Crawford, J. Kagan, and P. J. Doran. 1997. A vegetation, land use, and habitat classification system for the terrestrial and aquatic ecosystems of Oregon and Washington. Unpublished report prepared for Wildlife habitat and species associations within Oregon and Washington landscapes: Building a common understanding for management. Prepared by Washington and Oregon Natural Heritage Programs, Olympia WA, and Portland, OR. 177 pp.

Christensen, E.M. 1963. The foothill bunchgrass vegetation of central Utah. Ecology 44(1):156-158.

Christensen, E.M., and S.L. Welsh. 1963. Presettlement vegetation of the valleys of western Summit and Wasatch counties, Utah. Proceedings of the Utah Academy of Science, Arts and Letters 40:163-174.

Christy, J.A. 2004. Native freshwater wetland plant associations of northwestern Oregon. Oregon Natural Heritage Information Center, Oregon State University, Portland, OR.

Christy, J.A., J.S. Kagan, and A.M. Wiedemann. 1998. Plant associations of the Oregon Dunes National Recreation Area - Siuslaw National Forest, Oregon. USDA Forest Service Technical Paper R6-NR-ECOL-TP-09-98, Pacific Northwest Region, Portland, OR. 196 pp.

Christy, J.A., and L.C. Cornelius. 1980. Katherine Ordway Sycan Marsh Preserve: Preliminary classification of plant communities. The Nature Conservancy, Oregon Field Office, Portland.

Christy, S. 1973. An analysis of the woody vegetation on the South Platte River flood plain in northeastern Colorado. Unpublished thesis, University of Northern Colorado, Greeley. 82 pp.

Clary, W.P. 1978. Arizona fescue mountain rangelands. Pages 205-207 in: D.N. Hyder, editor. Proceedings of the First International Rangeland Congress, Denver, CO, 14-18 August 1978. Society for Range Management, Denver.

Clary, W.P., M.B. Baker, Jr., P.F. O'Connell, T.N. Johnsen, Jr., and R.E. Campbell. 1974. Effects of pinyon-juniper removal on natural resource products and uses in Arizona. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Research Paper RM-128. Fort Collins, CO. 28 pp.

Clary, W.P., and H.A. Pearson. 1969. Cattle preferences for forage species in northern Arizona. Journal of Range Management 22(2):114-116.

Clausnitzer, R.R., and B.A. Zamora. 1987. Forest habitat types of the Colville Indian Reservation. Unpublished report prepared for the Department of Forest and Range Management, Washington State University, Pullman. 110 pp.

Clements, F.E. 1904. Formation and succession herbaria. University of Nebraska, University Studies IV(4):329-355. Coenenberg, J.G., and E.J. Depuit. 1979. Baseline wildlife studies, Crow Coal Lease, southeastern Montana, 1975-1978. Montana Agricultural Experiment Station, Reclamation Research Unit, Bozeman, MT. 133 pp.

Cogan, D., M. Reid, K. Schulz, and M. Pucherelli. 2004. Zion National Park, Utah 1999-2003. Vegetation Mapping Project. Technical Memorandum 8260-03-01. Remote Sensing and GIS Group Technical Service Center, Bureau of Reclamation, Denver, CO. Appendix F: Vegetation Association Descriptions for Zion.

Cole, D.N. 1977b. Man's impact on wilderness: An example from Eagle Cap Wilderness, northeastern Oregon. Ph.D. dissertation, Oregon State University, Corvallis. 307 pp.

Cole, D.N. 1982. Vegetation of two drainages in Eagle Cap Wilderness, Wallowa Mountains, Oregon. USDA Forest Service Research Paper INT-288.

Cole, N.K. 1995. Cover type map and vegetation classification of the Hagerman study area, southwestern Idaho. Technical appendix E.3.3-A for new license application: Upper Salmon Falls (FERC No. 2777), Lower Salmon Falls (FERC No. 2061), Bliss (FERC No. 1975). Volume 4. Idaho Power Company, Boise ID. 61 pp. plus appendices.

Cole, N.K. 1996. Cover type map and vegetation classification of the Shoshone Falls study area, southwestern Idaho. Technical appendix E.3.3-A for new license application: Shoshone Falls (FERC No. 2778), Volume 2. Idaho Power Company, Boise ID. 38 pp. plus appendices.

Coles, Janet. Personal communication. Ecologist/Project Manager, NatureServe, Boulder, CO.

Collins, E. I. 1984. Preliminary classification of Wyoming plant communities. Unpublished classification prepared for the Wyoming Natural Heritage Program, The Nature Conservancy, Laramie, WY.

Collins, E.I., R.W. Lichvar, and E.F. Evert. 1984. Description of the only known fen-palsa in the 48 contiguous United States. Arctic and Alpine Research 16:255-258.

Colorado Natural Heritage Program Ecology Team. 2001. A classification of the native vegetation of Colorado. Colorado Natural Heritage Program, Colorado State University, Fort Collins.

Comer, P. (editor), L. Allen, S. Cooper, D. Faber-Langendoen, and G. Jones. 1999. Selected shrubland and grassland communities of the northern Great Plains. Report to the Nebraska National Forest. The Nature Conservancy.

Comer, P.J., W.A. MacKinnon, M.L. Rabe, D.L. Cuthrell, M.R. Penskar, and D.A. Albert. 1995b. A survey of Lakeplain Prairie in Michigan. CZM Project 94D-0.04. Michigan Natural Features Inventory, Lansing, MI.

Comer, P., editor. 1999. Selected shrubland and grassland communities of the Northern Great Plains. A report to the Nebraska National Forest from The Nature Conservancy, Western Conservation Science Department, Boulder CO. 119 pp.

Comer, Pat. Personal communication. Regional Ecologist. NatureServe, Western Resource Office, Boulder, CO.

Conard, S.G., and S.R. Radosevich. 1982. Post-fire succession in white fir (*Abies concolor*) vegetation of the northern Sierra Nevada. Madrono 29(1):42-56.

Cooper, D.J. 1988. Advanced identification of wetlands in the City of Boulder Comprehensive Planning Area. Unpublished technical report prepared for U.S. Environmental Protection Agency, Region VIII and the City of Boulder, CO.

Cooper, D J. 1993. Wetlands of the Crested Butte region: Mapping, functional evaluation, and hydrologic regime. Prepared for Town of Crested Butte and the U.S. Environmental Protection Agency, Region VIII, Denver, CO. Cooper, D.J., and C. Severn. 1992. Wetlands of the San Luis Valley, Colorado: An ecological study and analysis of the hydrologic regime, soil chemistry, vegetation and the potential effects of a water table

drawdown. Report submitted to the State of Colorado Division of Wildlife, the USDI Fish & Wildlife Service and the Rio Grande Water Conservation District.

Cooper, D.J., and T.R. Cottrell. 1990. Classification of riparian vegetation in the northern Colorado Front Range. Unpublished report prepared for The Nature Conservancy, Colorado Field Office, Boulder. 115 pp.

Cooper, S.V. 1975. Forest habitat types of northwestern Wyoming and contiguous portion of Montana and Idaho. Unpublished dissertation, Washington State University, Pullman. 190 pp.

Cooper, S.V., C. Jean, and B.L. Heidel. 1999. Plant associations and related botanical inventory of the Beaverhead Mountains Section, Montana. Unpublished report to the Bureau of Land Management. Montana Natural Heritage Program, Helena. 235 pp.

Cooper, S.V., K.E. Neiman, R. Steele, and D.W. Roberts. 1987. Forest habitat types of northern Idaho: A second approximation. USDA Forest Service, Intermountain Research Station. General Technical Report INT-236. Ogden, UT. 135 pp. [reprinted in 1991]

Cooper, S.V., P. Lesica, R.L. DeVelice, and T. McGarvey. 1995. Classification of southwestern Montana plant communities with emphasis on those of Dillon Resource Area, Bureau of Land Management. Montana Natural Heritage Program, Helena, MT. 154 pp.

Cooper, S.V., and B.L. Heidel. 1997. Population status and ecology of trembling aspen and black cottonwood communities on the Blackfeet Indian Reservation. Prepared for the Blackfeet Nation-Fish and Wildlife Department and the USDI Fish & Wildlife Service by Montana Natural Heritage Program, Helena, MT.

Cooper, S.V., and R.D. Pfister. 1985. Forest habitat types of the Crow and Northern Cheyenne Indian Reservations. Unpublished termination report prepared for Bureau of Indian Affairs, Billings Area Office by USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT. 118 pp.

Cooper, S., and R. Pfister. 1981. Forest habitat types of the Blackfeet Indian Reservation. Review Draft, 5/21/81, for Bureau of Indian Affairs, Wind River Agency, Fort Washakie, WY.

Copeland, W.N. 1978. Botanical survey of Eight Dollar Mountain, May 6-9, 1978. Oregon Natural Heritage Data Base, Portland, OR.

Copeland, W.N. 1979. Harney Lake RNA Guidebook, Supplement #9. USDA Forest Service Experiment Station, Portland, OR.

Copeland, W.N. 1980a. The Lawrence Memorial Grassland Preserve, a biophysical inventory with management recommendations. June 1980. Unpublished report prepared by The Nature Conservancy Field Office, Portland, Oregon. 161 pp.

Copeland, W.N., and S.E. Greene. 1982. Stinking Lake Research Natural Area. Supplement #12 to Franklin, J.F., F.C. Hall, C.T. Dyrness and C. Maser. 1972. Federal research natural areas in Oregon and Washington: A guidebook for scientists and educators. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR.

Costello, D.F. 1944b. Important species of the major forage types in Colorado and Wyoming. Ecological Monographs 14:107-134.

Costello, D.F. 1954. Vegetation zones in Colorado. Pages iii-x in: H.D. Harrington, editor. Manual of the plants of Colorado. Sage Books, Denver.

Costello, D.F., and H.E. Schwan. 1946. Conditions and trends on ponderosa pine ranges in Colorado. USDA Forest Service Mimeograph. 33 pp.

Cotter-Ferguson Project. No date. Application No. 490, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service, Biological Service Program. FWS/OBS-79/31. Washington, DC. 103 pp.

Cox, B.J. 1968. A vegetational comparison of the Gothic and Galena Mountain area. Transactions of the Missouri Academy of Science 2:72-83.

Crane, M.F. 1982. Fire ecology of Rocky Mountain Region forest habitat types. USDA Forest Service report. 272 p.

Crawford, R.C. 2001. Initial riparian and wetland classification and characterization of the Columbia Basin in Washington. Prepared for Environmental Protection Agency and Bureau of Land Management, Spokane District. Washington Natural Heritage Program, WA Department of Natural Resources, Olympia. 83 pp.

Cronquist, A., A.H. Holmgren, N.H. Holmgren, J.L. Reveal, and P.K. Holmgren. 1977. Intermountain flora: Vascular plants of the Intermountain West, U.S.A. Volume 6: The Monocotyledons. Columbia University Press, New York. 584 pp.

Cronquist, A., N.H. Holmgren, and P.K. Holmgren. 1997. Intermountain flora: Vascular plants of the Intermountain West, USA. Volume 3, Part A, subclass Rosidae (except Fabeles). NY Botanical Garden, Bronx, NY. 446 pp.

Cross, A.F. 1991. Vegetation of two southeastern Arizona desert marshes. Madrono 38(3):185-194.
Crouch, G.L. 1961a. Wildlife populations and habitat conditions on grazed and ungrazed bottomlands in Logan County, Colorado. Unpublished thesis, Colorado State University, Fort Collins.
Crouch, G.L. 1961b. Inventory and analysis of wildlife populations and habitat, South Platte River Valley. Final report, Federal Aid in Wildlife Restoration, Project W-104-R-1-2, Colorado Game and Fish Department. 68 pp.
Crouch, G.L. 1978. Effects of protection from livestock grazing on a bottomland wildlife habitat in northeastern Colorado. Pages 118-125 in: Lowland river and stream habitat in Colorado: A symposium. Greeley, CO. 4-5 October 1978.
Crouch, G.L. 1979a. Long-term changes in cottonwoods on a grazed and an ungrazed plains bottomland in northeastern Colorado. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Research Note RM-370. Fort Collins, CO. 4 pp.
Crouch, G.L. 1979b. Changes in the vegetation complex of a cottonwood ecosystem on the South Platte River. Pages 19-22 in: Riparian and wetland habitats of the Great Plains: Proceedings of the 31st annual meeting. Great Plains Agricultural Council Publication 91. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.
Crouch, G.L. 1983. Effects of commercial clear-cutting of aspen on understory vegetation and wildlife habitat values in southwestern Colorado. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Research Paper RM-246. Fort Collins, CO.
Crow, J.H. 1968. Plant ecology of the Copper River Delta, Alaska. Ph.D. thesis, Washington State University, Pullman. 120 pp.
Crow, J.H. 1977. Salt marshes of Port Valdez, Alaska, and vicinity: A baseline study. Final report. Newark College of Arts and Sciences, Rutgers University, New Brunswick, NJ. 113 pp.
Crowe, E.A., B.L. Kovalchik, and M.J. Kerr. 2004. Riparian and wetland vegetation of central and eastern Oregon. Oregon Natural Heritage Information Center, Institute for Natural Resources, Oregon State University, Portland. 473 pp. [<http://oregonstate.edu/ornhic/ publications.html>]
Crowe, E.A., and R. R. Clausnitzer. 1997. Mid-montane wetland plant associations of the Malheur, Umatilla, and Wallowa-Whitman national forests. USDA Forest Service, Pacific Northwest Region. Technical Paper R6-NR-ECOL-TP-22-97.
Crowe, E., B. Kovalchik, M.J. Kerr, J. Titus, and J.S. Kagan. 2002. Riparian and wetland plant communities of eastern Oregon. Draft report. Oregon Natural Heritage Information Center, Portland, OR.
Culver, D.R., M.A. March, S.M. Kettler, and C.A. Pague. 1996. Natural Heritage Inventory of significant animals and plants and classification of riparian plant associations: Timpas Grazing District and Kim Grazing Association. Report prepared for USDA Forest Service, Pike-San Isabel National Forest, La Junta, CO, by Colorado Natural Heritage Program, Fort Collins.
Culver, D.R., and J.S. Sanderson. 1997. A Natural Heritage assessment of wetland and riparian areas in Summit County, Colorado. Report prepared for the Department of Natural Resources, Denver, CO, by Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.
Culwell, L.D., and K.L. Scow. 1982. Terrestrial vegetation inventory: Dominy Project Area, Custer County, Montana 1979-1980. Unpublished technical report for Western Energy Company by Westech, Helena, MT. 144 pp. plus 15 pp. appendix.
Current, F.B. 1984. The distribution and description of the vegetation of Battle Mountain as explained by abiotic factors. Unpublished dissertation, University of Wyoming, Laramie.
Currie, P.O. 1975. Grazing management of ponderosa pine - bunchgrass ranges of the central Rocky Mountains: The status of our knowledge. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station.
Research Paper RM-159. Fort Collins, CO. 24 pp.
Curry, R.R. 1962. Geobotanical correlations in the alpine and subalpine regions of the Tenmile Range, Summit
County, Colorado. Unpublished thesis, University of Colorado, Boulder. 133 pp.
Dale, E.E., and P.M. Kuroda. 1979. Vegetation map and natural areas survey. Pages 77-82 of unspecified report [incomplete citation]. Includes USDI National Park Service memo and tables.
Dalen, R.S., and W.R. Snyder. 1987. Economic and social aspects of pinyon-juniper treatment - then and now. Pages 343-350 in: R.L. Everett, editor. Proceedings -Pinyon-Juniper Conference, Reno, NV, 13-16 January 1986. USDA Forest Service. General Technical Report INT-215.
Daniels, F.P. 1911. The flora of Boulder, Colorado and vicinity. University of Missouri Studies, Science Series II(2):8-48.
Dastrup, B.C. 1963. Vegetational changes of the Uinta Basin since settlement. Unpublished thesis, Brigham Young University, Provo, UT. 118 pp.

Daubenmire, R. 1952. Forest vegetation of northern Idaho and adjacent Washington, and its bearing on concepts of vegetation classification. Ecological Monographs 22(4):301-330.

Daubenmire, R. 1975. Floristic plant geography of eastern Washington and northern Idaho. Journal of Biogeography 2:1-18.

Daubenmire, R. 1992. Palouse prairie. Pages 297-312 in: R.T. Coupland, editor. Natural grasslands introduction and Western Hemisphere. Ecosystems of the world, Volume 8A. Elsevier Publishing Company, Amsterdam.

Daubenmire, R.F. 1970. Steppe vegetation of Washington. Washington State University Agricultural Experiment Station Technical Bulletin No. 62. 131 pp.

Daubenmire, R.F., and J.B. Daubenmire. 1968. Forest vegetation of eastern Washington and northern Idaho. Washington State University Agricultural Experiment Station Technical Bulletin No. 60. 104 pp.

Day, T.A. 1985. Plant association and soil factors in primary succession on cinder cones in Idaho. Unpublished thesis, University of Idaho, Moscow. 62 pp.

Day, T.A., and R.G. Wright. 1985. The vegetation types of Craters of the Moon National Monument. Forestry, Wildlife, and Range Experiment Station Bulletin No. 38. University of Idaho, Moscow. 6 pp.

DeByle, N.V. 1985. Managing wildlife habitat with fire in the aspen ecosystem. Pages 73-82 in: Fire's effects on wildlife habitat-Symposium proceedings. USDA Forest Service General Technical Report INT-186. Intermountain Research Station, Ogden, UT.

DeByle, N.V. 1989. Aspen ecology and management in the western United States. Pages 11-20 in: USDA Forest Service General Technical Report.

DeByle, N.V., and R. P. Winokur, editors. 1985. Aspen: Ecology and management in the western United States. USDA Forest Service General Technical Report RM-119. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 283 pp.

DeLeuw, Cather & Company. 1977. Vegetation sampling (Glenwood Canyon). Unpublished report prepared by

DeLeuw, Cather & Company, Consulting Engineers and Planners, Chicago, Illinois for Colorado Division of Highways, Glenwood Springs, CO.

DeSelm, H.R. 1989. The barrens of Tennessee. Journal of the Tennessee Academy of Science 64:89-95.

DeVelice, R.L. 1983. Forest vegetation of northern New Mexico and southern Colorado. Unpublished dissertation, New Mexico State University, Las Cruces. 191 pp.

DeVelice, R.L. 1992. Classification of the plant communities of Beaverhead, Silver Bow, and Madison counties, Montana. Volume I (text). Prepared for the Montana Natural Heritage Program, Helena, MT. 35 pp.

DeVelice, R.L., G.J. Daumiller, P.S. Bourgeron, and J.O. Jarvie. 1992. Assessing the representativeness of nature preserves in the upper Blackfoot River area, Montana. The Northwest Environmental Journal 8(1):___.

DeVelice, R.L., J.A. Ludwig, W.H. Moir, and F. Ronco, Jr. 1986. A classification of forest habitat types of northern New Mexico and southern Colorado. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. General Technical Report RM-131. Fort Collins, CO. 59 pp.

DeVelice, R.L., J. Lichthardt, and P.S. Bourgeron. 1991. A preliminary classification of the plant communities of northeastern Montana. Prepared for the Montana Natural Heritage Program. Helena, MT. 144 pp.

DeVelice, R.L., S.V. Cooper, J.T. McGarvey, J. Lichthardt, and P.S. Bourgeron. 1995. Plant communities of northeastern Montana: A first approximation. Montana Natural Heritage Program, Helena, MT. 116 pp.

DeVelice, R.L., and J.A. Ludwig. 1983a. Climax forest series of northern New Mexico and southern Colorado. Pages 45-53 in: Proceedings of the Workshop on Southwestern Habitat Types, 6-8 April 1983, Albuquerque, NM. USDA Forest Service, Southwest Region, Albuquerque, NM.

DeVelice, R.L., and J.A. Ludwig. 1983b. Forest habitat types south of the Mogollon Rim, Arizona and New Mexico. Final Report, CA K-28-240. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 48 pp. plus appendices.

DeVelice, R.L., and P. Lesica. 1993. Plant community classification for vegetation on BLM lands, Pryor Mountains, Carbon County, Montana. Unpublished report by Montana Natural Heritage Program, Helena, MT. 78 pp.

Dealy, J.E. 1971. Habitat characteristics of the Silver Lake mule deer range. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station. Research Paper PNW-125. Portland, OR. 99 pp.

Dealy, J.E. 1975. Ecology of curl-leaf mahogany (*Cercocarpus ledifolius* Nutt.) in Oregon and adjacent areas. Unpublished dissertation, Oregon State University, Corvallis. 168 pp.

Dealy, J.E., D.A. Leckenby, and D.M. Concannon. 1981. Wildlife habitats in managed rangelands--the Great Basin of southeastern Oregon. Plant communities and their importance to wildlife. USDA Forest Service Pacific Northwest Region. General Technical Report PNW-120. 66 pp.

Del Moral, R., and J.N. Long. 1977. Classification of montane forest community types in the Cedar River drainage of western Washington, U.S.A. Canadian Journal of Forest Research 7(2):217-225.

Despain, D.G. 1973a. Vegetation of the Big Horn Mountains, Wyoming, in relation to substrate and climate. Ecological Monographs 43(3):329-354.

Dethier, M.N. 1990. A marine and estuarine habitat classification system for Washington State. Washington Natural Heritage Program, Department of Natural Resources, Olympia, WA. 56 pp.

Diamond, D.D. 1993. Classification of the plant communities of Texas (series level). Unpublished document. Texas Natural Heritage Program, Austin. 25 pp.

Dick-Peddie, W.A. 1986. Draft manuscript for book on vegetation of New Mexico to be published by University of New Mexico Press.

Dick-Peddie, W.A. 1993. New Mexico vegetation: Past, present, and future. University of New Mexico Press, Albuquerque. 244 pp.

Dick-Peddie, W.A., J.K. Meents, and R. Spellenberg. 1984. Vegetation resource analysis for the Velarde Community Ditch Project, Rio Arriba and Santa Fe counties, New Mexico. Unpublished final report prepared for the USDI Bureau of Reclamation, Southwestern Region, Amarillo, TX. 251 pp.

Dix, R.L., and F.E. Smeins. 1967. The prairies, meadows, and marsh vegetation of Nelson County, North Dakota. Canadian Journal of Botany 45:21-58.

Dixon, H. 1935. Ecological studies on the high plateaus of Utah. Botanical Gazette 97:272-320.

Dodd, J.D., and R.T. Coupland. 1966. Vegetation of saline areas in Saskatchewan. Ecology 47(6):958-968.

Doescher, P.S., R.F. Miller, S.R. Swanson, and A.H. Winward. 1986. Identification of the *Artemisia tridentata* ssp. *wyomingensis/Festuca idahoensis* habitat type in eastern Oregon. Northwest Science 60(1):55-60.

Donart, G.B., D.D. Sylvester, and W.C. Hickey. 1978b. Potential natural vegetation-New Mexico. New Mexico Interagency Range Commission Report 11.

Donart, G.B., D. Sylvester, and W. Hickey. 1978a. A vegetation classification system for New Mexico, USA. Pages 488-490 in: Rangeland Congress, Denver, CO, 14-18 August 1978. Society for Range Management, Denver.

Donnelly, P., D. Lindsey, E. Muldavin, Y. Chauvin, and A. Browder. 2006. Vegetation communities of Bosque del Apache National Wildlife Refuge. Prepared by U.S. Fish and Wildlife Service, National Wildlife Refuge Remote Sensing Lab, Albuquerque, NM, and Natural Heritage New Mexico, University of New Mexico, Albuquerque. Final report submitted to U.S. Fish and Wildlife Service, Southwest Region (R2), National Wildlife Refuge System (NWR), NWR Remote Sensing Lab, Division of Planning. 27 pp. [http://www.fws.gov/data/documents/BDA%20NVCS%20Veg%20Community%20Report%20Example.pdf]

Donovan, L.A., J.H. Richards, and M.W. Muller. 1996. Water relations and leaf chemistry of Chrysothamnus nauseosus ssp. consimilis (Asteraceae) and Sarcobatus vermiculatus (Chenopodiaceae). American Journal of Botany 83(12):1637-1646.

Dorn, R.D. 1969. Relations of moose, cattle and willows in southwestern Montana. Unpublished thesis, Montana State University, Bozeman. 79 pp.

Dorn, R.D. 1997. Rocky Mountain region willow identification field guide. Renewable Resources R2-RR-97-01. USDA Forest Service, Rocky Mountain Region, Denver, CO. 107 pp.

Douglas, G.W. 1971. An ecological survey of potential natural areas in the North Cascades National Park complex. Unpublished report prepared for Intercampus Education and Science Preserves Commission, State of Washington. 137 pp.

Drake, J., and D. Faber-Langendoen. 1997. An alliance level classification of the vegetation of the midwestern United States. Unpublished report. The Nature Conservancy, Midwest Conservation Science Department, Minneapolis, MN.

Driese, K.L., W.A. Reiners, E.H. Merrill, and K.G. Gerow. 1997. A digital land cover map of Wyoming, USA: A tool for vegetation analysis. Journal of Vegetation Science 8:133-146.

Driscoll, R.S., D.L. Merkel, D.L. Radloff, D.E. Snyder, and J.S. Hagihara. 1984. An ecological land classification framework for the United States. USDA Forest Service. Misc.Publication No. 1439. Washington, DC. 56 pp.

Durkin, P., M. Bradley, E. Muldavin, and P. Mehlhop. 1994b. A riparian/wetland vegetation community classification of New Mexico: Pecos River Basin. Unpublished report for New Mexico Environment Department Surface Water Quality Bureau.

Durkin, P., M. Bradley, E. Muldavin, and P. Mehlhop. 1995a. Riparian/wetland vegetation community classification of Rio Grande: A classification and site evaluation. Unpublished report for New Mexico Environment Department Surface Water Quality Bureau. New Mexico Natural Heritage Program, Albuquerque.

Dwyer, D.D., and R.D. Pieper. 1967. Fire effects on blue gramma-pinyon-juniper rangeland in New Mexico. Journal of Range Management 20:359-362.

Dyrness, C.T. 1960. Soil-vegetation relationships within the ponderosa pine type in the central Oregon pumice

region. Unpublished dissertation. Oregon State College, Corvallis.
Dyrness, C.T., J.F. Franklin, and W.H. Moir. 1974a. A preliminary classification of forest communities in the central portion of the western Cascades of Oregon. Coniferous Forest Biome Bulletin 4:1-123.
Earth Resource Technology. No date. Vanguard II Mine Application No. 334-T2, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.
Easterday, J.C., and M. S. Mamone. 1980. Vegetation of Warner Valley. Pages 3-66 in: C. Gilman, project director. Analysis of the aquatic habitats of Warner Valley with relation to land use patterns. Final report. National Science Foundation Grant SPI-78-03490. Department of Fisheries and Wildlife, Oregon State University, Corvallis. 175 pp.
Eddleman, L.E., and R. Jaindl. 1994. Great Basin National Park vegetation analysis. USDI National Park Service Technical Report NPS/PNROSU/NRTR-94/02. USDI National Park Service, PNW Region. 110 pp.
Eggler, W.A. 1941. Primary succession on volcanic deposits in southern ID. Ecological Monographs 11(3):278-298.
Ellis, S.L., T. Shoemaker, and R. Sanz. 1979. Inventories of plants, birds, mammals, reptiles, and amphibians of the Unaweep Canyon Springs, Mesa County, Colorado. Unpublished report prepared for Colorado Natural Areas Program, Department of Natural Resources, Denver.
Ellis, S., and P. Hackney. 1981. Vegetation baseline report: Clear Creek property. Unpublished report prepared for Chevron Shale Oil Co., Denver, CO, by Environmental Research and Technology Inc., Fort Collins, CO.
Empire Engineering and Land Surveying. 1986. Vegetation resources, Volume 2, Chapter 9, Sections 9.0-9.3, pages 9-1 through 9-19 and 9-38 through 9-41 in: Mining and Reclamation Plan for Black Jack Mine #1. Report for New Tech Mining Corporation. Utah Division of Oil, Gas, and Mining Act/019/004. Salt Lake City, UT.
Englund, S.R. 2004. Bromus tectorum impacts soil carbon storage in semiarid grasslands of Canyonlands National Park. M.S. thesis, University of Utah, Salt Lake City.
Erdman, J.A. 1962. Ecology of the pinyon-juniper woodland of Wetherill Mesa, Mesa Verde National Park, Colorado. Unpublished thesis, University of Colorado, Boulder. 109 pp.
Erdman, J.A. 1969. Pinyon-juniper succession after fires on residual soils of the Mesa Verde, Colorado. Unpublished dissertation, University of Colorado, Boulder. 81 pp.
Erdman, J.A. 1970. Pinyon-juniper succession after natural fires on residual soils of Mesa Verde, Colorado. Brigham Young University Science Bulletin, Biological Series 11(2):1-26.
Erdman, J.A., C.L. Douglas, and J.W. Marr. 1969. Wetherill Mesa Studies, environment of Mesa Verde, Colorado. USDI National Park Service. Archeological Research Series 7-B. Washington, DC. 72 pp.
Evans, M. 1991. Kentucky ecological communities. Draft report to Kentucky Nature Preserves Commission. 19 pp.
Evans, R. D., R. Rimer, L. Sperry, and J. Belnap. 2001. Exotic plant invasion alters nitrogen dynamics in an arid grassland. Ecological Applications 11(5):1301-1310.
Evans, S. 1989a. Riparian survey of Washington's Columbia Basin. Unpublished report prepared for The Nature Conservancy Washington Natural Heritage Program, Olympia, Washington.
Evans, S. 1989b. Provisional riparian and aquatic wetland plant communities on the Columbia Plateau. Unpublished report prepared under Contract No. C0089098, with Washington State Department of Ecology. 52 pp.
Evenden, A.G. 1990. Ecology and distribution of riparian vegetation in the Trout Creek Mountains of southeastern Oregon. Ph.D. dissertation, Oregon State University, Corvallis. 156 pp.
Evenden, Angela. Personal communication. Northern Colorado Plateau Network Vegetation Program Manager, Canyon Country Research Learning Center, Moab, UT.
Everett, R.L. 1987. Plant response to fire in the pinyon-juniper zone. Pages 152-157 in R. L. Everett, compiler. Proceedings pinyon-juniper conference: 1986 January 13-16, Reno, NV. USDA Forest Service, General Technical Report INT-215. Intermountain Research Station, Ogden, UT.
Everett, R.L., compiler. 1986. Proceedings pinyon-juniper conference: 1986 January 13-16, Reno, NV. USDA Forest Service, General Technical Report INT-215. Intermountain Research Station, Ogden, UT. 581 pp.
Eyre, F.H., editor. 1980. Forest cover types of the United States and Canada. Society of American Foresters, Washington, DC. 148 pp.
Fire Effects Information System. 1998. USDA Forest Service. URL http://www.fs.fed.us/database/feis/.
Fire Effects Information System. 2001. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2001, May). http://www.fs.fed.us/database/feis/. Accessed [07-20-01].
Faber-Langendoen, D., J. Drake, G. Jones, D. Lenz, P. Lesica, and S. Rolfsmeier. 1997. Rare plant communities of the northern Great Plains. Report to Nebraska National Forest, The Nature Conservancy. 155 pp.
Faber-Langendoen, D., and Midwest State Natural Heritage Program Ecologists. 1996. Terrestrial vegetation of the midwest United States. International classification of ecological communities: Terrestrial vegetation of the

United States. The Nature Conservancy, Arlington, VA.
Faber-Langendoen, D., editor. 2001. Plant communities of the Midwest: Classification in an ecological context. Association for Biodiversity Information, Arlington, VA. 61 pp. plus appendix (705 pp.).
Faden, A.O. 1977. Vegetation zonation of a Mohave Desert playa. Unpublished thesis, University of NV Las Vegas.
Fautin, R.W. 1946. Biotic communities of the northern desert shrub biome in western Utah. Ecological Monographs 16(4):251-310.
Fenemore, R.M., Jr. 1970. Plant succession in a receding lake bed in the western Great Basin. Unpublished thesis, University of Nevada, Reno.
Ferchau, H.A. 1973. Vegetation inventory analysis & impact study of the Parachute Creek area, Garfield County, Colorado. Part II, Volume 1, Chapter VI:1-77 in: Unpublished Colony Environmental Report for Colony Develop. Operation, Denver, prepared by Thorne Ecological Institute, Boulder.
Ferguson, Jim. 1997. Personal communication. Biologist, Bureau of Land Management, Montrose, CO.
Fike, J. 1999. Terrestrial and palustrine plant communities of Pennsylvania. Pennsylvania Natural Diversity Inventory. Pennsylvania Department of Conservation & Recreation. Bureau of Forestry. Harrisburg, PA. 86 pp.
Fischer, W.C., and A.F. Bradley. 1987. Fire ecology of western Montana forest habitat types. USDA Forest Service General Technical Report INT-223. Intermountain Research Station, Ogden, UT. 95 pp.
Fischer, W.C., and B.D. Clayton. 1983. Fire ecology of Montana forest habitat types east of the Continental Divide. USDA Forest Service, Intermountain Forest Range Experiment Station. General Technical Report INT-141. Ogden, UT. 83 pp.
Fisser, H.G. 1962. An ecological study of the *Artemisia tripartita* subsp. *rupicola* and related shrub communities in Wyoming. Unpublished dissertation, University of Wyoming, Laramie.
Fisser, H.G. 1964. Range survey in Wyoming's Big Horn Basin of Wyoming. Wyoming Agricultural Experiment Station Bulletin 424.
Fisser, H.G. 1970. Exclosure studies with transects of permanent plots, 1969 results. University of Wyoming Cooperative Research Report to the USDI Bureau of Land Management, sections I-IV. Wyoming Agricultural Experiment Station. Science Report 240. Laramie, WY. 128 pp.
Fisser, H.G., D.C. Trueblood, and C.H. Butterfield. 1980. Soil-vegetation relationships on rangeland exclosures in the Overland Planning Unit of south central Wyoming. University of Wyoming Scientific Report Number 1042. Wyoming Agricultural Experiment Station, Laramie.
Fisser, H.G., J.R. Wight, J.R. Flesland, and L.D. Robinson. 1965. *Halogeton* research, 1964 results. University of Wyoming Cooperative Research Report to the USDI Bureau of Land Management, Sections I-VI. Wyoming Agricultural Experiment Station. Mimeographed Circular pages 1-82. University of Wyoming, Laramie.
Fitzgerald, J.P. 1978. Vertebrate associations in plant communities along the South Platte River in northeastern Colorado. Pages 73-88 in: W.D. Graul and J. Bissell, editors. Lowland River and Stream Habitat in Colorado: A symposium, Greeley, Colorado, October 4-5, 1978. Colorado Chapter of the Wildlife Society and Colorado Audubon Council.
Fitzhugh, E.L., W.H. Moir, J.A. Ludwig, and F. Ronco, Jr. 1987. Forest habitat types in the Apache, Gila, and part of the Cibola national forests. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. General Technical Report RM-145. Fort Collins, CO. 116 pp.
Flowers, S. 1962. Vegetation of Morrow Point and Blue Mesa Reservoir basins of the upper Gunnison River, CO. Pp. 47-102 in: A.M. Woodbury, editor. Ecological studies of the flora and fauna of the Curecanti Reservoir Basins, western Colorado. University of Utah, Anthropological Papers No. 59 (Upper Colo. Series #8).
Floyd, M.L., D. D. Hanna, and G. Salamacha. 2001. Post-fire treatment of noxious weeds in Mesa Verde National Park, Colorado. Pages 147-157 in: C. Van Riper, III, et al., editors. Proceedings of the 5th Biennial Conference of Research on the Colorado Plateau, U.S. Geological Survey / FRESC Report Series USGSFRESC/COPL/2001/24.
Floyd, M.L., editor. 2003. Ancient piñon-juniper woodlands: A natural history of Mesa Verde country. University Press of Colorado, Boulder.
Fonda, R.W., and J.A. Bernardi. 1976. Vegetation of Sucia Island in Puget Sound, Washington. Bulletin of the Torrey Botanical Club 103(3):99-109.
Foti, T., M. Blaney, X. Li, and K.G. Smith. 1994. A classification system for the natural vegetation of Arkansas. Proceedings of the Arkansas Academy of Science 48:50-53.
Foti, T., compiler. 1994b. Natural vegetation classification system of Arkansas, draft five. Unpublished document. Arkansas Natural Heritage Commission, Little Rock. 8 pp.
Fowler, J.F. 1995. Biogeography of hanging gardens on the Colorado Plateau. Ph.D. dissertation, University of Wyoming, Laramie, WY. 209 pp plus abstract, appendices.

Francis, R.E. 1983. Sagebrush-steppe habitat types in northern Colorado: A first approximation. Pages 67-71 in: Proceedings of the Workshop on Southwestern habitat types. USDA Forest Service, Southwestern Region, Albuquerque, NM.

Francis, R.E. 1986. Phyto-edaphic communities of the Upper Rio Puerco Watershed, New Mexico. USDA Forest Service, RM Forest and Range Experiment Station. Research Paper RM-272. Fort Collins, CO. 73 pp.

Francis, R.E., and E.F. Aldon. 1983. Preliminary habitat types of a semiarid grassland. Pages 62-66 in: W.H. Moir and L. Hendzel, technical coordinators. Proceedings of the workshop on southwestern habitat types, 6-8 April 1983, Albuquerque, NM. USDA Forest Service, Southwestern Region, Albuquerque, NM.

Franklin, J.F., W.H. Moir, M.A. Hemstrom, S.E. Greene, and B.G. Smith. 1988. The forest communities of Mount Rainier National Park. USDI National Park Service. Scientific Monograph Series 19. Washington, DC. 194 pp.

Franklin, J.F., and C.T. Dyrness. 1969. Vegetation of Oregon and Washington. USDA Forest Service Research Paper PNW-80. Pacific Northwest Forest and Range Experiment Station, Portland, OR. 216 pp.

Franklin, J.F., and C.T. Dyrness. 1973. Natural vegetation of Oregon and Washington. USDA Forest Service, Pacific Northwest Forest & Range Experiment Station. Gen. Tech. Rep. PNW-8. Portland, OR. 417 pp.

Freeman, C.E., and W.A. Dick-Peddie. 1970. Woody riparian vegetation in the Black and Sacramento Mountain ranges, southern New Mexico. The Southwestern Naturalist 15(2):145-164.

Galatowitsch, S., and P.S. Bourgeron. 1985. Colorado plant association classification draft. Unpublished report prepared for The Nature Conservancy, Rocky Mountain Heritage Task Force, Lakewood, CO. 49 pp.

Ganskopp, D.C. 1979. Plant communities and habitat types of the Meadow Creek Experimental Watershed. Unpublished thesis, Oregon State University, Corvallis. 162 pp.

Ganskopp, D.C. 1986. Tolerances of sagebrush, rabbitbrush, and greasewood to elevated water tables. Journal of Range Management 39(4): 334-337.

Gates, D.H., L.A. Stoddart, and C. W. Cook. 1956. Soil as a factor influencing plant distribution on salt-deserts of Utah. Ecological Monographs 26(2):155-175.

Giese, T.G. 1975. The ecology of the Middle Blue River Valley, Summit County, Colorado, with an analysis of modifications due to powerline construction. Unpublished thesis, University of Colorado, Boulder. 109 pp.

Girard, M.M., H. Goetz, and A.J. Bjugstad. 1989. Native woodland habitat types of southwestern North Dakota. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Research Paper RM-281. Fort Collins, CO. 36 pp.

Girard, M., D.L. Wheeler, and S B. Mills. 1997. Classification of riparian communities on the Bighorn National Forest. R2-RR-97-02. USDA Forest Service, Rocky Mountain Region, Sheridan, WY. 308 pp.

Gleason, H.A., and A. Cronquist. 1991. Manual of vascular plants of northeastern United States and adjacent Canada. New York Botanical Garden, Bronx, NY. 910 pp.

Godfread, C. 1994. The vegetation of the Little Missouri Badlands of North Dakota. Pages 17-24 in: Proceedings of the Leafy Spurge Strategic Planning Workshop, March 29-30, Dickinson, ND.

Gom, L.A., and S.B. Rood. 1999. Patterns of clonal occurrence in a mature cottonwood grove along the Oldman River, Alberta. Canadian Journal of Botany 77:1095-1105.

Goodding, L.N. 1923. An interesting area of limber pine extending into southwestern Nebraska. Journal of Forestry 21:175-176. Goodrich, S., and E. Neese. 1986. Uinta Basin flora. Cooperative Project of Ashley National Forest and USDI Bureau of Land Management, Vernal District. USDA Forest Service, IM Region, Ogden, UT. 320 p.

Graham, E.H. 1937. Botanical studies in the Uinta Basin of Utah and Colorado. Annals of the Carnegie Museum 26:28-432.

Graybosch, R.A., and H. Buchanan. 1983. Vegetative types and endemic plants of the Bryce Canyon Breaks. Great Basin Naturalist 43:701-712.

Great Plains Flora Association. 1986. Flora of the Great Plains. University Press of Kansas, Lawrence. 1402 pp.

Green, R.N., and K. Klinka. 1994. A field guide to site interpretation for the Vancouver Forest Region. British Columbia Ministry of Forests. ISSN 0229-1622 Land Management Handbook 28. 285 pp.

Greenall, J.A. 1996. Manitoba's terrestrial plant communities. MS Report 96-02, Manitoba Conservation Data Centre, Winnipeg.

Greenwood, L.R., and J.D. Brotherson. 1978. Ecological relationships between pinyon-juniper and true mountain mahogany stands in the Uintah Basin, Utah. Journal of Range Management 31(3):164-167.

Griffiths, D. 1902. Forage conditions in the northern border of the Great Basin. USDA Bureau of Plant Industry Bulletin 15.

Groeneveld, D.P., and D.E. Crowley. 1988. Root system response to flooding in three desert shrub species.

Functional Ecology 2:491-497.
Gross, J.E. 1955. A vegetation survey of the Poudre bighorn sheep range. Unpublished paper prepared for Big Game Management, WM-190D, Colorado State University, Fort Collins. 65 pp.
Gross, K.L., and P.A. Werner. 1982. Colonizing abilities of "biennial" plant species in relation to ground cover: Implications for their distributions in a successional sere. Ecology 63(4):921-931.
Grossman, D.H., K. Lemon Goodin, and C.L. Reuss, editors. 1994. Rare plant communities of the conterminous United States: An initial survey. The Nature Conservancy. Arlington, VA. 620 pp.
Gruell, G.E., S. Bunting, and L. Neuenschwander. 1985. Influence of fire on curlleaf mountain-mahogany in the Intermountain West. Pages 58-72 in: J.E. Lotan and J.K. Brown, compilers. Fire's effects on wildlife habitat-symposium proceedings. USDA Forest Service Technical Report INT-186, Intermountain Forest and Range Experiment Station, Ogden, UT.
Hadley, R.F., and F.A. Branson. 1965. Surficial geology and microclimatic effects on vegetation, soils and geomorphology in the Denver, Colorado, area. Pages 56-63 in: Guidebook for 1-day field conferences-Boulder area, CO. 7th International Association for Quaternary Research Congress. Nebraska Academy of Science.
Hall, F.C. 1967. Vegetation-soil relations as a basis for resource management on the Ochoco National Forest of central Oregon. Unpublished dissertation, Oregon State University, Corvallis. 207 pp.
Hall, F. . 1973. Plant communities of the Blue Mountains in eastern Oregon and southeastern Washington. USDA Forest Service, Pacific Northwest Region. R6 Area Guide 3-1. 62 pp.
Hall, J.B., and P.L. Hansen. 1997. A preliminary riparian habitat type classification system for the Bureau of Land Management districts in southern and eastern Idaho. Riparian and Wetland Research Program, School of Forestry, University of Montana. Idaho Bureau of Land Management, Technical Bulletin No. 97-11. 381 pp.
Hamner, R.W. 1964. An ecological study of *Sarcobatus vermiculatus* communities of the Big Horn Basin, Wyoming. Unpublished thesis, University of Wyoming, Laramie.
Hanks, J.P., E.L. Fitzhugh, and S.R. Hanks. 1983. A habitat type classification system for ponderosa pine forests of northern Arizona. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. General Technical Report RM-97. Fort Collins, CO. 22 pp.
Hansen, M., J. Coles, K.A. Thomas, D. Cogan, M. Reid, J. Von Loh, and K. Schulz. 2004b. USGS-NPS Vegetation Mapping Program: Wupatki National Monument, Arizona, vegetation classification and distribution. U.S. Geological Survey Technical Report. Southwest Biological Science Center, Flagstaff, AZ.
Hansen, M., J. Coles, K.A. Thomas, D. Cogan, M. Reid, J. Von Loh, and K. Schulz. 2004c. USGS-NPS Vegetation Mapping Program: Sunset Crater National Monument, Arizona, vegetation classification and distribution. U.S. Geological Survey Technical Report. Southwest Biological Science Center, Flagstaff, AZ.
Hansen, P.L. 1985. An ecological study of the vegetation of the Grand River/Cedar River, Sioux, and Ashland districts of the Custer National Forest. Unpublished dissertation, South Dakota State University. 257 pp.
Hansen, P.L., G.R. Hoffman, and A.J. Bjugstad. 1984. The vegetation of Theodore Roosevelt National Park, North Dakota: A habitat type classification. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. General Technical Report RM-113. Fort Collins, CO. 35 pp.
Hansen, P.L., R.B. Hopkins, and G.R. Hoffman. 1980. An ecological study of Theodore Roosevelt National Park: Habitat types and their animal components. Department of Biology, University of S.Dakota, Vermillion. 182 p.
Hansen, P.L., R.D. Pfister, K. Boggs, B.J. Cook, J. Joy, and D.K. Hinckley. 1995. Classification and management of Montana's riparian and wetland sites. Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana, Miscellaneous Publication No. 54. 646 pp. + posters.
Hansen, P.L., S.W. Chadde, and R.D. Pfister. 1988b. Riparian dominance types of Montana. University of Montana Miscellaneous Publication 49. Montana Forest and Conservation Experiment Station, Missoula. 411 pp.
Hansen, P.L., and G.R. Hoffman. 1988. The vegetation of the Grand River/Cedar River, Sioux, and Ashland districts of the Custer National Forest: A habitat type classification. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. General Technical Report RM-157. Fort Collins, CO. 68 pp.
Hansen, P.L., and J.B. Hall. 2002. Classification and management of the USDI Bureau of Land Management's riparian and wetland sites in eastern and southern Idaho. Unpublished draft prepared for the Upper Snake River District, Bureau of Land Management, by Bitterroot Restoration, Inc., Corvallis, MT.
Hansen, P., K. Boggs, and R. Pfister. 1991. Classification and management of riparian and wetland sites in Montana. Unpublished draft version prepared for Montana Riparian Association, Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana, Missoula. 478 pp.
Hansen, P., R. Pfister, J. Joy, D. Svoboda, K. Boggs, L. Myers, S. Chadde, and J. Pierce. 1989. Classification and management of riparian sites in southwestern Montana. Unpublished draft prepared for the Montana Riparian

Association, School of Forestry, University of Montana, Missoula. 292 pp.
Hansen, P., S. Chadde, R. Pfister, J. Joy, D. Svoboda, J. Pierce, and L. Myers. 1988a. Riparian site types, habitat types, and community types of southwestern Montana. Draft Version 1. MT Riparian Association, Missoula.
Hanson, H.C. 1929. Range resources of the San Luis Valley. Pages 5-61 in: Range resources of the San Luis Valley. Bulletin 335. Colorado Experiment Station, Fort Collins, CO.
Hanson, H.C. 1957. The use of basic principles in the classification of range vegetation. Journal of Range Management 10:26-33.
Hanson, H.C., L.D. Love and M.S. Morris. 1931. Effects of different systems of grazing by cattle upon a western wheat grass type of range near Fort Collins, CO. CO Agricultural Experiment Station Bulletin 377. 82 pp.
Hanson, H.C., and E. Dahl. 1956. Some grassland communities in the mountain-front zone in northern Colorado. Vegetatio 7:249-270.
Hanson, H.C., and W.S. Ball. 1928. An application of Raunkiaer's law of frequency to grazing studies. Ecology 9:467-473.
Hanson, H. ., and W. Whitman. 1938. Characteristics of major grassland types in western North Dakota. Ecological Monographs 8:58-114.
Harmon, W.E. 1980. Survey of the flora and vegetation of the Bodo Wildlife Management Area. Unpublished report prepared for The Nature Conservancy, Denver, CO. On file at the CO Natural Areas Program, Denver. 40 pp.
Harper, K.T., and R.A. Jaynes. 1986. Some edaphic and compositional characteristics of Artemisia tridentata and associated plant communities in southeastern Utah. Pages 265-272 in: E.D. McArthur and B.L. Welch, compilers. Proceedings-Symposium on the Biology of *Artemisia* and *Chrysothamnus*, 9-13 July, Provo, UT. USDA Forest Service, General Technical Report INT-200. Intermountain Research Station, Ogden, UT.
Harrington, T.C., and F.W. Cobb, Jr., editors. 1988. Leptographium root diseases on conifers. The American Phytopathological Society Press, St. Paul, MN. 149 pp.
Harris, S.W. 1954. An ecological study of the waterfowl of the Potholes area, Grant County, Washington. American Midland Naturalist 52:403-432.
Harvey, S.J. 1980. The potential and current vegetation of the Sun River Game Range. Montana Department of Fish, Wildlife and Parks. Helena, MT. 85 pp.
Hauke, R.L. 1993. Equisetaceae Michaux ex DeCandolle: Horsetail Family. Pages 76-84 in: Flora of North America Editorial Committee, editors. Flora of North America, North of Mexico. Vol. 2. Oxford University Press, NY.
Heerwagen, A. 1956. Mixed prairie in New Mexico. Pages 284-300 in: J.E. Weaver and F.O. Albertson, editors. Grasslands of the Great Plains, their nature and use. Johnson Publishing Company, Lincoln, NE.
Hefley, H.M. 1937. Ecological studies on the Canadian River floodplain in Cleveland County, Oklahoma. Ecological Monographs 7:347-402.
Heidel, B. and C. Jean. 2002. Plant species of special concern and plant associations of Powder River County, Montana. Working draft. Unpublished report to the Bureau of Land Management, Montana Natural Heritage Program, Helena.
Heinze, D.H., R.E. Eckert, and P.T. Tueller. 1962. The vegetation and soils of the Steptoe Watershed. Unpublished report prepared for the USDI Bureau of Land Management. 40 pp.
Helm, D.J. 1981. Vegetation diversity indexes in several vegetation types of western Colorado. Unpublished dissertation, Colorado State University, Fort Collins. 113 pp.
Hemstrom, M.A., S.E. Logan, and W. Pavlat. 1987. Plant association and management guide, Willamette National Forest. USDA Forest Service Report R6-Ecol 257-B-86. Pacific Northwest Region, Portland, OR. 312 pp.
Henderson, J.A., D.A. Peter, R. Lesher, and D.C. Shaw. 1989. Forested plant associations of the Olympic National Forest. USDA Forest Service, Pacific Northwest Region. R6-ECOL-TP-001-88. Portland, OR. 502 pp.
Henderson, J.S., and M.L. McAllister. 1983. Downey Lake, an inventory of vegetation and wildlife. The Nature Conservancy, Portland, OR.
Hendrickson, D.A., and W.L. Minckley. 1984. Cienegas - Vanishing climax communities of the American Southwest. Desert Plants 6(3):131-175.
Henrickson, J. 1974. Saline habitats and halophytic vegetation of the Chihuahuan Desert region. Pages 249-272 in: R.H. Wauer and D.H. Riskind, editors. Transactions of the symposium on the biological resources of the Chihuahuan Desert region, United States and Mexico. USDI National Park Service. Transactions of Proceedings Series No. 3. Washington, DC.
Henry, R.J. 1981. Riparian vegetation of two mountain ranges in southwestern New Mexico. Unpublished thesis, New Mexico State University, Las Cruces.
Hermann, F.J. 1970. Manual of the Carices of the Rocky Mountains and Colorado Basin. Agriculture Handbook No.

374. USDA Forest Service, Washington, DC. 397 pp.
Hess, K. 1981. Phyto-edaphic study of habitat types of the Arapaho-Roosevelt National Forest, Colorado. Unpublished dissertation, Colorado State University, Fort Collins. 558 pp.
Hess, K., and C.H. Wasser. 1982. Grassland, shrubland, and forest habitat types of the White River-Arapaho National Forest. Unpublished final report 53-82 FT-1-19. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO. 335 pp.
Hess, K., and R.R. Alexander. 1986. Forest vegetation of the Arapaho and Roosevelt national forests in northcentral Colorado: A habitat type classification. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Research Paper RM-266. Fort Collins, CO. 48 pp.
Heusser, C.J. 1960. Late-Pleistocene environments of North Pacific North America. American Geographic Society Special Publication 35. American Geographical Society, New York. 308 pp.
Hickman, J.C. 1993. The Jepson Manual: Higher plants of California. University of California Press, Ltd., Berkeley, CA. 1400 pp.
Hironaka, M. 1978. Basic synecological relationships of the Columbia River sagebrush type. University of Idaho, Forest Wildlife and Range Experiment Station Contribution Number 124:27-31.
Hironaka, M., M.A. Fosberg, and A.H. Winward. 1983. Sagebrush-grass habitat types of southern Idaho. Forestry, Wildlife, and Range Experiment Station Bulletin No. 15, University of Idaho, Moscow. 44 pp.
Hirsch, K.J. 1985. Habitat type classification of grasslands and shrublands of southwestern North Dakota. Ph.D. thesis, North Dakota State University, Fargo.
Hitchcock, C.L., A. Cronquist, M. Ownbey, and J.W. Thompson. 1964. Vascular plants of the Pacific Northwest. Part 2: Salicaeae to Saxifragaceae. University of Washington Press, Seattle. 597 pp.
Hoagland, B. 2000. The vegetation of Oklahoma: A classification for landscape mapping and conservation planning. The Southwestern Naturalist 45(4):385-420.
Hoagland, B.W. 1997. Preliminary plant community classification for Oklahoma. Unpublished draft document, version 35629. University of Oklahoma, Oklahoma Natural Heritage Inventory, Norman. 47 pp.
Hoagland, B.W. 1998a. Classification of Oklahoma vegetation types. Working draft. University of Oklahoma, Oklahoma Natural Heritage Inventory, Norman. 43 pp.
Hoagland, B.W. 1998c. Oklahoma riparian vegetation. In: A. Fallon and M. Smolen, editors. Riparian area management handbook. Publication number E-952. Oklahoma Cooperative Extension Service, Oklahoma State University, Stillwater.
Hoffman, G.R., and R.R. Alexander. 1976. Forest vegetation of the Bighorn Mountains, Wyoming: A habitat type classification. USDA Forest Service Research Paper RM-170. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 38 pp.
Hoffman, G.R., and R.R. Alexander. 1980. Forest vegetation of the Routt National Forest in northwestern Colorado: A habitat type classification. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. General Technical Report RM-221. Fort Collins, CO. 41 pp.
Hoffman, G.R., and R.R. Alexander. 1983. Forest vegetation of the White River National Forest in western Colorado: A habitat type classification. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Research Paper RM-249. Fort Collins, CO. 36 pp.
Hoffman, G.R., and R.R. Alexander. 1987. Forest vegetation of the Black Hills National Forest of South Dakota and Wyoming: A habitat type classification. Research Paper RM-276. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 48 pp.
Holecheck, J.L., and T. Stephenson. 1983. Comparison of big sagebrush in northcentral New Mexico under moderately grazed and grazing excluded conditions. Journal of Range Management 36:455-456.
Holland, R.F. 1986b. Preliminary descriptions of the terrestrial natural communities of California. Unpublished report prepared for the California Department of Fish and Game, Nongame-Heritage Program and Natural Diversity Database, Sacramento. 156 pp.
Holm, T. 1927. The vegetation of the alpine region of the Rocky Mountains in Colorado. Pages 1-45 in: National Academy of Sciences 19. Third Memoir.
Holmstead, G. 2001. Vegetation of the Snake River corridor in Hells Canyon-Weiser, Idaho to the Salmon River. Technical Report Appendix E.3.3-1 prepared for FERC License No. 1971, Hells Canyon Complex by Idaho Power Company, Boise, ID. 49 pp. plus appendices.
Hopkins, W.E. 1979a. Plant associations of the Fremont National Forest. USDA Forest Service Technical Report R6ECOL-79-004. Pacific Northwest Region, Portland.
Hopkins, W.E. 1979b. Plant associations of South Chiloquin and Klamath Ranger Districts - Winema National

Forest. USDA Forest Service, Publication R6-ECOL-79-005, Pacific Northwest Region. 96 pp.
Horton, L.E. 1971. Vegetation and ecological relationships, west slope of the Teton study area, Targhee National Forest. USDA Forest Service, Intermountain Region. Unpublished mimeographed report. 50 pp. + appendices.
Hughes, H.G. 1977. Factors influencing vegetative and reproductive phenology of black sagebrush (*Artemisia nova* Nels.). Unpublished thesis, University of Wyoming, Laramie.
Hull, A.C., Jr., and M.K. Hull. 1974. Presettlement vegetation of Cache Valley, Utah and Idaho. Journal of Range Management 27(1):27-29.
Hyde, R.M. 1964. Vegetation in Sunlight Basin, Park County, Wyoming. Unpublished dissertation, University of Wyoming, Laramie.
Hyder, D.N., R.E. Bement, E.E. Remmenga, and C. Terwilliger, Jr. 1966. Vegetation-soils and vegetation-grazing relations from frequency data. Journal of Range Management 19:11-17.
Idaho Conservation Data Center. 2002. Unpublished riparian and wetland association occurrence and plot data on file at the Idaho Conservation Data Center, Idaho Department of Fish and Game, Boise, ID.
Idaho Conservation Data Center. 2005. Wetland and riparian plant associations in Idaho. Idaho Conservation Data Center, Idaho Department of Fish and Game, Boise. [http://fishandgame.idaho.gov/tech/CDC/ecology/wetland_riparian_assoc.cfm] (accessed 14 June 2005).
Ibrahim, K.M. , N.E. West, and D.L. Goodwin. 1972. Phytosociological characteristics of perennial *Atriplex*-dominated vegetation of southeastern Utah. Vegetatio 24:13-22.
Isaacson, H.E. 1967. Ecological provinces within the pinyon-juniper type of the Great Basin and Colorado Plateau. Unpublished thesis, Utah State University, Logan. 44 pp.
Jackson, J.R. 1972. Vegetation of the flood plain of the South Platte River in the proposed Narrows Reservoir site. Unpublished thesis, University of Northern Colorado, Greeley. 83 pp.
Jackson, J.R., and I.E. Lindauer. 1978. Vegetation of the flood plain of the south Platte River in the proposed Narrows Reservoir site. Transactions of the Mississippi Academy of Science 12:37-46.
Jameson, D.A. 1962. Effects of burning on a galleta-black grama range invaded by juniper. Ecology 43:760-763.
Jameson, D.A., J.A. Williams, and E.W. Wilton. 1962. Vegetation and soils of Fishtail Mesa, AZ. Ecology 43:403-410.
Jameson, D.A., and E.H. Reid. 1965. The pinyon-juniper type of AZ. Journal of Range Management 18:152-154.
Jankovsky-Jones, M., C.J. Murphy, and C.L. Coulter. 2001. Riparian and wetland plant associations of southwestern Idaho in the Lower Snake River District, Bureau of Land Management. Idaho Conservation Data Center, Idaho Department of Fish and Game, Boise.
Jankovsky-Jones, M., S.K. Rust, and R.K. Moseley. 1999. Riparian reference areas in Idaho: A catalog of plant associations and conservation sites. USDA Forest Service, Rocky Mountain Research Station. General Technical Report RMRS-GTR-20. Ogden, UT. 141 pp.
Jefferson, C.A. 1975. Plant communities and succession in Oregon coastal salt marshes. Ph.D. dissertation, Oregon State University, Corvallis. 192 pp.
Jennings, R.H. 1978. Vegetation. Pages 1-103 in: H.A. Ferchau, editor. Buttes Gas and Oil Iron Hill-Powderhorn Environmental Study 1977, Volume II, Chapter 8. Western State College, Gunnison, CO.
Jennings, R.H. 1979. Vegetation of the Iron Hill complex, Powderhorn, Colorado: An environmental baseline inventory and analysis. Unpublished thesis. Western State College, Gunnison, CO. 211 pp.
Jensen, M.E., L.S. Peck, and M.V. Wilson. 1988a. A sagebrush community type classification for mountainous northeastern Nevada rangelands. Great Basin Naturalist 48(4):422-433.
Jensen, M.E., L.S. Peck, and M.V. Wilson. 1988b. Vegetation characteristics of mountainous northeastern Nevada sagebrush community types. The Great Basin Naturalist 48(4):403-421.
Jensen, M., F. Heisner, J. DiBenedetto, L. Wessman, and G. Phillips. 1992. Ecological sites and habitat types of the Little Missouri National Grassland and western North Dakota (Draft II). Custer National Forest, Billings, MT, and Northern Region, USDA Forest Service. Missoula, MT.
Johannessen, C.L., W.A. Davenport, A. Millet, and S. McWilliams. 1971. The vegetation of the Willamette Valley. Annals of the Association of American Geographers 61:286-302.
Johnsen, T.N., Jr. 1962. One-seed juniper invasion of northern AZ grasslands. Ecological Monographs 32:187-207.
Johnson, C.G., Jr. 1985a. Plant associations of Hells Canyon National Recreation Area. USDA Forest Service Pacific Northwest Region.
Johnson, C.G., Jr., and S.A. Simon. 1987. Plant associations of the Wallowa-Snake Province Wallowa-Whitman National Forest. USDA Forest Service, Pacific Northwest Region, Wallowa-Whitman National Forest. Technical Paper R6-ECOL-TP-255A-86. 399 pp. plus appendices.
Johnson, C.G., and R.R. Clausnitzer. 1992. Plant associations of the Blue and Ochoco Mountains. USDA Forest

Service, Pacific Northwest Region, Wallowa-Whitman National Forest R6-ERW-TP-036-92. 163 pp. plus appendices.
Johnson, C.G., and S.A. Simon. 1985. Plant associations of the Wallowa Valley Ranger District, Part II: Steppe. USDA Forest Service, Pacific Northwest Region, Wallowa-Whitman National Forest. 258 pp.
Johnson, J.L., and R.D. Pfister. 1982. A survey of potential ecological natural landmarks of the middle Rocky Mountains. USDA Forest Service Intermountain Forest and Range Experiment Station, Ogden, UT. Unpublished report prepared for USDI National Park Service. 197 pp.
Johnson, J.R., and G.F. Payne. 1968. Sagebrush reinvasion as affected by some environmental influences. Journal of Range Management 21:209-213.
Johnson, R.E. 1950. An ecological analysis of a mountain mahogany community. Unpublished thesis, University of Wyoming, Laramie.
Johnson, S. R., and A. K. Knapp. 1995. The influence of fire on *Spartina pectinata* wetland communities in a northeastern Kansas tallgrass prairie. Canadian Journal of Botany 73:84-90.
Johnson, W.C., R.L. Burgess, and W.R. Keammerer. 1976. Forest overstory vegetation and environment on the Missouri River floodplain in North Dakota. Ecological Monographs 46:59-84.
Johnson, W.M. 1945. Natural revegetation of abandoned crop land in the ponderosa pine zone of the Pike's Peak region in Colorado. Ecology 26:363-374.
Johnson, W.M. 1953. Effect of grazing intensity upon vegetation and cattle gains on ponderosa pine-bunchgrass ranges of the Front Range of Colorado. USDA Circular Number 929. 36 pp.
Johnson, W.M. 1956a. The effect of grazing intensity on plant composition, vigor, and growth of pine-bunchgrass ranges in central Colorado. Ecology 37:790-798.
Johnson, W.M., and C.H. Niederhof. 1941. Some relationships of plant cover to run-off, erosion, and infiltration on granitic soils. Journal of Forestry. 39:854-858.
Johnson, W.M., and E.H. Reid. 1958. Herbage utilization on pine-bunchgrass ranges of Colorado. Journal of Forestry 56:647-651.
Johnson, W.M., and E.H. Reid. 1964. Range condition classification of bunchgrass range at the Manitou Experimental Forest in Colorado. Journal of Range Management 17:137-141.
Johnston, B.C. 1984. Plant associations of Region Two. Edition 3.5. USDA Forest Service, Rocky Mountain Region. Lakewood, CO.
Johnston, B.C. 1987. Plant associations of Region Two: Potential plant communities of Wyoming, South Dakota, Nebraska, Colorado, and Kansas. R2-ECOL-87-2. USDA Forest Service, RM Region. Lakewood, CO. 429 pp.
Johnston, B.C. 2001. Ecological types of the Upper Gunnison Basin. USDA Forest Service. Technical Report R2-RR2001-01. Rocky Mountain Region. Denver, CO.
Johnston, B.C., L. Huckaby, T.J. Hughes, and J. Pecor. 2001. Ecological types of the Upper Gunnison Basin: Vegetation-soil-landform-geology-climate-water land classes for natural resource management. Technical Report R2-RR-2001-01. USDA Forest Service, Rocky Mountain Region, Lakewood, CO. 858 pp.
Johnston, B.C., and L. Hendzel. 1985. Examples of aspen treatment, succession and management in western Colorado. USDA Forest Service, Range Wildlife Fisheries and Ecology. Denver, CO. 164 pp.
Johnston, B.C., and L. Huckaby. 2001. Ecological types of the Upper Gunnison Basin. Technical Report R2-RR-2001-01. USDA Forest Service, Rocky Mountain Region, Denver, CO.
Jones, G. 1992b. Wyoming plant community classification (Draft). Wyoming Natural Diversity Database, Laramie, WY. 183 pp.
Jones, G.P. 1989b. Survey of plant species and communities of interest in the Beaver Rim Area of Critical Environmental Concern. Report submitted to the Bureau of Land Management, Rawlins District Office, under Work Effort No. WY030-09-4352-06-2512. Wyoming Natural Diversity Database, Laramie, WY.
Jones, G.P., and G.M. Walford. 1995. Major riparian vegetation types of eastern Wyoming. Submitted to Wyoming Department of Environmental Quality, Water Quality Division. Wyoming Natural Diversity Database, Laramie, WY. 245 pp.
Jones, G.P., and W. Fertig. 1996. Plant associations and plant species of special concern in the Jack Morrow Hills ecosystem. Unpublished report prepared for the Bureau of Land Management, Rock Springs District by the Wyoming Natural Diversity Database. 2 volumes.
Jones, G., and S. Ogle. 2000. Characterization abstracts for vegetation types on the Bighorn, Medicine Bow, and Shoshone national forests. Prepared for USDA Forest Service, Region 2 by the Wyoming Natural Diversity Database, University of Wyoming.
Jones, George P. Personal communication. Ecologist, Wyoming Natural Diversity Database, Laramie, WY.

Jorgensen, H.E. 1979. Vegetation of the Yellow Water Triangle, Montana. Montana Department of Fish and Game, in cooperation with the Bureau of Land Management. Helena, MT. 57 pp.

Kagan, J. 1997. Draft of Oregon and Washington vegetation report. Oregon Natural Heritage Program, Portland.

Kagan S. 1987c. Draft species management guide for *Astragalus robbinsii* var. *alpiniformis*. Challenge grant funding with USDA Forest Service. Oregon Natural Heritage Data Base, The Nature Conservancy, Portland.

Kagan, J.S., J.A. Christy, M.P. Murray, and J.A. Titus. 2000. Classification of native vegetation of Oregon. Oregon Natural Heritage Program, Portland. 63 pp.

Kagan, J.S., J.A. Christy, M.P. Murray, and J.A. Titus. 2004. Classification of native vegetation of Oregon. January 2004. Oregon Natural Heritage Information Center, Portland. 52 pp.

Kahler, L.J. 1973. Correlation of slope exposure with differences in the composition of the vegetation community at 7000 feet in Clear Creek Canyon west of Golden, Colorado. Unpublished thesis, University of Colorado, Boulder. 105 pp.

Karl, M.G., R.K. Heitschmidt, and M.R. Haferkamp. 1999. Vegetation biomass dynamics and patterns of sexual reproduction in a northern mixed-grass prairie. The American Midland Naturalist 141:227-237.

Kartesz, J.T. 1994a. A synonymized checklist of the vascular flora of the United States, Canada, and Greenland. Second edition. Volume 1--Checklist. Timber Press, Portland, OR. 622 pp.

Kartesz, J.T. 1999. A synonymized checklist and atlas with biological attributes for the vascular flora of the United States, Canada, and Greenland. First edition. In: J.T. Kartesz and C.A. Meacham. Synthesis of the North American Flora, Version 1.0. North Carolina Botanical Garden, Chapel Hill, NC.

Keammerer, W.R. 1974a. Vegetation of the Grand Valley area. Pages 73-117 in: Ecological inventory of the Grand Valley area. Report prepared for the Colony Development Operation, Atlantic Richfield Co., Denver, CO.

Keammerer, W.R. 1974b. Vegetation of Parachute Creek Valley. Pages 4-91 in: Environmental inventory and impact analysis of a proposed utilities corridor in Parachute Creek Valley, Co. Unpublished report prepared for Colony Development Operation, Denver, Colo.

Keammerer, W.R. 1977. Final report: Vegetation baseline studies, oil shale tract C-b. Unpublished report. Stoecker-Keammerer and Associates, Ecological Consultants, Boulder, CO. 183 pp.

Keammerer, W.R. 1987. Bentonite regional vegetation study. Prepared for Crook County Bentonite Producers and Wyoming Department of Environmental Quality, Land Quality Division, by Stoeker-Keammerer and Associates, Boulder, CO.

Keammerer, W.R., and R.E. Stoecker. 1975. Vegetation and wildlife studies along proposed corridors for oil shale tract C-b. Unpublished report prepared for Shell Oil Co., Denver, by Stoecker-Keammerer and Associates, Boulder, CO. 86 pp.

Keammerer, W.R., and R.E. Stoecker. 1980. Vegetation and wildlife studies for the Mount Emmons project. Unpublished report prepared for AMAX Environmental Services, Inc., by Stoecker-Keammerer and Associates, Ecological Consultants, Boulder, CO. 3 volumes.

Keammerer, W.R., and S.J. Peterson. 1981. Vegetation studies on the Naval Oil Shale Reserve. Unpublished report prepared for TRW Energy Systems Group, McLean, Virginia, by Stoecker-Keammerer and Associates, Ecological Consultants, Boulder, CO. 77 pp.

Kearney, T.H., and R.H. Peebles, and collaborators. 1969. Arizona Flora. University of California, Berkeley, CA. 1085 pp.

Keeler-Wolf, T., and M. Vaghti. 2000. Vegetation mapping of Suisun Marsh, Solano County, California. A report to the California Department of Water Resources. Available from Wildlife and Habitat Data Analysis Branch, Department of Fish and Game Sacramento, CA.

Keeler-Wolf. T., and X. Thomas. 2000. Draft descriptions of vegetation alliances for the Mojave Ecosystem Mapping project. California Natural Diversity Database. California Department of Fish and Game.

Keim, F.D., A.L. Frolik, and G.W. Beadle. 1932. Studies of prairie hay in north central Nebraska. Research Bulletin 60. University of Nebraska Agricultural Experiment Station. Lincoln. 54 pp.

Kennedy, K.L. 1983a. A habitat-type classification for the pinyon-juniper woodlands of the Lincoln National Forest. Unpublished thesis, New Mexico State University, Las Cruces. 87 pp.

Kettler, S., and A. McMullen. 1996. Routt National Forest riparian vegetation classification. Report prepared for Routt National Forest by the Colorado Natural Heritage Program, Colorado State University, Fort Collins.

Kierstead, J., and T. Pogson. 1976. A summer flora of the Alvord Basin. Appendix 1. Pages 1-1 to 1-54 in: K. Roberts, editor. A preliminary ecological survey of the Alvord Basin. Final Technical Report. NSF-SOS (76-08175). Eastern Oregon State College. 15 pp. plus 6 appendices.

Kittel, G.M. 1994. Montane vegetation in relation to elevation and geomorphology along the Cache la Poudre River,

Colorado. Unpublished thesis, University of Wyoming, Laramie.
Kittel, G.M., and N.D. Lederer. 1993. A preliminary classification of the riparian vegetation of the Yampa and San Miguel/Dolores river basins. Unpublished report prepared for Colorado Department of Health and the Environmental Protection Agency by The Nature Conservancy, Colorado Field Office, Boulder.
Kittel, G., E. Van Wie, M. Damm, R. Rondeau, S. Kettler, A. McMullen, and J. Sanderson. 1999b. A classification of riparian and wetland plant associations of Colorado: A user's guide to the classification project. Colorado Natural Heritage Program, Colorado State University, Fort Collins CO. 70 pp. plus appendices.
Kittel, G., E. Van Wie, M. Damm, R. Rondeau, S. Kettler, and J. Sanderson. 1999a. A classification of the riparian plant associations of the Rio Grande and Closed Basin watersheds, Colorado. Unpublished report prepared by the Colorado Natural Heritage Program, Colorado State University, Fort Collins.
Kittel, G., E. Van Wie, and M. Damm. 1997a. A classification of the riparian vegetation of the South Platte Basin (and part of Republican River Basin), Colorado. Submitted to Colorado Department of Natural Resources and the Environmental Protection Agency, Region VIII. Prepared by Colorado Natural Heritage Program, Colorado State University, Fort Collins.
Kittel, G., R. Rondeau, N. Lederer, and D. Randolph. 1994. A classification of the riparian vegetation of the White and Colorado River basins, Colorado. Final report submitted to Colorado Department of Natural Resources and the Environmental Protection Agency. Colorado Natural Heritage Program, Boulder. 166 pp.
Kittel, G., R. Rondeau, and A. McMullen. 1996. A classification of the riparian vegetation of the Lower South Platte and parts of the Upper Arkansas River basins, Colorado. Submitted to Colorado Department of Natural Resources and the Environmental Protection Agency, Region VIII. Prepared by Colorado Natural Heritage Program, Fort Collins. 243 pp.
Kittel, G., R. Rondeau, and S. Kettler. 1995. A classification of the riparian vegetation of the Gunnison River Basin, Colorado. Submitted to Colorado Department of Natural Resources and the Environmental Protection Agency. Prepared by Colorado Natural Heritage Program, Fort Collins. 114 pp.
Klein, A., J. Crawford, J. Evens, D. Hickson, and T. Keeler-Wolf. 2007. Vegetation alliances and associations of the northern Sierra Nevada foothills, California. A report to Habitat Conservation Division, California Department of Fish and Game, California Native Plant Society, Sacramento.
Kleiner, E.F. 1968. Comparative study of grasslands of Canyonlands National Park. Unpublished dissertation, University of Utah, Salt Lake City. 58 pp.
Kleiner, E.F. 1983. Successional trends in an ungrazed, arid grassland over a decade. Journal of Range Management 36(1):114-118.
Kleiner, E.F., and K.T. Harper. 1972. Environment and community organization in grasslands of Canyonlands National Park. Ecology 53(2):299-309.
Kleiner, E.F., and K.T. Harper. 1977. Occurrence of four major perennial grasses in relation to edaphic factors in a pristine community. Journal of Range Management 30(4):286-289.
Kline, R.P. 1973. Establishment report for West Fork Mink Creek Research Natural Area within Caribou National Forest, Bannock County, Idaho. Unpublished report. 7 pp. plus maps.
Klipple, G.E., and D.F. Costello. 1960. Vegetation and cattle responses to different intensities of grazing on short-grass ranges of the central Great Plains. USDA Forest Service Technical Bulletin 1216. 82 pp.
Knight, D.H. 1994. Mountains and plains: Ecology of Wyoming landscapes. Yale University Press, New Haven, MA. 338 pp.
Knight, D.H., G.P. Jones, Y. Akashi, and R.W. Myers. 1987. Vegetation ecology in the Bighorn Canyon National Recreation Area. Unpublished report prepared for the USDI National Park Service and University of Wyoming-National Park Service Research.
Knight, D.H., R.J. Hill, and A.T. Harrison. 1976. Potential natural landmarks in the Wyoming Basin, terrestrial and aquatic ecosystems. Unpublished report prepared for the USDI National Park Service. Contract 9900X20047.
Knopf, F.L. 1985. Significance of riparian vegetation to breeding birds along an altitudinal cline. Pages 105-111 in: R.R. Johnson, et al., editors. Riparian ecosystems and their management. USDA Forest Service General Technical Report RM-120.
Komarkova, V. 1986. Habitat types on selected parts of the Gunnison and Uncompahgre national forests. Unpublished final report prepared for USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO. 270 pp. plus appendices.
Komarkova, V.K., R.R. Alexander, and B.C. Johnston. 1988b. Forest vegetation of the Gunnison and parts of the Uncompahgre national forests: A preliminary habitat type classification. USDA Forest Service. Research Paper RM-163. 65 pp.

Komarkova, V., A. Peters, G. Kamani, W. Jones, V. Howard, H. Gordon, and K. Southwick. 1988a. Natural recovery of plant communities on disturbance plots and history of land use in the Niwot Ridge/Green Lakes Valley, Front Range, Colorado. University of Colorado Longterm Ecological Research Working Paper 88/1. Boulder, CO. 46 pp.

Koniak, S. 1985. Succession in pinyon-juniper woodlands following wildfire in the Great Basin. Great Basin Naturalist 45:556-566.

Kooiman, M., and Y.B. Linhart. 1986. Structure and change in herbaceous communities of four ecosystems in the Front Range Colorado, USA. Arctic and Alpine Research 18(1):97-110.

Kovalchik, B.L. 1987. Riparian zone associations - Deschutes, Ochoco, Fremont, and Winema national forests. USDA Forest Service Technical Paper 279-87. Pacific Northwest Region, Portland, OR. 171 pp.

Kovalchik, B.L. 1993. Riparian plant associations on the national forests of eastern Washington - Draft version 1. USDA Forest Service, Colville National Forest, Colville, WA. 203 pp.

Kovalchik, B.L. 2001. Classification and management of aquatic, riparian and wetland sites on the national forests of eastern Washington. Part 1: The series descriptions. 429 pp. plus appendix. [http://www.reo.gov/col/wetland_classification/wetland_classification.pdf]

Krajina, V.J. 1969. Ecology of western North America. Volume II. Illustrated, University of British Columbia, Department of Botany.

Kuchler, A.W. 1964. Potential natural vegetation of the conterminous United States. American Geographic Society Special Publication 36. New York, NY. 116 pp.

Kuchler, A.W. 1974. A new vegetation map of Kansas. Ecology 55:586-604 (with map supplement).

Kudray, G., P. Hendricks, E. Crowe, and S. Cooper. 2004. Riparian forests of the Wild and Scenic Missouri River: Ecology and management. Report to the Lewistown Field Office, Bureau of Land Management. Montana Natural Heritage Program, Helena, MT. 29 pp. plus appendices.

Kunze, L.M. 1994. Preliminary classification of native, low elevation, freshwater wetland vegetation in western Washington. Washington State Department of Natural Resources, Natural Heritage Program. 120 pp.

Kurzius, M. 1981. Vegetation and flora of the Grapevine Mountains, Death Valley National Monument, California – Nevada. Unpublished thesis, University of Nevada, Las Vegas.

Ladyman, J.A.R., and E. Muldavin. 1996. Terrestrial cryptograms of Pinyon-Juniper woodlands in the Southwestern United States: A review. USDA Forest Service General Technical Report RM-GTR-280. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 33 pp.

Langenheim, J.H. 1962. Vegetation and environmental patterns in the Crested Butte area, Gunnison County, Colorado. Ecological Monographs 32:249-285.

Lanner, R.M., and S.B. Vander Wall. 1980. Dispersal of limber pine seed by Clark's nutcracker. Journal of Forestry 78(10):637-639.

Larson, G.E. 1993. Aquatic and wetland vascular plants of the northern Great Plains. USDA Forest Service General Technical Report RM-238. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 681 pp.

Larson, L.L. 1974. Discriminant and hierarchical analyses in vegetation classification. Unpublished thesis, Colorado State University, Fort Collins. 103 pp.

Larson, M., and W.H. Moir. 1986. Forest and woodland habitat types (plant associations) of southern New Mexico and central Arizona (north of the Mogollon Rim). USDA Forest Service, Southwestern Region, Albuquerque, NM. 76 pp.

Larson, M., and W.H. Moir. 1987. Forest and woodland habitat types of northern New Mexico and northern Arizona. Edition 2. USDA Forest Service, Southwestern Region, Albuquerque, NM.

Laurenzi, A.W., R.D. Ohmart, and N.C. Hink. 1983. Classification of mixed broadleaf riparian forests in Tonto National Forest. Pages 72-81 in: Proceedings of the workshop on Southwestern habitat types. USDA Forest Service, Southwestern Region.

Lauver, C.L., K. Kindscher, D. Faber-Langendoen, and R. Schneider. 1999. A classification of the natural vegetation of Kansas. The Southwestern Naturalist 44:421-443.

Leary, K.D., and P.M. Peterson. 1984. Soil analyses in relation to vegetation in the Cottonwood Mountains, Death Valley National Monument. University of Nevada Cooperative National Park Resources Studies Unit Report 036/01, Las Vegas.

Lee, L.C., and C.J. Jonkel. 1980. The vegetation structure and ecology of grizzly bear habitat in the Pine and Antelope Butte Wetlands, Montana. Unpublished Border Grizzly Project Special Report 36. University of Montana, Missoula. 63 pp.

Lesica, P. 1989. The vegetation and flora of glaciated prairie potholes of the Blackfeet Indian Reservation, Montana.

Final report to The Nature Conservancy, Montana Field Office, Helena, MT. 26 pp.
Lesica, P., and R.L. DeVelice. 1992. Plant communities of the Pryor Mountains. Preliminary report prepared by the Montana Natural Heritage Program, Helena, MT.
Leucite Hills Mine Application. No date. No. 520-T2, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.
Lewis, M.E. 1971. Flora and major plant communities of the Ruby-East Humboldt Mountains with special emphasis on Lamoille Canyon. Unpublished report compiled for USDA Forest Service, Region IV, Ogden, UT. 62 pp.
Lewis, M.E. 1975a. Plant communities of the Jarbidge Mountain Complex, Humboldt National Forest. Unpublished report compiled for USDA Forest Service, Region IV, Ogden, UT. 22 pp.
Lillybridge, T.R., B.L. Kovalchik, C.K. Williams, and B.G. Smith. 1995. Field guide for forested plant associations of the Wenatchee National Forest. USDA Forest Service General Technical Report PNW-GTR-359, Pacific Northwest Research Station, Portland. Portland, OR. 335 pp.
Lindauer, I.E. 1970. The vegetation of the flood plain of the Arkansas River in southeastern Colorado. Unpublished dissertation, Colorado State University, Fort Collins. 92 pp.
Lindauer, I.E. 1978. A comparison of the vegetative communities of the South Platte and Arkansas River drainages in eastern Colorado. Pages 56-72 in: W.D. Graul and S.J. Bissel, editors. Lowland River and Stream Habitat in Colorado: A Symposium, 4-5 October 1978. Colorado Chapter of Wildlife Society and Audubon Council.
Lindauer, I.E. 1983. A comparison of the plant communities of the South Platte and Arkansas River drainages in eastern Colorado. Southwestern Naturalist 28:249-259.
Lindauer, I.E., J.P. Fitzgerald, and L.L. Lindauer. 1973. Ecological analyses of flood plain communities, Narrows Reservoir Site, Colorado. Unpublished report to U.S. Bureau of Reclamation, Denver, CO, by the University of Northern Colorado, Department of Biology, Greeley. 108 pp.
Lindauer, I.E., and J.P. Fitzgerald. 1974. Ecological survey and analysis of terrestrial communities at the Weld County (Hardin) proposed reservoir site. Unpublished report to U.S. Bureau of Reclamation, Denver, CO, by University of Northern Colorado, Greeley. 45 pp.
Lindauer, I.E., and R.T. Ward. 1968. A survey of the woody phreatophytes in the lower Arkansas River Valley of Colorado Unpublished report to U.S. Bureau of Reclamation, Denver, CO, by the Department of Botany, Colorado State University, Fort Collins. 46 pp.
Lindauer, I.E., and S.J. Christy. 1972. An analysis of the woody vegetation on the South Platte River floodplain in northeastern Colorado. Unpublished report to the U.S. Bureau of Reclamation, Denver, CO, by the University of Northern Colorado, Biology Department, Greeley.
Lindsey, A.A. 1951. Vegetation and habitats in a southwestern volcanic area. Ecological Monographs 21(3):227-253.
Little, E.L. 1987. Pinyon trees (*Pinus edulis*) remeasured after 47 years. Pages 65-68 in: Proceedings - pinyon-juniper conference. USDA Forest Service General Technical Report INT-215. Intermountain Research Station, Ogden, UT.
Little, E.L., Jr. 1996. Forest trees of Oklahoma: How to know them. Oklahoma Forestry Services, State Department of Agriculture. Publication No. 1, Revised Edition No. 14. Oklahoma City. 205 pp.
Livingston, R. B. 1949. An ecological study of the Black Forest, Colorado. Ecological Monographs 19:123-144.
Loope, L.L. 1969. Subalpine and alpine vegetation of northeastern Nevada. Unpublished thesis, Duke University, Durham, NC.
Lucky McMine Application. No date. Nos. 356C and 356C-A2, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.
Lundberg, C.E. 1977. The local composition and distribution of vegetation in the soda ash producing area of Sweetwater County, Wyoming. Unpublished thesis, University of Wyoming, Laramie.
Lusby, G.C., G.T. Turner, J.R. Thompson, and V.H. Reid. 1963. Hydrologic and biotic characteristics of grazed and ungrazed watersheds of the Badger Wash Basin in western Colorado, 1953-1958. U.S. Geological Survey Water-Supply Paper 1532-B.
Luti, R. 1953. Ecological features of the vegetation of a ridge in the montane forest of Boulder County, Colorado. Unpublished thesis, University of Colorado, Boulder. 100 pp.
Lynn, R., M. Larson, D. Hoeft, L. Todd, T. Raetz, L. Fager, and G. Barranco. No date. Black Hills National Forest ecological land units study. USDA Forest Service, Black Hills National Forest, SD.
Lyon, Peggy. Personal communication. Botanist, Colorado Natural Heritage Program, Fort Collins, CO.
Minnesota Natural Heritage Program. 1993. Minnesota's native vegetation: A key to natural communities. Version 1.5. Minnesota Department of Natural Resources, Natural Heritage Program, St. Paul, MN. 110 pp.
Montana Natural Heritage Program. 1988. Draft guide to the natural vegetation of Montana. Montana Natural

Heritage Program, Helena. 389 pp.
Montana Natural Heritage Program. 2002b. List of ecological communities for Montana. Montana Natural Heritage Program, Montana State Library, Helena, MT.
Montana Natural Heritage Program. No date. Unpublished data on file. Helena, MT.
MacCracken, J.G., D.W. Uresk, and R.M. Hansen. 1983b. Plant community variability on a small area in southeastern Montana. Great Basin Naturalist 43(4):660-668.
MacCracken, J.G., L.E. Alexander, and D.W. Uresk. 1983a. An important lichen of southeastern Montana rangelands. Journal of Range Management 36(1):35-37.
MacKenzie, W.H., and J.R. Moran. 2004. Wetlands of British Columbia: A guide to identification. Land Management Handbook #52, British Columbia Ministry of Forests, Victoria, BC. 287 pp.
Macdonald, K.B. 1977. Plant and animal communities of Pacific North American salt marshes. Pages 167-191 in: V.J. Chapman, editor. Wet Coastal Ecosystems. Elsevier Scientific Publications Company, Amsterdam.
Malanson, G.P. 1980. Habitat and plant distributions in hanging gardens of the Narrows, Zion National Park, Utah. Great Basin Naturalist 40(2):178-182.
Malanson, G.P. 1982. The assembly of hanging gardens: Effects of age, area, and location. The American Naturalist 119:145-150.
Manning, M. 1988. Ecology and rooting characteristics of four intermountain meadow community types. Unpublished thesis, University of Nevada, Reno.
Manning, M.E., and W.G. Padgett. 1991. Riparian community type classification for the Humboldt and Toiyabe national forests, Nevada and eastern California. Unpublished draft report prepared for USDA Forest Service, Intermountain Region Ecology and Classification Program, Ogden, UT. 490 pp.
Manning, M.E., and W.G. Padgett. 1992. Riparian community type classification for the Humboldt and Toiyabe national forests, Nevada and eastern California. USDA Forest Service, Intermountain Region Ecology and Classification Program. 274 pp.
Manning, M.E., and W. G. Padgett. 1995. Riparian community type classification for Humboldt and Toiyabe national forests, Nevada and eastern California. USDA Forest Service, Intermountain Region. 306 pp.
Marks, M., B. Lapin, and J. Randall. 1994. *Phragmites* australis (*P. communis*): Threats, management, and monitoring. Natural Areas Journal 14(4):285-294.
Marr, J.W., D.A. Boyce, and J.W. Todd. 1973b. Preliminary report on the Redcliff project, Eagle County, Colorado. Unpublished report to the D.E. Fleming Company, Denver, and the Colorado River Water Conservation District, Glenwood Springs, by University of Colorado, Boulder. 9 pp.
Marr, J.W., D. Buckner, and C. Mutel. 1973a. Ecological analyses of potential shale oil products pipeline corridors in Colorado and Utah. Unpublished report prepared for Colony Development Operation, Atlantic Richfield Company, Denver, by Thorne Ecological Institute and University of Colorado, Boulder. 96 pp. plus apps.
Marr, J.W., D.M. Armstrong, H. Chronic, J. Chronic, R. W. Pennak, W.A. Weber, R.E. Marr, D. Steward, and J.C.
Meyer. 1980. Natural landmarks of the southern Rocky Mountain region. Unpublished report prepared for USDI Heritage Conservation and Recreation Service, Denver, CO, by Thorne Ecological Institute, Boulder, CO. 736 pp.
Marr, J.W., R. Fritz, J. Meyer, and P. Murphy. 1979. Final report-terrestrial plant ecology-stand ecosystem data tables, Juniper/Cross Mountain Project. Report prepared for Colorado River Water Conservation District, Glenwood Springs, CO, by University of Colorado, Boulder. 47 pp.
Marr, J.W., and D.L. Buckner. 1974. Colorado to Wyoming pipeline corridor study. Unpublished report for Colony Development Operation, Atlantic Richfield Co., Denver by Thorne Ecological Institute, Boulder, CO. 79 pp.
Marriott, H.J. 1985. Flora of the northwestern Black Hills, Crook and Weston counties, Wyoming. Unpublished M.S. thesis, Department of Botany, University of Wyoming, Laramie.
Marriott, H.J., and D. Faber-Langendoen. 2000. The Black Hills community inventory. Volume 2: Plant community descriptions. The Nature Conservancy, Midwest Conservation Science Center and Association for Biodiversity Information, Minneapolis, MN. 326 pp.
Marriott, H.J., and G.P. Jones. 1989. Special status plant surveys and plant community surveys in the Trapper Creek and Medicine Lodge Wilderness Study Areas and the Spanish Point Karst ACEC. Report submitted to the Bureau of Land Management, Worland District Office, under Cooperative Agreement Task Order No. WY910-CA9001TQE1. Wyoming Natural Diversity Database, Laramie. 42 pp. plus appendices.
Marriott, Hollis J. Personal communication. Former Heritage Botanist, WYNDD, and former Public Lands Coordinator, The Nature Conservancy. 655 N. Cedar, Laramie, WY 82070. (307) 721-4909.
Martin, W., R. Fletcher, and P. Knight. 1981. An analysis of the flora of the Canadian River Canyon-Mills Canyon section. Unpublished report prepared for the USDA Forest Service, Range Management Division. 79 pp.

Masek, J. 1979. Vegetation community descriptions for the South Platte River in Colorado and Nebraska. Unpublished report prepared for the Water and Power Resources Service, Denver, CO. 23 pp.

Mason, L.R., H.M. Andrews, J.A. Carley, and E.D. Haacke. 1967. Vegetation and soils of No Man's Mesa relict area. Journal of Range Management 20:45-59.

Mauk, R.L., and J.A. Henderson. 1984. Coniferous forest habitat types of northern Utah. USDA Forest Service. General Technical Report INT-170. Intermountain Forest and Range Experiment Station, Ogden, UT. 89 pp.

Maxwell, E.L. 1975. Multispectral analysis of rangeland conditions. Unpublished dissertation, Colorado State University, Fort Collins. 198 pp.

Mayfield, M.M., and J. Kjelmyr. 1984. Boardman Research Natural Area. Supplement No. 17 to: J. F. Franklin, F.C. Hall, C.T. Dyrness, and C. Maser. 1972. Federal Research Natural Areas in Oregon and Washington: A guidebook for scientists and educators. Pacific Northwest Forest and Range Experiment Station, Portland, OR.

Mayo, J.E. 1971. A comparative study of the forest floor produced by three age-class stands of Pinus ponderosa. Unpublished thesis, University of Colorado, Boulder. 44 pp.

McArthur, E.D., and B.L. Welch, compilers. 1986. Proceedings-Symposium on the biology of Artemisia and *Chrysothamnus*. 1984 July 9-13, Provo, Utah. USDA Forest Service General Technical Report INT-200. Intermountain Research Station, Ogden, UT. 398 pp.

McEachern, K. 1979. Population biology of Populus sargentii in northeastern Colorado. Unpublished thesis, University of Northern Colorado, Greeley. 41 pp.

McLean, A. 1970. Plant communities of the Similkameen Valley, British Columbia, and their relationships to soils. Ecological Monographs 40(4):403-424.

Medicine Bow Mine Application. No date. Application No. 331-T1, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.

Medina, A.L. 1986. Riparian plant communities of the Fort Bayard watershed in southwestern New Mexico. Southwestern Naturalist 31(3):345-359.

Mehl, M.S. 1992. Old-growth descriptions for the major forest cover types in the Rocky Mountain Region. Pages 106120 in: M.R. Kaufmann, W.H. Moir, and R. L.Bassett. Old-growth forests in the southwest and Rocky Mountain regions. Proceedings of the old-growth forests in the Rocky Mountains and Southwest conference, Portal, AZ. March 9-13, 1992. USDA Forest Service, General Technical Report RM-213, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

Merkle, J. 1962. Plant communities of the Grand Canyon area, Arizona. Ecology 43(4):698-711.

Midwestern Ecology Working Group of NatureServe. No date. International Ecological Classification Standard: International Vegetation Classification. Terrestrial Vegetation. NatureServe, Minneapolis, MN.

Miller, D.A., D.A. Mouat, and B.D. Treadwell. 1977. Remote sensing analysis and literature survey pertaining to the vegetation of the Petrified Forest NP. Report to NASA and the National Park Service. 48 pp.

Miller, P.C. 1964. Factors influencing the vegetation pattern on the White River Plateau in northwestern Colorado. Unpublished dissertation, University of Colorado, Boulder. 208 pp.

Milton, N.M., and T.L. Purdy. 1983. Plant and soil relationships in two hydrothermally altered areas of the Great Basin. Great Basin Naturalist 43(3):457-469.

Mitchell, J.E., N.E. West, and R.W. Miller. 1966. Soil physical properties in relation to plant community patterns in the shadscale zone of northwestern Utah. Ecology 47(4):627-630.

Moir, W.H. 1963. Vegetational analysis of three southern New Mexico mountain ranges. Unpublished thesis, New Mexico State University, Las Cruces. 77 pp.

Moir, W.H. 1969b. Steppe communities in the foothills of the Colorado Front Range and their relative productivities. The American Midland Naturalist 81(2):331-340.

Moir, W.H., C. Maser, and J.F. Franklin. 1973b. Bagby Research Natural Area. Supplement #2 to: J. F. Franklin, C. T. Dyrness, and C. Maser. 1972. Federal Research Natural Areas in Oregon and Washington: A guidebook for scientists and educators. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR.

Moir, W.H., and J.A. Ludwig. 1979. A classification of spruce-fir and mixed conifer habitat types of Arizona and New Mexico. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Research Paper RM-207. Fort Collins, CO. 47 pp.

Moir, W.H., and J.O. Carleton. 1987. Classification of pinyon-juniper (P-J) sites on national forests in the Southwest. Pages 216-226 in: R.L. Everett, editor. Proceedings of the Pinyon-Juniper Conference, Reno, NV, 13-16 January 1986. USDA Forest Service, Intermountain Forest and Range Experiment Station. General Technical Report. Ogden, UT. 581 pp.

Mooney, M.J. 1985. A preliminary classification of high elevation sagebrush-grass plant vegetation in northern and central Nevada. Unpublished thesis, University of Nevada, Reno. 118 pp.

Moran, P. 1981. Patterns of plant life at Pawnee National Grassland: A manual for the interpreter. Unpublished report prepared for the Pawnee National Grasslands, Greeley, CO. 88 pp.

Moretti, M.C. 1979. Vegetation and soil factors in relation to slope position: A study of plant communities on foothill knolls in the Uintah Basin of Utah. Unpublished thesis, Brigham Young University, Provo. 31 pp.

Moretti, M.C., and J.D. Brotherson. 1982. Vegetation and soil factors in relation to slope position of foothill knolls in the Uinta Basin of Utah. Great Basin Naturalist 42(1):81-90.

Morgan, M.D. 1969. Ecology of aspen in Gunnison County, CO. The American Midland Naturalist 82(1):204-228.

Moseley, R.K. 1987a. Synecological relationships of alpine spike-fescue (Leucopoa kingii (Wats.) Weber) grasslands in eastcentral Idaho, U.S.A. Unpublished manuscript, 33 pp.

Moseley, R.K. 1987b. Area of Critical Environmental Concern and Research Natural Area proposal for the Malm Gulch and Germer Basin area, Bureau of Land Management, Salmon District, Idaho. Unpublished report prepared for USDI Bureau of Land Management, Salmon District, ID, by The Nature Conservancy, Moscow, ID. 18 pp.

Moseley, R.K. 1998. Riparian and wetland community inventory of 14 reference areas in southwestern Idaho. Technical Bulletin 98-5. USDI Bureau of Land Management, Boise State Office, Boise, ID. 52 pp.

Moulton, M.P., J.R. Choate, S.J. Bissell, and R.A. Nicholson. 1981. Associations of small mammals on the central high plains of eastern Colorado. Southwestern Naturalist 26(1):53-57.

Mozingo, H. 1987. Shrubs of the Great Basin: A natural history. University of Nevada Press, Las Vegas. 342 pp.

Mueggler, W.F. 1988. Aspen community types of the Intermountain Region. USDA Forest Service General Technical Report INT-250. Intermountain Research Station, Ogden, UT. 135 pp.

Mueggler, W.F., and R.B. Campbell, Jr. 1982. Aspen community types on the Caribou and Targhee national forests in southeastern Idaho. USDA Forest Service, Intermountain Forest and Range Experiment Station. Research Paper INT-294. Ogden, UT. 32 pp.

Mueggler, W.F., and R.B. Campbell, Jr. 1986. Aspen community types of Utah. USDA Forest Service Research Paper INT-362, Intermountain Forest and Range Experiment Station, Ogden, UT.

Mueggler, W.F., and W.L. Stewart. 1980. Grassland and shrubland habitat types of western Montana. USDA Forest Service, General Technical Report INT-66. IM Forest and Range Experiment Station. Ogden, UT. 154 pp.

Muldavin, E. 1991. Riparian and wetlands survey, Pecos National Historic Park. Unpublished report prepared for the National Park Service, NM Natural Heritage Program, University of New Mexico, Albuquerque. 30 pp.

Muldavin, E. 1994. Organ Mountains sensitive species and plant community inventory. Unpublished report prepared by the New Mexico Natural Heritage Program, Albuquerque.

Muldavin, E.H., R.L. DeVelice, and F. Ronco, Jr. 1996. A classification of forest habitat types southern Arizona and portions of the Colorado Plateau. USDA Forest Service General Technical Report RM-GTR-287. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 130 pp.

Muldavin, E.,B. Sims, and L. Johnson. 1993b. Pecos Wild and Scenic River in stream flow report. Final Report prepared for the USDA National Forest Service, Santa Fe National Forest, Santa Fe, NM.

Muldavin, E., G. Harper, P. Neville, and Y. Chauvin. 1998b. The vegetation of White Sands Missile Range, New Mexico. Volume II. Vegetation map. Final report for Cooperative Agreement No. 14-16-00-91-233 White Sands Missile Range, USFWS. The Nature Conservancy and the University of New Mexico.

Muldavin, E., P. Durkin, M. Bradley, M. Stuever, and P. Mehlhop. 2000a. Handbook of wetland vegetation communities of New Mexico: Classification and community descriptions (volume 1). Final report to the New Mexico Environment Department and the Environmental Protection Agency prepared by the New Mexico Natural Heritage Program, University of New Mexico, Albuquerque, NM.

Muldavin, E., P. Mehlhop, and E. DeBruin. 1994a. A survey of sensitive species and vegetation communities in the Organ Mountains of Fort Bliss. Volume III: Vegetation communities. Report prepared for Fort Bliss, Texas, by New Mexico Natural Heritage Program, Albuquerque.

Muldavin, E., R. Wallace, and P. Mehlhop. 1993a. Riparian ecological site inventory for New Mexico Bureau Land Management lands. Final Report COOP Agreement F91070-0003, USDI Bureau of Land Management, New Mexico State Office, Santa Fe.

Muldavin, E., Y. Chauvin, and G. Harper. 2000b. Vegetation of White Sands Missile Range, New Mexico: Volume I. Handbook of vegetation communities. Final Report to White Sands Missile Range by New Mexico Natural Heritage Program, University of New Mexico, New Mexico. 192 pp.

Muldavin, E., and P. Mehlhop. 1992. A preliminary classification and test vegetation map for White Sands Missile

Range and San Andreas National Wildlife Refuge, New Mexico. University of New Mexico, New Mexico Natural Heritage Program.
Muldavin, E., et al. 1998c. Plant community inventory for Fort Bliss. Unpublished report in preparation by the New Mexico Natural Heritage Program, Albuquerque, NM.
Murphy, P.H. 1982. The forest vegetation of the Lost Creek area in the southern Front Range, Colorado. Unpublished thesis, University of Colorado, Boulder. 145 pp.
Murray, M.P. 2000. Wetland plant associations of the western hemlock zone in the central coastal and westslope Cascade Mountains. Unpublished report, Oregon Natural Heritage Program, Portland, OR. 82 pp. http://www.natureserve.org/nhp/us/or/nw_or_wetlands.pdf
Mutel, C.F. 1973. An ecological study of the plant communities of certain montane meadows in the Front Range of Colorado. Unpublished thesis, University of Colorado, Boulder. 77 pp.
Mutel, C.F. 1976. From grassland to glacier: An ecology of Boulder County, Colorado. Johnson Publishing Company, Boulder. 169 pp.
Mutel, C., and J.W. Marr. 1973. A vegetative study of three montane herbaceous basins. Journal of the Colorado-Wyoming Academy of Science 7(4):28 (Abstract).
Muthukumar, T., K. Udaiyan, and P. Shanmughavel. 2004. Mycorrhiza in sedges: an overview. Mycorrhiza 14:65-77.
Mutz, K.M., and R. Graham. 1982. Riparian community type classification-Big Piney Range District, Wyoming. Unpublished report prepared for USDA Forest Service, Intermountain Region under contract 53-84M8-1-974, by Meiiji Resource Consultants, Layton, UT. 88 pp.
Myhre, J., and E.A. Clements. 1972. A study of the flora of the islands and the shoreline of the Snake River between Grandview, Idaho, and Guffey Butte, Owyhee County, Idaho. Unpublished report prepared for Biology Department, College of Idaho, Caldwell. 18 pp.
North Dakota Natural Heritage Inventory. No date. Vegetation classification of North Dakota. North Dakota Natural Heritage Inventory, North Dakota Parks & Recreation Department, Bismarck.
Nevada Natural Heritage Program. 2003. National Vegetation Classification for Nevada. Nevada Natural Heritage Program, Department of Conservation and Natural Resources, Carson City. 26 September 2003.
Nachlinger, J.L., and G.A. Reese. 1996. Plant community classification of the Spring Mountains National Recreation Area, Clark and Nye counties, Nevada. Unpublished report submitted to USDA Forest Service, Humboldt-Toiyabe National Forest, Spring Mountains National Recreation Area, Las Vegas, NV. The Nature Conservancy, Northern Nevada Office, Reno, NV. 85 pp. plus figures and appendices.
Naumann, Tamara. Personal communication. Botanist, National Park Service, Dinosaur National Monument, Dinosaur, CO.
Neher, R.E., and O.F. Bailey. 1976. Soil survey of White Sands Missile Range, New Mexico, parts of Dona Ana, Lincoln, Otero, Sierra, and Socorro counties. USDA Soil Conservation Service in cooperation with U.S. Army and New Mexico Agriculture Experiment Station.
Nelson, J.B. 1986. The natural communities of South Carolina: Initial classification and description. South Carolina Wildlife and Marine Resources Dept., Division of Wildlife & Freshwater Fisheries, Columbia, SC. 55 pp.
Nelson, L.P., and M.E. Jensen. 1987. Sagebrush-grass community types of the Humboldt National Forest. Unpublished report prepared for USDA Forest Service, Humboldt National Forest, Elko, NV. 80 pp.
Nelson, W.T., W.T. Barker, and H. Goetz. 1981. Habitat type classification of grasslands of Sheyenne National Grassland of southeastern North Dakota. Completion Report for Cooperative Agreement No. RM-80-139-CA. Unpublished report. 138 pp.
Nichol, A.A. 1937. The natural vegetation of Arizona. University of Arizona Agricultural Experiment Station Technical Bulletin 68:177-222.
Nichols, J.T. 1964a. Soil-vegetation relationships of the 15-mile drainage, Washakie County, Wyoming. Unpublished dissertation, University of Wyoming, Laramie.
Nichols, J.T. 1964b. Effect of protection from grazing on two vegetative types in the Big Horn Basin of Wyoming. Wyoming Range Management 192:60-69.
Niering, W.A., and R.S. Warren. 1977. Our dynamic tidal marshes: Vegetation changes as revealed by peat analysis. The Connecticut Arboretum Bulletin 22.
Nixon, E.S. 1977. A mountain *Cercocarpus* population revisited. Great Basin Naturalist 37:97-99.
Northcutt, B.E. 1978. The plant ecology of Butler Wash, southeastern Utah. Unpublished thesis, University of Colorado, Boulder. 118 pp.
Northwest Resources Co. 1981. Grass Creek Mine Application No. 211-T1, on file at Wyoming Department of environmental Quality, Land Quality Division, Cheyenne.

ORNHP [Oregon Natural Heritage Program]. No date. Unpublished data files. Oregon Natural Heritage Program, The Nature Conservancy, Portland, OR.

Ode, Dave. Personal communication. South Dakota Natural Heritage Program, Pierre, SD.

Ogilvie, R.T. 1962. Ecology of spruce forests on the east slope of the Rocky Mountains in Alberta. Unpublished dissertation, Washington State University, Pullman. 189 pp.

Olson, R.A., and W.A. Gerhart. 1982. A physical and biological characterization of riparian habitat and its importance to wildlife in Wyoming. Unpublished report prepared for Wyoming Fish and Game Department, Cheyenne, WY. 188 pp.

Ortenberger, A.I., and R.D. Bird. 1933. The ecology of the western Oklahoma salt plains. Publications of the University of Oklahoma Biological Survey 5:49-64.

Osborn, L.W. 1974. Soil-plant relationships in a saltgrass meadow. Unpublished thesis, Colorado State University, Fort Collins. 41 pp.

Oswald, E.T. 1966. A synecological study of the forested moraines of the valley floor of Grand Teton National Park, Wyoming. Unpublished thesis, Montana State University, Bozeman. 101 pp.

Padgett, W.G. 1981. Ecology of riparian plant communities in southern Malheur National Forest. M.S. thesis. Oregon State University, Corvallis. 143 pp.

Padgett, W.G. 1982. Ecology of riparian plant communities in southern Malheur National Forest. Unpublished thesis, Oregon State University, Corvallis. 143 pp.

Padgett, W.G., A.P. Youngblood, and A.H. Winward. 1988b. Riparian community type classification of Utah. USDA Forest Service, Intermountain Region Publication R4-ECOL-88-01. Ogden, UT.

Padgett, W.G., A.P. Youngblood, and A.H. Winward. 1989. Riparian community type classification of Utah and southeastern Idaho. USDA Forest Service, Intermountain Region. Rep. R4-ECOL-89-01. Ogden, UT. 191 pp.

Padgett, W.G., and M.E. Manning. 1988. Preliminary riparian community type classification for Nevada. Draft. Unpublished report prepared for USDA Forest Service Region IV, Intermountain Region Ecology and Classification Program, Ogden, UT.

Page, C.N. 1997. The ferns of Britain and Ireland. Second edition. Cambridge University Press.

Palmer, E.J. 1929. The ligneous flora of the Davis Mountains. Journal of Arnold Arboretum 10:8-45.

Pammel, L.H. 1924. Ecological notes in the Arapahoe Mountains near Fraser, Colorado. Proceedings of the Iowa Academy of Science 31:133 (Abstract).

Pase, C.P., and A.W. Lindenmuth, Jr. 1971. Effects of prescribed fire on vegetation and sediment in oak-mountain mahogany chaparral. Journal of Forestry 69:800-805.

Paulsen, H.A., Jr. 1969. Forage values on a mountain grassland-aspen range in western Colorado. Journal of Range Management 22:102-107.

Paysen, T.E., J.A. Derby, H. Blake, Jr., V.C. Bleich, and J.W. Mincks. 1980. A vegetation classification system applied to southern California. USDA Forest Service General Technical Report PSW-45. USDA Forest Service, Pacific Southwest Research Station, Berkeley, CA.

Peet, R.K. 1975. Forest vegetation of the east slope of the northern Colorado Front Range. Unpublished dissertation, Cornell University, Ithaca, NY.

Peet, R.K. 1978a. Latitudinal variation in southern Rocky Mountain forests. Journal of Biogeography 5:275-289.

Peet, R.K. 1981. Forest vegetation of the Colorado Front Range. Vegetatio 45:3-75.

Peet, R.K. 1988. Forests of the Rocky Mountains. Pages 64-101 in: M.G. Barbour and W.D. Billings, editors. North American Terrestrial Vegetation. Cambridge University Press, New York.

Penfound, W.T. 1953. Plant communities of Oklahoma lakes. Ecology 34:561-583.

Peterson, P.M. 1984. Flora and physiognomy of the Cottonwood Mountains, Death Valley National Monument, California. University of Nevada Cooperative National Park Resources Studies Unit Report CPSU/UNLV 022/06. Las Vegas, NV.

Pfister, R.D. 1977. Ecological classification of forest land in Idaho and Montana. Pages 329-358 in: Proceedings of Ecological Classification of Forest Land in Canada and Northwestern USA, University of British Columbia, Vancouver.

Pfister, R.D., B.L. Kovalchik, S.F. Arno, and R.C. Presby. 1977. Forest habitat types of Montana. USDA Forest Service. General Technical Report INT-34. Intermountain Forest and Range Exp.Sta., Ogden, UT. 174 pp.

Phillips, C.M. 1977. Willow carrs of the upper Laramie River Valley, Colorado. Unpublished thesis, Colorado State University, Fort Collins. 71 pp.

Pickart, A. 2006. Vegetation of diked herbaceous wetlands of Humboldt Bay National Wildlife Refuge: Classification, description, and ecology. USDI Fish and Wildlife Service. Humbolt Bay National Wildlife Refuge, Humbolt County, CA.

Pieper, R.D. 1968. Comparison of vegetation on grazed and ungrazed pinyon-juniper grassland sites in south-central New Mexico. Journal of Range Management 21:51-53.

Plumb, G.A. 1988. An algorithmic approach to automated vegetation mapping of Big Bend National Park, Texas. Ph.D. dissertation, University of Kansas, Lawrence. 449 pp.

Potter, L.D., R.C. Reynolds, Jr., and E.T. Louderbough. 1985. Mancos shale and plant community relationships: Analysis of shale, soil, and vegetation transects. Journal of Arid Environments 9:147-165.

Potter, L.D., and D.L. Green. 1964. Ecology of ponderosa pine in western North Dakota. Ecology 45(1):10-23.

Potter, L.D., and D.R. Moir. 1961. Phytosociological study of burned and unburned deciduous woods, Turtle Mountains, North Dakota. Ecology 42:468-480.

Poulton, C.E. 1955. Ecology of the non-forested vegetation in Umatilla and Morrow counties, Oregon. Unpublished dissertation. State College of Washington, Pullman. 166 pp.

Powell, A.M. 1988b. Trees and shrubs of Trans-Pecos Texas including Big Bend and Guadalupe Mountains national parks. Big Bend Natural History Assoc., Inc. 536 pp.

Powell, D.C. 1988a. Aspen community types of the Pike and San Isabel national forests in south-central Colorado. USDA Forest Service, Rocky Mountain Region, Report R2-ECOL-88-01. 254 pp.

Price, J., et al. 1981. Ecological study of the Alvord Basin Dunes, southeastern Oregon. Oregon State University Technical Report, Corvallis.

Price, K.P., and J.D. Brotherson. 1987. Habitat and community relationships of cliffrose (*Cowania mexicana* var. *stansburiana*) in central Utah. Great Basin Naturalist 47(1):132-151.

Prodgers, R. 1978. Circle West vegetation baseline study: Final report. Circle West Technical Report No. 1. Energy Division, Montana Department of Natural Resources and Conservation, Helena. 115 pp.

Progulske, D.R., and F.J. Shideler. 1974. Following Custer. South Dakota State University, Agricultural Experiment Station. Bulletin No. 674. Brookings. 139 pp.

Ralston, G.L. 1969. Plant zonation on dune sands of Washoe Lake, Washoe County, Nevada. Unpublished thesis, University of Nevada, Reno.

Ramaley, F. 1909. The silva of Colorado. IV. Forest formations and forest trees. University of Colorado Studies 6:249-281.

Ramaley, F. 1916b. Dry grassland of a high mountain park in northern Colorado. The Plant World 19(4):249-270.

Ramaley, F. 1919a. The role of sedges in some Colorado plant communities. American J. of Botany 6:120-130.

Ramaley, F. 1919b. Some mountain plant communities of sandy soil. The Plant World 22(11):313-329.

Ramaley, F. 1927. Colorado plant life. University of Colorado Semicentennial series 1877-1927. Volume II. 299 pp.

Ramaley, F. 1937. Sand-hill vegetation in northwest-central Colorado. Journal of the Colorado-Wyoming Academy of Science 2(2):32-33.

Ramaley, F. 1939b. Sand-hill vegetation of northeastern Colorado. Ecological Monographs 9:1-51.

Ramaley, F. 1942. Vegetation of the San Luis Valley in southern Colorado. University of Colorado Studies, Series D, 1:231-277.

Rasmussen, L.L., and J.D. Brotherson. 1986. Response of winterfat (*Ceratoides lanata*) communities to release from grazing pressure. Great Basin Naturalist 46(1):148-156.

Rector, C.D. 1979. Lower Gunnison River Basin wetland inventory and evaluation. Unpublished thesis, University of Colorado, Boulder. 71 pp.

Redente, E.F., J.E. Friedlander, and T. McLendon. 1992. Response of early and late semiarid seral species to nitrogen and phosphorus gradients. Plant and Soil 140(1):127-135.

Redmann, R.E. 1972. Plant communities and soils of an eastern North Dakota prairie. Bulletin of the Torrey Botanical Club 99(2):65-76.

Reed, R.M. 1971. Aspen forests of the Wind River Mountains, Wyoming. The American Midland Naturalist 86(2):327-343.

Reed, R.M. 1976. Coniferous forest habitat types of the Wind River Mountains, Wyoming. The American Midland Naturalist 95(1):159-173.

Reid, M. 1990. Yampa River Basin riparian vegetation classification project. Unpublished data prepared for The Nature Conservancy, Colorado Field Office and Western Heritage Task Force, Boulder, CO.

Reid, M.S., L.S. Engelking, and P.S. Bourgeron. 1994. Rare plant communities of the conterminous United States, Western Region. Pages 305-620 in: D.H. Grossman, K.L. Goodin, and C.L Reuss, editors. Rare plant communities of the conterminous United States, a initial survey. The Nature Conservancy, Arlington, VA.

Reid, W.H. 1980. Vegetative structure, physical environment and disturbance in White Sands National Monument, New Mexico. Pages 71-85 in: Proceedings of the Second Conference on Scientific Research in the National

Parks, Volume 9. Human Impact on Natural Resources.
Richard, C., G. Kittel, and S. Kettler. 1996. A classification of the riparian vegetation of the San Juan National Forest. Draft 1 report. Colorado Natural Heritage Program, Colorado State University, Fort Collins.
Rickard, W.H., and J.C. Beatley. 1965. Canopy-coverage of the desert shrub vegetation mosaic of the Nevada Test Site. Ecology 46(4):524-529.
Rippel, P., Pieper, R.D., and G.H. Lymbery. 1983. Vegetational evaluations of pinyon-juniper cabling in south-central New Mexico. Journal of Range Management 36:13-15.
Roberts, D.W. 1980. Forest habitat types of the Bear's Paw Mountains and Little Rocky Mountains, Montana. Unpublished thesis, Department of Forestry, University of Montana, Missoula. 116 pp.
Roberts, D.W., D.W. Wight, and G.P. Hallsten. 1992. Plant community distribution and dynamics in Bryce Canyon National Park. Unpublished final report for Bryce Canyon National Park Project PX1200-7-0966. 146 pp.
Roberts, D.W., J.I. Sibbernsen, and R.D. Pfister. 1979a. Forest and woodland habitat types of northcentral Montana. Volume 2: The Missouri River Breaks. Unpublished report prepared by University of Montana, School of Forestry. IFRES YA-512-CT6-B4. Prepared for the USDI Bureau of Land Management State Office, Research Division, Billings, MT. 24 pp.
Robertson, J.H. 1971. Changes on a sagebrush-grass range in Nevada ungrazed for 30 years. Journal of Range Management 24:397-400.
Rogers, C.M. 1953. The vegetation of the Mesa de Maya region of Colorado, New Mexico, and Oklahoma. Lloydia 16(4):257-290.
Rominger, J.M., and L.A. Paulik. 1983. A floristic inventory of the plant communities of the San Francisco Peaks Research Natural Area. USDA Forest Service General Technical Report RM-96. Rocky Mountain Forest and Range Experiment Station, Ft Collins, CO. 9 pp.
Romme, W.H., K.D. Heil, J.M. Porter, and R. Fleming. 1993. Plant communities of Capitol Reef National Park, Utah. USDI National Park Service, Technical Report NPS/NAUCARE/NRTER-93/02. Cooperative Park Studies Unit, Northern Arizona University. 37 pp.
Rondeau, Renee. Personal communication. Interim Director/Ecologist, Colorado Natural Heritage Program, Colorado State University, 254 General Services Building, Fort Collins, CO, 80523.
Rosgen, D. 1996. Applied river morphology. Wildland Hydrology, Pagosa Springs, CO.
Ross, R.L., E.P. Murray, and J.G. Haigh. 1973. Soil and vegetation inventory of near-pristine sites, Montana. USDA Soil Conservation Service, Bozeman, MT. 55 pp.
Rothwell, G.W. 1996. Pteridophytic evolution: An often underappreciated phytological success story. Review of Paleobotany and Palynology 90: 209-222.
Roughton, R.D. 1966. Age structure of browse populations. Unpublished thesis, Colorado State University, Fort Collins. 154 pp.
Roughton, R.D. 1972. Shrub age structures on a mule deer winter range in Colorado. Ecology 53(4):615-625.
Rowdabaugh, K.M. 1978. The role of fire in the ponderosa pine-mixed conifer ecosystems. Unpublished thesis, Colorado State University, Fort Collins. 121 pp.
Rust, S.K. 1999. Pinyon-juniper woodland classification and description in Research Natural Areas of southeastern Idaho. In: S.B. Monson and R. Stevens, compilers. Proceedings: Ecology and management of pinyon-juniper communities within the interior west. 1997 September 15-18, Provo, UT. Proceedings RMRS-P-9. USDA Forest Service, Rocky Mountain Research Station. Ogden, UT. 411 pp.
Rust, S.K., C.J. Murphy, G. Easdale, and C. Coulter. 2000b. Owyhee Plateau vegetation mapping project: Fixed area plots and stand level community observations, 1998-2000. Unpublished data on file at Idaho Fish and Game, Idaho Conservation Data Center, Boise, ID.
Rzedowski, J. 1981. Vegetaciòn de México. Editorial Limusa, Mexico City, Mexico. 432 pp.
Saul, S. 1974. A report on the proposed Harney Lake Research Natural Area. Malheur National Wildlife Refuge, Burns, OR. 16 pp.
Savage, D.E. 1968. The relationship of sage grouse to upland meadows in Nevada. Unpublished thesis, University of Nevada, Reno.
Sawyer, J.O., and T. Keeler-Wolf. 1995. A manual of California vegetation. California Native Plant Society, Sacramento. 471 pp.
Schafale, M.P., and A.S. Weakley. 1990. Classification of the natural communities of North Carolina. Third approximation. North Carolina Department of Environment, Health, and Natural Resources, Division of Parks and Recreation, Natural Heritage Program, Raleigh. 325 pp.
Schlatterer, E.F. 1972. A preliminary description of plant communities found on the Sawtooth, White Cloud,

Boulder, and Pioneer mountains. Unpublished report prepared for USDA Forest Service, Intermountain Region, Ogden, UT. 111 pp.
Schmoll, H.M. 1935. Vegetation of the Chimney Rock area, Pagosa-Piedra region, Colorado. Private Edition, Distributed by University of Chicago Libraries, Chicago, IL. 58 pp.
Schramm, D.R. 1982. Floristics and vegetation of the Black Mountains, Death Valley National Monument. Unpublished report prepared for the University of Nevada, Las Vegas.
Seminoe I Mine Application. No date. Application No. 378-T1, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne, WY.
Seminoe II Mine Application. No date. Application No. 377-T2, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.
Severson, K.E., and J.F. Thilenius. 1976. Classification of quaking aspen stands in the Black Hills and Bear Lodge Mountains. USDA Forest Service Research Paper RM-166. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 24 pp.
Seyer, S. 1984. Inventory of Guard Slough wild-rye stand. Unpublished report prepared for Oregon Natural Heritage Program, Portland, OR.
Seyer, S.C. 1981. Survey of vegetation of 18 lakes in Wallowa-Whitman National Forest, Oregon. USDA Forest Service, Forest Sciences Laboratory, Corvallis, Oregon. 47 pp.
Shanks, D.L. 1977. Aerial photo densitometry for rangeland planning and evaluation. Unpublished thesis, Colorado State University, Fort Collins. 66 pp.
Shantz, H.L. 1906. A study of the vegetation of the mesa region east of Pike's Peak, the Bouteloua formation. II. Development of the formation. Botanical Gazette 42:179-207.
Shantz, H.L. 1911. Natural vegetation as an indicator of the capabilities of land for crop production in the Great Plains area. USDA Bureau of Plant Industry Bulletin 201. 100 pp.
Shantz, H.L. 1923. The natural vegetation of the Great Plains region. Annals of the Association of American Geographers 13:81-107.
Shantz, H.L. 1925. Plant communities in Utah and Nevada. Pages 15-23 in: I. Tidestrom. Flora of Utah and Nevada. Contributions of the U.S. National Herbarium 25, Washington, DC.
Shantz, H.L., and R.L. Piemeisel. 1940. Types of vegetation in Escalante Valley, Utah, as indicators of soil conditions. USDA Technical Bulletin 713. U.S. Department of Agriculture, Washington, DC. 46 pp.
Shaw, R.B., S.L. Anderson, K.A. Schultz, and V.E. Diersing. 1989. Plant communities, ecological checklist, and species list for the U.S. Army Pinon Canyon Maneuver Site, Colorado. Colorado State University, Department of Range Science, Science Series No. 37, Fort Collins. 71 pp.
Shelford, V.E. 1954. Some lower Mississippi Valley flood plain biotic communities: Their age and elevation. Ecology 35:1-14.
Shephard, M.E. 1995. Plant community ecology and classification of the Yakutat Foreland, Alaska. R10-TP-56. USDA Forest Service, Alaska Region. 213 pp. plus appendices.
Shepherd, H.R. 1975. Vegetation of two dissimilar bighorn sheep ranges in Colorado. Colorado Division of Wildlife Report 4. 223 pp.
Shepperd, W.D. 1990. Initial growth, development, and clonal dynamics of regenerated aspen in the Rocky Mountains. USDA Forest Service Research Paper RM-312. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 8 pp.
Sherman, R.J. 1969. Spatial and developmental patterns of vegetation of Black Butte, Oregon. Unpublished dissertation, Oregon State University, Corvallis. 80 pp.
Shiflet, T.N., editor. 1994. Rangeland cover types of the United States. Society for Range Management. Denver, CO. 152 pp.
Shupe, J.B., J.D. Brotherson, and S.R. Rushforth. 1986. Patterns of vegetation surrounding springs in Goshen Bay, Utah County, Utah, U.S.A. Hydrobiologia 139:97-107.
Shute, D., and N.E. West. 1978. The application of ECOSYM vegetation classifications to rangelands near Price, Utah. Appendix reports 14 and 16 in: J.A. Henderson, L.S. Davis, and E.M. Ryberg, editors. ECOSYM: A classification and information system for wildland resource management. Utah State University, Logan. 53 pp.
Singh, T., and N.E. West. 1971. Comparison of some multivariate analyses of perennial *Atriplex* vegetation in southeastern Utah. Vegetatio 23(5-6):289-313.
Skull Point Mine Application. No date. Application No. 2335-T2, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.
Skull Point Mine Permit Renewal. No date. On file at Wyoming Department of Environmental Quality, Land

Quality Division, Cheyenne.
Smith, D.R. 1967. Effects of cattle grazing on a ponderosa pine-bunchgrass range in Colorado. USDA Forest Service. General Technical Bulletin 1371. 60 pp.
Smith, E.L., Jr. 1966. Soil-vegetation relationships of some *Artemisia* types in North Park, Colorado. Unpublished dissertation, Colorado State University, Fort Collins. 27 pp.
Smith, J. No date (b). Comprehensive data base for surface mining in Wyoming. Unpublished data, Department of Environmental Quality, Land Quality Division, Cheyenne.
Smith, S. 1994b. Ecological guide to eastside pine plant associations, northeastern California. USDA Forest Service, Pacific Southwest Region, R5-ECOL-TP-004. 174 pp.
Smith, T.L. 1989. An overview of old-growth forests in Pennsylvania. Natural Areas Journal 9:40-44.
Smith, T.L. 1991. Natural ecological communities of Pennsylvania. First revision. Unpublished report. Pennsylvania Science Office of The Nature Conservancy, Middletown, PA. 111 pp.
Sneddon, L., M. Anderson, and K. Metzler. 1996. Community alliances and elements of the Eastern Region. Unpublished report. The Nature Conservancy, Eastern Heritage Task Force, Boston, MA. 235 pp.
Soil Conservation Service. 1978. Range site descriptions for Colorado. Technical Guide, Section II-E. USDA Soil Conservation Service, Colorado State Office, Denver.
Soil Conservation Service. 1981b. Average annual precipitation Montana. USDA-SCS, Bozeman, MT.
Soil Conservation Service. No date. Range site descriptions of vegetation in Colorado. Unpublished report series MLRA dating from 1975 to 1989. Soil Conservation Service, Colorado Field Office, Denver.
Somers, P., G.E. Nichols, and R.W. Stransky. 1980. Final report: Baseline ecological study of Narraguinnep Research Natural Area, San Juan National Forest. Unpublished report prepared by Fort Lewis College, Durango, CO. 23 pp.
Southeastern Ecology Working Group of NatureServe. No date. International Ecological Classification Standard: International Vegetation Classification. Terrestrial Vegetation. NatureServe, Durham, NC.
Spence, J. Personal communication. Botanist, National Park Service, Glen Canyon National Recreation Area, UT.
Spies, T.A., J.F. Franklin, and M. Klopsch. 1990. Canopy gaps in Douglas-fir forests of the Cascade Mountains. Canadian Journal of Forest Research 20:649-658.
Stearns-Roger, Inc. 1978. Rawhide Energy Project. Transmission system, ecological investigations. Volume II. Technical baseline report to Platte River Power Authority. 51 pp.
Steele, R., R.D. Pfister, R.A. Ryker, and J.A. Kittams. 1981. Forest habitat types of central Idaho. USDA Forest Service General Technical Report INT-114. IM Forest and Range Experiment Station, Ogden, UT. 138 pp.
Steele, R., S.V. Cooper, D.M. Ondov, D.W. Roberts, and R.D. Pfister. 1983. Forest habitat types of eastern Idaho – western Wyoming. USDA Forest Service General Technical Report INT-144. Intermountain Forest and Range Experiment Station, Ogden, UT. 122 pp.
Steele, R., and K. Geier-Hayes. 1995. Major Douglas-fir habitat types of central Idaho: A summary of succession and management. USDA Forest Service General Technical Report INT-GTR-331. USDA Forest Service Intermountain Research Station, Ogden, UT.
Steger, R.E. 1970. Soil moisture and temperature relationships of six salt desert shrub communities in northcentral Wyoming. Unpublished thesis, University of Wyoming, Laramie.
Steinauer, G. 1989. Characterization of the natural communities of Nebraska. Appendix D, pages 103-114 in: M. Clausen, M. Fritz, and G. Steinauer. The Nebraska Natural Heritage Program, two year progress report. Unpublished document. Nebraska Game and Parks Commission, Natural Heritage Program, Lincoln, NE.
Steinauer, G., and S. Rolfsmeier. 2000. Terrestrial natural communities of Nebraska. Unpublished report of the Nebraska Game and Parks Commission. Lincoln, NE. 143 pp.
Steinauer, Gerry. Personal communication. Botanist, Nebraska Natural Heritage Program, Game and Parks Commission, 2200 North 33rd Street, P.O. Box 30370, Lincoln, NE, 68503. 402-694-2498
Steinhoff, H.W. 1978. Management of Gambel oak associations for wildlife and livestock. Unpublished report prepared for USDA Forest Service, Denver, CO. 119 pp.
Stevens, R.L., and C.W. Shannon. 1917. Plant life in Oklahoma. In: C.W. Shannon, editor. Animal and plant life of Oklahoma. Oklahoma Geological Survey, Norman.
Stewart, B.K. 1940. Plant ecology and paleoecology of the Creede Valley, Colorado. Unpublished dissertation, University of Colorado, Boulder. 154 pp.
Stewart, G., W.P. Cottam, and S. S. Hutchings. 1940. Influence of unrestricted grazing on northern salt desert plant associations in western Utah. Journal of Agricultural Research 60(5):289-317.
Stewart, R.E., and H.A. Kantrud. 1971. Classification of natural ponds and lakes in the glaciated prairie region. USDI Bureau of Sport Fisheries and Wildlife Resources, Publication 92. Washington, DC. 77 pp.

Stoddart, L.A. 1941. The palouse grassland association in northern Utah. Ecology 22(2):158-163.

Stoecker-Keammerer Consultants. No date (a). Black Thunder Mine Application No. 233-T3, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.

Stoecker-Keammerer Consultants. No date (b). Coal Creek Mine Application No. 483-T1, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.

Strong, L.L. 1980. Estimating phytomass production of habitat types on sagebrush steppe. Unpublished thesis, Colorado State University, Fort Collins. 133 pp.

Strong, N.M., R.D. Comer, and D.G. Steward. 1978. An ordination and classification of the woody vegetation in Boulder County, Colorado. Journal of the Colorado-Wyoming Academy of Science 10(1):35-36 (Abstract).

Stuever, M.C., and J.S. Hayden. 1997a. Plant associations of Arizona and New Mexico. Volume 2: Woodlands. USDA Forest Service, Southwestern Region, Habitat Typing Guides. 196 pp.

Stuever, M.C., and J.S. Hayden. 1997b. Plant associations of Arizona and New Mexico. Edition 3. Volume 1: Forests. USDA Forest Service, Southwestern Region. Habitat Typing Guides. 291 pp.

Sturges, D.L. 1968. Hydrologic properties of peat from a Wyoming mountain bog. Soil Science 106:262-264.

Sullivan, J. 1993. Equisetum arvense. In: Fire Effects Information System [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/plants/fern/equarv/botanical_and_ecological_characteristics.html>.]. (accessed January 2006)

Sweetwater Uranium Project. 1978. Application No. 481, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.

Sweetwater Uranium Project. No date. Application for amendment No. 1, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.

Swift, R.L. 1974. Vegetation-site relations of ponderosa pine forest in the Front Range of central Colorado. Unpublished thesis, Colorado State University, Fort Collins. 121 pp.

Szaro, R.C. 1989. Riparian forest and scrubland community types of Arizona and New Mexico. Desert Plants Special Issue 9(3-4):70-139.

The Nature Conservancy. 1995a. A classification and description of plant communities in southern Illinois. Report by the Southern Illinois Field Office, Ullin, IL, and the Midwest Regional Office, Minneapolis, MN.

Tart, D. L. 1996. Big sagebrush plant associations of the Pinedale Ranger District. Final review draft. Bridger-Teton National Forest, Jackson WY. 97 pp.

Tausch, R. J., and P. T. Tueller. 1977. Plant succession following chaining of pinyon-juniper woodlands in eastern Nevada. Journal of Range Management 30(1):44-49.

Taylor, A.H. 1980. Plant communities and elevation in the diked portion of Joe Ney Slough: A baseline assessment of a marsh restoration project in Coos Bay, Oregon. M.S. thesis. Oregon State University, Corvallis. 105 pp.

Taylor, D.W., and K.A. Teare. 1979a. Ecological survey of the vegetation of the proposed Trelorita Research Natural Area, Shasta-Trinity National Forest, Trinity County, California. Unpublished report. USDA Forest Service, Pacific Southwest Research Station, Berkeley, CA.

Terwilliger, C., Jr., K. Hess, and C.H. Wasser. 1979b. The habitat types of Region II. USDA Forest Service: A preliminary list and description. Unpublished initial progress report for Habitat Type Classification, Region 2, USDA Forest Service.

Terwilliger, C., Jr., and E.L. Smith. 1978. Range resource types in North Park, Colorado. Colorado State University Range Science Department Science Series 32. 48 pp.

Terwilliger, C., Jr., and J. A. Tiedemann. 1978. Habitat types of the mule deer critical winter range and adjacent steppe region of Middle Park, Colorado. Unpublished report prepared for USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 108 pp.

Terwilliger, C., K. Hess, and C. Wasser. 1979a. Key to the preliminary habitat types of Region 2. Addendum to initial progress report for habitat type classification. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO.

Thilenius, J.F. 1971. Vascular plants of the Black Hills of South Dakota and adjacent Wyoming. USDA Forest Service, RM Forest and Range Experiment Station. General Technical Report RM-71. Fort Collins, CO.

Thilenius, J.F. 1972. Classification of the deer habitat in the ponderosa pine forest of the Black Hills, South Dakota. USDA Forest Service Research Paper RM-91. RM Forest and Range Experiment Station, Ft Collins, CO. 28 p.

Thilenius, J.F., G.R. Brown, and A.L. Medina. 1995. Vegetation on semi-arid rangelands, Cheyenne River Basin, Wyoming. USDA Forest Service. General Technical Report RM-GTR-263. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 60 pp.

Thilenius, J.F., and D.R. Smith. 1985. Vegetation and soils of an alpine range in the Absaroka Mountains, Wyoming. USDA Forest Service General Technical Report RM-121. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 18 pp.

Thomas, D.W. 1980. Study of the intertidal vegetation of the Columbia River estuary, July-September 1980. Columbia River Estuary Study Task Force, Astoria, OR. 22 pp.

Thompson, J. 2001. Draft vegetation associations of Zion National Park, Utah. Prepared for Association for Biodiversity Information, Boulder.

Thompson, W.H., and P.L. Hansen. 2002. Classification and management of riparian and wetland sites of Alberta's Grasslands Natural Region and adjacent subregions. Bitterroot Restoration, Inc. 416 pp.

Thorne Ecological Institute. 1973a. Environmental setting of the Parachute Creek Valley: An ecological inventory. Unpublished report prepared for Colony Development Operations, Atlantic Richfield Company, by Thorne Ecological Institute, Boulder, CO. [Veg.: pages 36-40, map].

Thorne Ecological Institute. 1973b. Pages 26-30 in: Part 1 of Vegetation. The Colony Environmental Study – Parachute Creek, Garfield County, Colorado. Unpublished report prepared for Colony Development Operation by Thorne Ecological Institute, Boulder, CO.

Tiedemann, J.A. 1978. Phyto-edaphic classification of the Piceance Basin. Unpublished dissertation, Colorado State University, Fort Collins. 281 pp.

Tiedemann, J.A., R.E. Francis, C. Terwilliger, Jr., and L.H. Carpenter. 1987. Shrub-steppe habitat types of Middle Park, Colorado. USDA Forest Service Research Paper RM-273. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 20 pp.

Tiedemann, J.A., and C. Terwilliger, Jr. 1978. Phyto-edaphic classification of the Piceance Basin. Colorado State University, Range Science Department Science Series 31. 265 pp.

Tisdale, E.W. 1947. The grasslands of the southern interior of British Columbia. Ecology 28(4):346-382.

Tisdale, E.W. 1979. A preliminary classification of Snake River Canyon grasslands in Idaho. Forestry, Wildlife, and Range Experiment Station Bulletin No. 32, University of Idaho, Moscow. 8 pp.

Tisdale, E.W. 1986. Canyon grasslands and associated shrublands of west-central Idaho and adjacent areas. Bulletin No. 40. Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow. 42 pp.

Tisdale, E.W., and A. McLean. 1957. The Douglas fir zone of southern British Columbia. Ecological Monographs 27:247-266.

Titus, J.H., M. Kerr, E Crowe, and B. Kovalchik. 1998. Riparian zones of eastern Oregon. Oregon Natural Heritage Program, Portland.

Titus, J.H., and J.A. Christy. 1996a. Vegetation of Big Marsh, Deschutes National Forest, Oregon. Report to Deschutes National Forest. Oregon Natural Heritage Program, The Nature Conservancy, Portland.

Titus, J.H., and J.A. Christy. 1999. Vegetation of Big Marsh, Deschutes National Forest. Natural Areas Journal. Report to the USDA Forest Service. Unpublished manuscript at ORNHP, Portland. [in press]

Tolstead, W.L. 1942. Vegetation of the northern part of Cherry County, Nebraska. Ecological Monographs 12(3):257-292.

Topik, C. 1989. Plant associations and management guide for the *Abies grandis* zone Gifford Pinchot National Forest. USDA Forest Service, Pacific Northwest Region R6-ECOL-TP-006-88. Portland, OR. 110 pp.

Topik, C., N.M. Halverson, and D.G. Brockway. 1986. Plant associations and management guide for the western hemlock zone. USDA Forest Service, Pacific Northwest Region. Gifford Pinchot National Forest. R6-ECOL-230a-1986, Portland, OR. 137 pp.

Topik, C., N.M. Halverson, and T. High. 1988. Plant associations and management guide of the ponderosa pine, Douglas-fir, and grand fir zone, Mt. Hood National Forest. USDA Forest Service R6-ECOL-TP-004-88. 136p.

Townsend, T.W. 1966. Plant characteristics relating to the desirability of rehabilitating the Arctostaphylos patula-*Ceanothus velutinus-Ceanothus prostratus* association on the east slope of the Sierra Nevada. Unpublished thesis, University of Nevada, Reno. 90 pp.

Tueller, P.T., D.H. Heinze, and R.E. Eckert. 1966. A tentative list of existing Nevada plant communities (A third approximation). Unpublished report prepared for the Department of Range Wildlife and Forestry, University of Nevada, Reno. 14 pp.

Tueller, P.T., and R.E. Eckert, Jr. 1987. Big sagebrush (*Artemisia tridentata vaseyana*) and longleaf snowberry (*Symphoricarpos oreophilus*) plant associations in northeastern Nevada. Great Basin Naturalist 47(1):117-131.

Tueller, P.T., and W.H. Blackburn. 1974. Condition and trend of the big sagebrush/needle-and-thread habitat type in Nevada. Journal of Range Management 27(1):36-40.

Tuhy, J.S., and J.A. MacMahon. 1988. Vegetation and relict communities of Glen Canyon National Recreation

Area. Unpublished final report prepared for USDI National Park Service, Rocky Mountain Region, Lakewood, CO. Utah State University, Logan. 299 pp.

Tuhy, J.S., and S. Jensen. 1982. Riparian classification for the Upper Salmon and Middle Fork Salmon River drainages, Idaho. Unpublished report prepared for the USDA Forest Service, Intermountain Region by White Horse Associates, Smithfield, UT. 183 pp.

Tweit, S., and K. Houston. 1980. Grassland and shrubland habitat types of the Shoshone National Forest. USDA Forest Service, Rocky Mountain Region, Shoshone National Forest.

U.S. Bureau of Reclamation. 1976. Flora and terrestrial vertebrate studies of the Grand Valley, Colorado. Pages 56-85 and 283-354 in: Final report to the Bureau of Reclamation by Ecology Consultants, Inc., Fort Collins, CO.

United Nations Educational, Scientific and Cultural Organization. 1973. International classification and mapping of vegetation. Series 6, Ecology and Conservation. United Nations Educational, Scientific, and Cultural Organization. Paris. 93 pp.

U.S. Forest Service. 1937. Range plant handbook. Dover Publications Inc., New York. 816 pp.

U.S. Forest Service. 1981a. TES-7, South La Luz grazing allotment. Unpublished report prepared for USDA Forest Service, Southwestern Region, Albuquerque, NM. Various pages, appendices and maps.

U.S. Forest Service. 1981b. TES-2, Cuba Ranger District. Unpublished report prepared for USDA Forest Service, Southwestern Region, Albuquerque, NM. Various pages, appendices, and maps.

U.S. Forest Service. 1982. TES-9, Heber Ranger District. Unpublished report prepared for USDA Forest Service, Southwestern Region, Albuquerque, NM. Various pages, appendices and maps.

U.S. Forest Service. 1983a. TES-4, Coyote Ranger District. Unpublished report prepared for USDA Forest Service, Southwestern Region, Albuquerque, NM. Various pages, appendices and maps.

U.S. Forest Service. 1985a. Forest and woodland plant associations (habitat types) for the Kaibab and Coconino national forests, AZ. Unpublished training materials. USDA Forest Service, SW Region, Albuquerque, NM.

U.S. Forest Service. 1985b. TES-5, western portion of the Glenwood Ranger District. Unpublished report prepared for USDA Forest Service, Southwestern Region, Albuquerque, NM. Various pages, appendices and maps.

U.S. Forest Service. 1985c. TES-1, Terrestrial ecosystem survey handbook, appendix B. Unpublished report prepared for USDA Forest Service, Southwestern Region, Albuquerque, NM.

U.S. Forest Service. 1985d. Woodland and forest plant associations (habitat types) south of the Mogollon Rim, Arizona. Unpublished training materials. USDA Forest Service, Southwestern Region, Albuquerque, NM.

U.S. Forest Service. 1985e. TES-3, western part Rio Arriba County. Unpublished report prepared for USDA Forest Service, Southwestern Region, Albuquerque, NM. Various pages, appendices and maps.

U.S. Forest Service. 1985g. Key to woodland plant associations and plant communities, Lincoln National Forest. Unpublished materials. USDA Forest Service, Southwestern Region, Albuquerque, NM.

U.S. Forest Service. 1992. Draft habitat types of the Little Missouri National Grasslands. Medora and McKenzie ranger districts, Custer National Forest. Dickinson, ND.

Ungar, I.A. 1967. Vegetation-soil relationships on saline soils in northern Kansas. The American Midland Naturalist 78(1):98-121.

Ungar, I.A. 1968. Species-soil relationships on the Great Salt Plains of northern Oklahoma. The American Midland Naturalist 80(2):392-407.

Ungar, I.A. 1970. Species-soil relationships on sulfate dominated soils of South Dakota. The American Midland Naturalist 83(2):343-357.

Ungar, I.A. 1972. The vegetation of inland saline marshes of North America, north of Mexico. Pages 397-411.

Ungar, I.A. 1974b. The effect of soil factors on the distribution of halophytic species at South Park, Colorado. Bulletin of the Ecological Society of America 55(2):31-32 (Abstract).

Ungar, I.A. 1974c. Halophyte communities of Park County, Colorado. Bull. of the Torrey Botanical Club 101:145-152.

Ungar, I.A., W. Hogan, and M. McClennand. 1969. Plant communities of saline soils at Lincoln, Nebraska. The American Midland Naturalist 82(2):564-577.

Utah Environmental and Agricultural Consultants. 1973. Pages 2-38 in: Environmental setting, impact, mitigation and recommendations for a proposed oil products pipeline between Lisbon Valley, Utah and Parachute Creek, Colorado. Unpublished report for Colony Development Operation, Atlantic Richfield Company, Denver, CO.

Vaghti, M.G. 2003. Riparian vegetation classification in relation to environmental gradients, Sacramento River, CA. Thesis, University of California, Davis.

Van Pelt, N.S. 1978. Woodland parks in southeastern Utah. Unpublished thesis, University of Utah, Salt Lake City.

Vanderhorst, J., S.V. Cooper, and B. Heidel. 1998. Botanical and vegetation survey of Carter County, Montana. Unpublished report prepared for the Bureau of Land Management. Montana Natural Heritage Program, Helena.

116 pp. + app.
Vest, E.D. 1962a. Biotic communities in the Great Salt Lake Desert. Institute of Environmental Biological Research, Ecology and Epizoology Series 73. Division of Biological Science, University of Utah. 122 pp.
Vest, E.D. 1962b. The plant communities and associated fauna of Dugway Valley in western Utah. Unpublished dissertation, University of Utah, Salt Lake City.
Vestal, A.G. 1913. Plains vegetation adjoining the mountains: The region about Boulder in Colorado. Unpublished thesis, University of Colorado, Boulder. 40 pp.
Vestal, A.G. 1914. Prairie vegetation of a mountain-front area in Colorado. Botanical Gazette 58(5):377-400.
Vestal, A.G. 1919. Phytogeography of the eastern mountain front in Colorado. I. Physical geography and distribution of vegetation. Botanical Gazette 68(3):153-193.
Volland, L.A. 1976. Plant communities of the central Oregon pumice zone. USDA Forest Service R-6 Area Guide 4-2. Pacific Northwest Region, Portland, OR. 113 pp.
Von Loh, J. 2000. Draft local descriptions of the vegetation associations of Ouray National Wildlife Refuge. USGS Bureau of Reclamation, Remote Sensing and GIS Group, Denver Federal Center, Denver.
Von Loh, J., D. Cogan, D. Faber-Langendoen, D. Crawford, and M. Pucherelli. 1999. USGS-NPS Vegetation Mapping Program, Badlands National Park, South Dakota. USDI Bureau of Reclamation. Technical Memorandum No. 8260-99-02. Denver, CO.
Von Loh, J., D. Cogan, D. J. Butler, D. Faber-Langendoen, D. Crawford, and M. J. Pucherelli. 2000. USGS-NPS Vegetation Mapping Program, Theodore Roosevelt National Park, North Dakota. USBR Technical Service Center. U.S. Department of the Interior, Bureau of Reclamation's Remote Sensing and GIS Group, Denver Federal Center, Denver, CO.
Von Loh, J., D. Cogan, K. Schulz, D. Crawford, T. Meyer, J. Pennell, and M. Pucherelli. 2002. USGS-USFWS Vegetation Mapping Program, Ouray National Wildlife Refuge, Utah. USDI Bureau of Reclamation, Remote Sensing and GIS Group, Technical Memorandum 8260-02-03. Denver Federal Center, Denver, CO.
Vories, K.C. 1974. A vegetation inventory and analysis of the Piceance Basin and adjacent drainages. Unpublished thesis. Western State College of Colorado, Gunnison. 243 pp.
Vujnovic, K., and J. Bentz. 2001. Preliminary classification of native wheat grass (*Agropyron* spp.) community types in Alberta. Alberta Natural Heritage Information Centre, Alberta Environment. Edmonton AB. 362 pp.
WNHP [Washington Natural Heritage Program]. No date. Unpublished data files. Washington Natural Heritage Program, Department of Natural Resources, Olympia, WA.
Wagner, W.H., and W.E. Hammitt. 1970. Natural proliferation of floating stems of scouring-rush, Equisetum hyemale. The Michigan Botanist 9:166-174.
Walford, G.M. 1996. Statewide classification of riparian and wetland dominance types and plant communities – Bighorn Basin segment. Report submitted to the Wyoming Department of Environmental Quality, Land Quality Division by the Wyoming Natural Diversity Database. 185 pp.
Walford, G., G. Jones, W. Fertig, S. Mellman-Brown, and K. Houston. 2001. Riparian and wetland plant community types of the Shoshone National Forest. General Technical Report RMRS-GTR-85. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO. 122 pp.
Walker, G.R., and J.D. Brotherson. 1982. Habitat relationships of basin wildrye in the high mountain valleys of central Utah. Journal of Range Management 35(5):628-633.
Wallis, C. 1990. Reconnaissance survey of saline wetlands and springs in the grassland-parkland region of eastern Alberta. A report prepared by Cottonwood Consultants, Ltd., Calgary, for World Wildlife Fund Canada, Edmonton. 104 pp.
Ward, R T., W. Slauson, and RL. Dix. 1974. The natural vegetation in the landscape of the Colorado oil shale region. Pages 9-17 in: C.W. Cook, editor. Surface rehabilitation of land disturbances resulting from oilshale development. Information Series 11, Environmental Resource Center, Colorado State University, Fort Collins.
Ware, G.H., and W.T. Penfound. 1949. The vegetation of the lower levels of the floodplain of the south Canadian River in central Oklahoma. Ecology 30:478-484.
Warren, A. No date. Range site descriptions in Divide Resource Area. Unpublished report prepared for USDI Bureau of Land Management, Great Divide Resource Area, Rawlins, WY.
Warren, P.L., K.L. Reichhardt, D.A. Mouat, B.T. Brown, and R R. Johnson. 1982. Vegetation of Grand Canyon National Park. Cooperative National Park Resources Studies Unit Technical Report 9. Tucson, AZ. 140 pp.
Warren, P.L., and B.D. Treadwell. 1980. Vegetation of the Three-Bar Wildlife Study Area, Mazatzal Mountains, Arizona. Unpublished report prepared for Arizona Game and Fish Department.
Wasser, C.H., and K. Hess. 1982. The habitat types of Region II. USDA Forest Service: A synthesis. Final report

prepared for USDA Forest Service, RM Forest and Range Experiment Station, Fort Collins, CO. 140 pp.
Waterfall, U.T. 1949. Some results of a summer's botanizing in Oklahoma. Rhodora February:18-29.
Watson, J.R. 1912. Plant geography of north central New Mexico: Contributions from the Hull Botanical Laboratory. Botanical Gazette 54:194-217.
Weaver, J.E. 1960. Flood plain vegetation of the central Missouri Valley and contacts of woodland with prairie. Ecological Monographs 30:37-64.
Weaver, J.E. 1965. Native vegetation of Nebraska. University of Nebraska Press, Lincoln. 185 pp.
Weaver, J.E., and F.W. Albertson. 1956. Grasslands of the Great Plains: Their nature and use. Johnsen Publishing Co., Lincoln, NE. 395 pp.
Weixelman, D.A., D.C. Zamudio, and K.A. Zamudio. 1996. Central Nevada riparian field guide. USDA Forest Service Technical Report R4-ECOL-96-01. USDA Forest Service, Intermountain Region.
Wells, P.V. 1965. Scarp woodlands, transported soils, and concept of grassland climate in the Great Plains region. Science 148:246-249.
Wells, P.V. 1970a. Postglacial vegetational history of the Great Plains. Science 167:1574-1582.
Wells, P.V. 1970b. Historical factors controlling vegetation patterns and floristic distributions in the central plains region of North America. Pages 211-221 in: W. Dort and J.D. Jones, editors. Pleistocene and recent environments of the central Great Plains. University of Kansas Press, Lawrence.
Welsh, S.L. 1957. An ecological survey of the vegetation of the Dinosaur National Monument, Utah. Unpublished thesis, Brigham Young University, Provo, UT. 86 pp.
Welsh, S.L. 1989. On the distribution of Utah's hanging gardens. Great Basin Naturalist 49(1):1-30.
Welsh, S.L., N.D. Atwood, S. Goodrich, and L.C. Higgins, editors. 1987. A Utah flora. Great Basin Naturalist Memoirs 9. Provo, UT. 894 pp.
Welsh, S. L., and C. A. Toft. 1981. Biotic communities of hanging gardens in southeastern Utah. National Geographic Society Research Reports 13:663-681.
West, N.E. 1983a. Great Basin-Colorado Plateau sagebrush semi-desert. Pp. 331-349 in: N.E. West, ed. Ecosystems of the World, Vol. 5: Temperate deserts and semi-deserts. Elsevier Publishing Company, Amsterdam.
West, N.E. 1983b. Intermountain salt desert shrublands. Pp. 375-397 in: N.E. West, ed. Ecosystems of the World, Vol. 5: Temperate deserts and semi-deserts. Elsevier Publishing Company, Amsterdam.
West, N.E. 1983c. Western Intermountain sagebrush steppe. Pages 351-374 in: N.E. West, editor. Temperate deserts and semi-deserts. Ecosystems of the world, Volume 5. Elsevier Publishing Company, Amsterdam.
West, N.E., F.D. Provenza, P.S. Johnson, and M.K. Owens. 1984. Vegetation change after 13 years of livestock grazing exclusion on sagebrush semidesert in west central Utah. Journal of Range Management 37(3):262-264.
West, N.E., R.J. Tausch, K.H. Rea, and A.R. Southard. 1978. Soils associated with pinyon-juniper woodlands of the Great Basin. Pages 68-88 in: C.T. Youngberg, editor. Forest soils and land use, Proceedings of the 5th North American Forest and Soils Conference, Colorado State University, Fort Collins.
West, N.E., R.J. Tausch, and P.T. Tueller. 1998. A management-oriented classification of pinyon-juniper woodlands of the Great Basin. USDA Forest Service General Technical Report RMRS-GTR-12. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT. 42 pp.
West, N.E., R.T. Moore, K.A. Valentine, L.W. Law, P.R. Ogden, F.C. Pinkney, P.T. Tueller, and A.A. Beetle. 1972. Galleta: Taxonomy, ecology and management of *Hilaria jamesii* on western rangelands. Utah Agricultural Experiment Station. Bulletin 487. Logan, UT. 38 pp.
West, N.E., and K.I. Ibrahim. 1968. Soil-vegetation relationships in the shadscale zone of southeastern Utah. Ecology 49(3):445-456.
Western Ecology Working Group of NatureServe. No date. International Ecological Classification Standard: International Vegetation Classification. Terrestrial Vegetation. NatureServe, Boulder, CO.
Western Resources Development Corporation. No date (a). North Antelope Mine Application No. 532-T2. On file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.
Wieland, R.G. 1994a. Marine and estuarine habitat types and associated ecological communities of the Mississippi Coast. Mississippi Department of Wildlife, Fisheries, and Parks. Museum of Natural Science. Museum Technical Report 25. Jackson, MS. 270 pp.
Wight, J.R. 1965. Site and vegetation characteristics and relationships of juniper communities in northwestern Wyoming Unpublished dissertation, University of Wyoming, Laramie.
Wight, J.R., and H.G. Fisser. 1968. *Juniperus osteosperma* in northwestern Wyoming: Their distribution and ecology. University of Wyoming Agricultural Experiment Station Science Monograph 7. Laramie. 28 pp.
Williams, C.K., B.F. Kelly, B.G. Smith, and T.R. Lillybridge. 1995. Forest plant associations of the Colville

National Forest. General Technical Report PNW-GTR-360. USDA Forest Service, Pacific Northwest Region, Portland, OR. 140 pp.
Williams, C.K., T.R. Lillybridge, and B.G. Smith. 1990b. Forested plant associations of the Colville National Forest. Report prepared for USDA Forest Service, Colville National Forest, Colville, WA. 133 pp.
Williams, C.K., and B.G. Smith. 1990. Forested plant associations of the Wenatchee National Forest. Unpublished draft prepared by the USDA Forest Service, Pacific Northwest Region, Portland, OR. 217 pp.
Williams, C.K., and T.R. Lillybridge. 1983. Forested plant associations of the Okanogan National Forest. USDA Forest Service, Pacific Northwest Region. R6-Ecol-132b-1983. 140 pp.
Williams, C.K., and T.R. Lillybridge. 1985. Forested plant associations of the Colville National Forest. Draft. Unpublished field guide prepared for USDA Forest Service.
Williams, C.S. 1961. Distribution of vegetation in the Wind River Canyon, Wyoming. Unpublished thesis, University of Wyoming, Laramie.
Wilson, R.E. 1970. Succession in stands of *Populus deltoides* along the Missouri River in southeastern South Dakota. The American Midland Naturalist 83(2):330-342.
Winward, A.H. 1970. Taxonomic and ecological relationships of the big sagebrush complex in Idaho. Unpublished dissertation, University of Idaho, Moscow. 90 pp.
Wirsing, J.M., and R.R. Alexander. 1975. Forest habitat types on the Medicine Bow National Forest, southeastern Wyoming: Preliminary report. USDA Forest Service General Technical Report RM-12. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 11 pp.
Woodbury, A.M., S.D. Durrant, and S. Flowers. 1961. A survey of vegetation in the Navajo Reservoir basin. University of Utah Anthropological Papers 51, Salt Lake City. 99 pp.
Wooten, S.A. 1980. Vegetation recovery following disturbance on the Central Plains Experimental Range. Unpublished thesis, Colorado State University, Fort Collins.
Wright, H.A., L.F. Neuenschwander, and C. M. Britton. 1979. The role and use of fire in sagebrush-grass and pinyon-juniper plant communities: A state of the art review. USDA Forest Service General Technical Report INT-58. Intermountain Forest and Range Experiment Station. Ogden, UT.
Wright, H.E., Jr., A.M. Bent, B.S. Hansen, and L.J. Mahar, Jr. 1973. Present and past vegetation of the Chuska Mountains, northwestern New Mexico. Geological Society of America Bulletin 84:1155-1179.
Yake, S., and J.D. Brotherson. 1979. Differentiation of serviceberry habitats in the Wasatch Mountains of Utah. Journal of Range Management 32(4):379-386.
Young, J.A., R.A. Evans, B.A. Roundy, and J.A. Brown. 1986. Dynamic landforms and plant communities in a pluvial lake basin. Great Basin Naturalist 46(1):1-21.
Young, J.A., and R.A. Evans. 1973. Downy brome-intruder in the plant succession of big sagebrush communities in the Great Basin. Journal of Range Management 26:410-415.
Young, J.A., and R.A. Evans. 1978. Population dynamics after wildfires in sagebrush grasslands. Journal of Range Management 31:283-289.
Young, J.F. 1982. Soil survey of Teton County, Wyoming, Grand Teton National Park Area. USDA Soil Conservation Service and Wyoming Agricultural Experiment Station. 173 pp.
Youngblood, A.P., W.G. Padgett, and A.H. Winward. 1985a. Riparian community type classification of eastern Idaho-western Wyoming. USDA Forest Service, Intermountain Region. R4-Ecol-85-01. Ogden, UT. 78 pp.
Youngblood, A.P., W.G. Padgett, and A.H. Winward. 1985b. Riparian community type classification of northern Utah and adjacent Idaho. Unpublished report prepared for USDA Forest Service, IM Region, Ogden, UT. 104 pp.
Youngblood, A.P., and R.L. Mauk. 1985. Coniferous forest habitat types of central and southern Utah. USDA Forest Service, Intermountain Research Station. General Technical Report INT-187. Ogden, UT. 89 pp.
Youngblood, A.P., and W.F. Mueggler. 1981. Aspen community types on the Bridger-Teton National Forest in western Wyoming. USDA Forest Service. Research Paper INT-272. Intermountain Forest and Range Experiment Station, Ogden, UT. 34 pp.
Youtie, B.A. 1990. Study of fire effects on *Stipa-Poa* grasslands at Boardman RNA-B. Unpublished report prepared for The Nature Conservancy, Portland, OR.
Zamora, B.A. 1983. Forest habitat types of the Spokane Indian Reservation. Agricultural Research Center, Washington State University Research Bulletin XB-0936-1983.
Zamora, B., and P.T. Tueller. 1973. *Artemisia arbuscula, A. longiloba*, and *A. nova* habitat types in northern Nevada. Great Basin Naturalist 33(4):225-242.
Zimmerman, T. 1978. Skull Creek Study Area Forestry. Unpublished report. USDI Bureau of Land Management, Craig District Office, Craig, CO. 62 pp.

Appendix G

Illustrated Keys to the Plant Associations of Dinosaur National Monument

The vegetation of Dinosaur National Monument was characterized from field data collected in 2002-2005 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 174 plant associations, alliances, and park specials described for the monument. It is 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. Thisguide also allows the user to crosswalk plant associations directly to the Dinosaur National Monument vegetation map so that all research may have a common focal point relative to the baseline years of aerial photography (2001-2002) and field data collection (2002-2005).

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.

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

- 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 below).

- The diagnostic layer consists of woody plants that may appear in either a shrub or a tree form, depending on site conditions and age of the stand. These species include *Pinus edulis, Juniperus osteosperma, Cercocarpus ledifolius*, and *Tamarix ramosissima*. In this key, the first three are ALWAYS considered to be evergreen trees, regardless of their height or growth form, whereas tamarisk is considered a deciduous shrub, regardless of its height or growth form.

- *Artemisia tridentata* ssp. *vaseyana* and *Artemisia tridentata* ssp. *wyomingensis* may hybridize in the zone of overlap (approximately 2100-2400 meters elevation), especially on the Yampa Plateau. There are no separate associations for the hybrid entity, so you will have to assign hybrids to one or the other species, based as best you can on "the preponderance of the evidence". This means that when keying the sagebrush, MOST of the characteristics will point toward one or the other species (e.g., plant shape, inflorescence characteristics, odor, fluorescence). You may also need to run the stand through both the ssp. *vaseyana* and the ssp. *wyomingensis* sections of the key.

- The same situation applies to hybrids of *Pseudoroegneria spicata* and *Elymus lanceolatus.*

- You can follow a key to a certain point, but you clearly have something not described in the key. This is to be expected occasionally – very likely you have an association that was not sampled by this project.

- Sparsely vegetated communities (e.g. less than approximately 10% total vascular plant cover) may need to be run through multiple keys, because it may not be clear whether they are woodlands, shrublands, or herbaceous communities.

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

- The National Vegetation Classification does not view all species as contributing equally to a classification. Species vary in their degree of habitat specialization; to a point, the more specialized and persistent a species, the more it is likely to be a "diagnostic" species that controls the assignment of a community to an association. Generalist species such as *Ephedra viridis, Ericameria nauseosa, Gutierrezia sarothrae, Poa secunda, Opuntia* spp. are only considered diagnostic if they are overwhelmingly dominant. For example, if you are in pinyon-juniper woodlands on a sandstone bench with about equal cover of *Cercocarpus montanus* and *Ephedra viridis* in the understory, the community will be classified as *Pinus edulis – Juniperus osteosperma / Cercocarpus montanus,* not *Pinus edulis – Juniperus osteosperma / Ephedra viridis*. The diagnostic species are not all created equal. There is a hierarchy, and it varies depending on the habitat. Some examples:

  Slickrock: *Cercocarpus intricatus* > *Cercocarpus montanus* > *Amelanchier utahensis* > *Ephedra viridis*
  Uplands: *Artemisia nova* > *Artemisia tridentata* > *Purshia tridentata* > *Amelanchier utahensis*
  Salt desert: *Atriplex corrugata* > *Atriplex gardneri* > *Zuckia brandegeei* > *Ephedra torreyana* > *Eriogonum leptocladon* > *Atriplex confertifolia*
  Alluvial flats and terraces: *Artemisia tridentata* ssp. *tridentata* > *Sarcobatus vermiculatus* > *Artemisia tridentata* ssp. *wyomingensis* > *Atriplex canescens* > *Ericameria nauseosa* Grasses: Strong indicators: *Pseudoroegneria spicata, Elymus lanceolatus, Hesperostipa comata, Sporobolus airoides, Distichlis spicata*. Medium: *Pleuraphis jamesii, Achnatherum hymenoides, Poa fendleriana*. Weak: *Poa secunda, Elymus elymoides, Aristida purpurea, Bromus tectorum, Sporobolus cryptandrus, Vulpia octoflora*.
  Tall trees: *Pinus flexilis* > *Pseudotsuga menziesii* > *Pinus ponderosa* > *Populus tremuloides,* although this will differ among seral stands versus persistent stands.

KEY I: MAJOR PHYSIOGNOMIC GROUPS OF DINOSAUR NATIONAL MONUMENT

1a Vegetation woody or appearing woody; the tallest stratum consists primarily or entirely of trees, shrubs or subshrubs; total vegetation cover may range from sparse to dense **(2)**

1a Vegetation non-woody; consisting predominantly of grasses, graminoids and/or broad-leaf herbs (forbs), which may be tall and coarse. Woody shrubs or trees may be present, but woody plant cover does not exceed approximately 10%. Characteristic genera include *Achnatherum, Aquilegia, Bromus, Calamagrostis, Carex, Distichlis, Eleocharis, Elymus, Equisetum, Glycyrrhiza, Halogeton, Hesperostipa, Heterotheca, Juncus, Leymus, Muhlenbergia, Pascopyrum, Phragmites, Pleuraphis, Pseudoroegneria, Schoenoplectus, Spartina, Sporobolus* or *Xanthium* **Key IV**

2a Vegetation of forest (predominantly interlocking tree canopies) or woodland (predominantly open, tree canopies) stands; tree cover except in sparse vegetation is usually greater than 10%; characteristic genera include *Acer, Cercocarpus (ledifolius), Elaeagnus, Juniperus, Pinus, Populus* or *Pseudotsuga* **Key II**

2b Vegetation of tall shrubs, short shrubs or dwarf-shrubs; canopies may interlock, but more commonly are less dense; characteristic genera include *Amelanchier, Arctostaphylos, Artemisia, Atriplex, Betula, Ceanothus, Cercocarpus* (*montanus* or *intricatus*), *Chrysothamnus, Ephedra, Ericameria, Eriogonum, Grayia, Krascheninnikovia, Philadelphus, Prunus, Rhus, Salix, Sarcobatus, Tamarix* or *Tetradymia* **Key III**



KEY II: FOREST AND WOODLAND ASSOCIATIONS OF DINOSAUR NATIONAL MONUMENT

1a Deciduous forests or woodlands occupying a variety of habitats including stream banks, floodplains and riparian areas or mesic high elevation slopes; includes mixed deciduous-evergreen woodlands in cold tributary canyons. Canopy dominants include *Populus, Tamarix, Acer, Elaeagnus*, sometimes with *Pseudotsuga menziesii* as a co-dominant **(2)**

1b Evergreen forests or woodlands occupying a variety of upland habitats; canopy dominants include *Pinus, Pseudotsuga, Juniperus* and/or *Cercocarpus ledifolius* **(22)**

2a (1) Forests or woodlands characterized by *Populus tremuloides*, typically occupying north-facing, high elevation mountain slopes, such as Martha's Peak, Zenobia Peak, and Roundtop Mountain . In xeric or post-fire situations, the trees may be dwarfed to little more than tall shrub height **(3)**

2b Forests or woodlands characterized by *Populus angustifolia, Populus deltoides* ssp. *wislizeni, Acer negundo, Elaeagnus angustifolia*, or a mixed canopy of *Pseudotsuga menziesii* with *Acer negundo* occurring within drainage bottoms or on mesic alluvial deposits **(8)**

3a (2) Forests or woodlands characterized by *Populus tremuloides* occupying high elevation plateaus and mountain slopes, usually in the lee of ridges where snow collects; typically with an understory stratum (sometimes dense) of tall shrubs including *Amelanchier* spp. and/or *Prunus virginiana* (these may be browed by elk to a short stature) *Symphoricarpos oreophilus* and *Rosa woodsii* are nearly always present and may dominate the short shrub layer **(4)**

3b Forests or woodlands characterized by *Populus tremuloides* occupying high elevation plateaus and mountain slopes, usually in the lee of ridges where snow collects; although tall shrubs may be present, they do not form a stratum. A short shrub stratum is present, consisting of *Symphoricarpos oreophilus, Ceanothus velutinus*, and/or *Juniperus communis* **(5)**

4a (3) Aspen forests or woodlands with a tall shrub understory dominated by *Prunus virginiana*. Amelanchier spp. may be present, but the cover of *Prunus* is always greater - **Populus tremuloides / Prunus virginiana Forest (Quaking Aspen / Chokecherry Forest) [Map Class 4]**





4b Aspen forests or woodlands with a tall shrub understory dominated by *Amelanchier utahensis* or *Amelanchier alnifolia*. If *Prunus virginiana* is present, the cover is a small fraction of that of *Amelanchier*. The understory may contain a diversity of short shrubs, grasses and forbs, but *Symphoricarpos oreophilus* is nearly always present - **Populus tremuloides / Amelanchier**

alnifolia - Symphoricarpos oreophilus / Mixed Graminoid Forest (Quaking Aspen / Saskatoon Serviceberry - Mountain Snowberry / Mixed Graminoid Forest) [Map Class 4]



5a (3) Aspen woodlands with a short shrub understory layer dominated by *Juniperus communis* or *Ceanothus velutinus. Symphoricarpos oreophilus* may be present with low cover **(6)**

5b Aspen forests or woodlands with a short shrub understory dominated by *Symphoricarpos oreophilus*, usually with a variety of other short shrubs, forbs and graminoids present, including *Mahonia repens* or *Rosa woodsii*. *Juniperus communis* is sparse to absent **(7)**

6a (5) Aspen forests or woodlands with a short shrub understory dominated by *Juniperus communis*, frequently with significant cover of *Paxistima myrsinites* and/or *Mahonia repens*. The herbaceous layer may be sparse - **Populus tremuloides / Juniperus communis Forest (Quaking Aspen / Common Juniper Forest) [Map Class 4]**



6b Aspen forests or woodlands with a short shrub understory characterized by *Ceanothus velutinus*. Some stands are young, having sprouted following fire. Other shrubs present with low cover in the understory include *Mahonia repens* and *Symphoricarpos oreophilus* - **Populus tremuloides / Ceanothus velutinus Forest (Quaking Aspen / Tobaccobrush Forest) [Map Class 4]**



7a (5) Aspen forests or woodlands with an understory characterized by Symphoricarpos oreophilus, often accompanied by *Mahonia repens* and/or *Paxistima myrsinites*, with an herbaceous layer containing at least 5% cover (usually more) of *Carex rossii* - **Populus tremuloides / Symphoricarpos oreophilus / Carex rossii Forest (Quaking Aspen / Mountain Snowberry / Ross' Sedge Forest) [Map Class 4]**



7b Aspen forests or woodlands with an understory characterized by *Symphoricarpos oreophilus*, often accompanied by *Mahonia repens* and/or *Paxistima myrsinites*, with an herbaceous layer containing a variety of grasses, sedges and forbs, but *Carex rossii* is absent or has trace cover - **Populus tremuloides / Symphoricarpos oreophilus Forest (Quaking Aspen / Mountain Snowberry Forest) [Map Class 4]**



8a (2) Mixed deciduous-evergreen riparian forests or woodlands, usually located in deep, narrow, usually intermittent tributary canyons. The canopy consists of a mix of *Pseudotsuga menziesii* with *Acer negundo* or *Populus* spp. (the latter not yet documented from the Monument). The understory is generally diverse, but may have low cover because of the deep shade cast by the Douglas-fir - **Pseudotsuga menziesii – Acer negundo Forest (Douglas-fir / Box-elder Woodland) [Map Class 79]**



8b Deciduous riparian or floodplain forests and woodlands with a canopy consisting *of Acer negundo, Elaeagnus angustifolia, Populus angustifolia, Populus x acuminata,* or *Populus deltoides* ssp. *wislizeni* **(9)**

9a (8) Deciduous riparian or floodplains woodlands with a canopy consisting primarily of *Elaeagnus angustifolia. Tamarix ramosissima* or *Acer negundo* often are also significant contributors to the canopy. The understory varies depending on the amount of tamarisk present and the elevation of the stand above the channel, and ranges in cover from sparse to dense. Understory elements may include *Rhus trilobata, Artemisia tridentata* ssp. *tridentata, Spartina pectinata* and *Glycyrrhiza lepidota* - **Elaeagnus angustifolia Semi-natural Woodland (Russian-olive Semi-natural**

Woodland) [Map Class 85]



9b Deciduous riparian or floodplain forests and woodlands with a canopy dominated by *Acer negundo, Populus angustifolia, Populus x acuminata* or *Populus deltoides* ssp. *wislizeni* **(10)**

10a (9) Riparian or floodplain forests and woodlands, mostly located in the main river canyons, with a canopy dominated by *Acer negundo; Celtis laevigata* ssp. *reticulata* is sometimes present to co-dominant. If both *Populus* and *Acer* are present in the canopy, continue to 10b **(11)**

10b Riparian or floodplain forests and woodlands with a canopy dominated by *Populus angustifolia, Populus x acuminata* or *Populus deltoides* ssp. *wislizeni*. Most stands occur along the main stem rivers where the floodplain is broad and well developed, including Deerlodge Park, Island Park, Rainbow Park and Echo Park **(15)**

11a (10) Riparian forests and woodlands with a canopy consisting of both *Acer negundo* and *Celtis laevigata* ssp. *reticulata*; either tree may be dominant in a stand. The understory is often sparse or weedy. Most stands are within two river miles of the Yampa-Green river confluence - **Acer negundo - Celtis laevigata var. reticulata Woodland (Box-elder - Netleaf Hackberry Woodland) [Map Class 83]**



11b Riparian forests and woodlands with a canopy consisting of *Acer negundo. Celtis laevigata* ssp. *reticulata* is absent, but *Tamarix ramosissima* or *Juniperus scopulorum* may be present **(12)**

12a (11) Box elder forests and woodlands occurring high above the occupied river channel. *Tamarix ramosissima* may also be a canopy element; the understory is sparse or consists primarily of weedy or upland species such as *Bromus tectorum, Iva axillaris, Piptatherum micranthum, Elymus repens, Thinopyrum intermedium, Ericameria nauseosa* and *Artemisia tridentata* ssp. *tridentata* - **Acer negundo / Disturbed Understory Woodland (Box-elder / Disturbed Understory Woodland) [Map Classes 80 and 81]**



12b Box elder forests and woodlands occurring in the active floodplain; the understory consists of mesic and/or wetland species and is often dense **(13)**

13a (12) Box elder forests and woodlands located along tributary streams such as Cub Creek and Jones Hole Creek that have a flashy flood regime; the understory is characterized by a well-developed herbaceous layer dominated by *Equisetum* spp. Scattered clumps of *Salix* spp., *Tamarix ramosissima* or other riparian shrubs may be present - **Acer negundo / Equisetum arvense Forest (Box-elder / Field Horsetail Forest) [Map Classes 80, 81]**



13b Box elder forests and woodlands, usually in tributary canyons rivers, with a well-developed tall-shrub understory; *Prunus virginiana* or *Rhus trilobata* are the dominant understory species **(14)**

14a (13) Box elder forests and woodlands with a tall-shrub understory dominated by *Prunus virginiana*. Other shrubs that may be present with low cover include *Rhus trilobata, Artemisia tridentata* ssp. *tridentata, Mahonia repens*. The herbaceous layer tends to be diverse and have moderate to high cover - **Acer negundo / Prunus virginiana Forest (Box-elder / Choke Cherry Forest) [Map Class 80]**



14b Box elder forests and woodlands with a tall-shrub understory dominated by *Rhus trilobata*. Few other shrubs are present with more than trace cover, but the herbaceous layer is well-developed and diverse - **Acer negundo / Rhus trilobata Forest (Box-elder / Threeleaf Sumac Woodland) [Map Class 80]**



15a (10) Riparian or floodplain forests and woodlands with a canopy dominated by *Populus deltoides* ssp. *wislizeni*, occasionally with *Acer negundo* sharing the canopy or forming a subcanopy **(16)**

15b Riparian or floodplain forests and woodlands with a canopy dominated by *Populus angustifolia* or *Populus* x *acuminata* **(19)**

16a (15) Rio Grande cottonwood forests and woodlands with *Acer negundo* and occasionally *Celtis laevigata* ssp. *reticulata* sharing the canopy or forming a subcanopy. The shrub and herbaceous layers vary depending on depth to water table and the amount of disturbance the stand has experienced, but may consist either of mesic or upland species or a mix, or may include perennial exotic species such as *Elymus repens* - **Populus deltoides ssp. wislizeni / Acer negundo Woodland (Rio Grande Cottonwood / Box-elder Woodland) [Map Class 76]**



16b Rio Grande cottonwood forests and woodlands lacking *Acer negundo* or *Celtis laevigata* ssp.

reticulata **(17)**

17a (16) Rio Grande cottonwood forests and woodlands with a well-developed shrub understory dominated by *Rhus trilobata*. *Chrysothamnus linifolius* and *Artemisia tridentata* ssp. *tridentata* may also occur in the shrub stratum. The herbaceous layer is diverse and variable and includes mesic and wetland graminoids and forbs - **Populus deltoides ssp. wislizeni / Rhus trilobata Woodland (Rio Grande Cottonwood / Threeleaf Sumac Woodland) [Map Class 76]**



17b Rio Grande cottonwood forests and woodlands without a shrub understory; the herbaceous layer consists of native grasses or exotic or weedy grasses and forbs **(18)**

18a (17) Rio Grande cottonwood woodlands with an herbaceous layer dominated by the rhizomatous grass *Distichlis spicata*. Stands are usually small, much less than 0.5 hectare - **Populus deltoides (ssp. wislizeni, ssp. monilifera / Distichlis spicata Woodland (Cottonwood / Saltgrass Woodland) [Map Class 76]**





18b Rio Grande cottonwood woodlands with a usually dense herbaceous layer dominated by a mix of the exotic grasses *Bromus tectorum, Poa pratensis*, or *Elymus repens* or the exotic forbs *Lepidium latifolium, Acroptilon repens*, or *Sisymbrium altissimum*. Relict native species may occur scattered throughout stands, including *Hesperostipa comata, Sporobolus cryptandrus, Iva axillaris*, and *Heterotheca villosa*. A sparse subcanopy consisting of scattered *Elaeagnus*

angustifolia, Acer negundo, Juniperus scopulorum, or *Tamarix ramosissima* may be present with a few percent cover. **Populus deltoides (ssp. wislizeni, ssp. monilifera / Disturbed Understory Woodland (Rio Grande Cottonwood / Disturbed Understory Woodland) [Map Class 76]**





19a (15) Lanceleaf or narrowleaf cottonwood woodlands located on middle or high terraces out of the flood zone and with a subcanopy of pinyon and/or juniper and an understory dominated by upland species or *Rhus trilobata* **(20)**

19b Lanceleaf or narrowleaf cottonwood woodlands located in the active floodplain and with a well-developed shrub understory of mesic species, including *Salix exigua* and/or *Betula occidentalis* **(21)**

20a (19) Lanceleaf or narrowleaf cottonwood woodlands located on high terraces out of the flood zone and with an understory dominated by upland species. Juniperus scopulorum occurs consistently in the subcanopy. Scattered shrubs may be present, and the herbaceous layer varies depending on depth to the water table and the degree to which the stand has been disturbed by grazing or camping - **Populus angustifolia / Juniperus scopulorum Woodland (Narrowleaf Cottonwood - Rocky Mountain Juniper Woodland) [Map Class 76]**



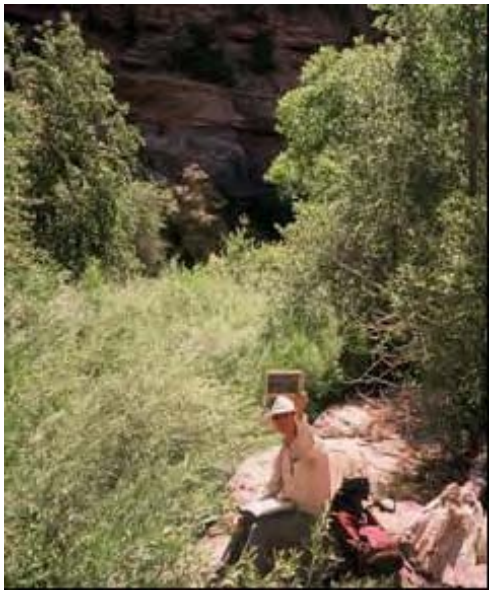
20b Lanceleaf or narrowleaf cottonwood woodlands located on middle terraces and with a subcanopy of scattered *Pinus edulis* and/or *Juniperus osteosperma*. Patchy, dense *Rhus trilobata* dominates the understory, with upland shrub species such as *Artemisia tridentata ssp. tridentata, Ericameria nauseosa,* and *Cercocarpus montanus* growing in the openings between clumps. The herbaceous

is variable and includes both mesic and xeric species such as *Phragmites australis, Bromus tectorum, Maianthemum stellatum, Juncus* spp., *Hesperostipa comata, Equisetum arvense, Eleocharis palustris,* and *Clematis ligusticifolia* – **Populus angustifolia / Rhus trilobata Woodland (Narrowleaf Cottonwood / Threeleaf Sumac Woodland) [Map Class 79]**





21a (19) Lanceleaf or narrowleaf cottonwood woodlands with a high water table and a shrub understory dominated by *Salix exigua. Populus deltoides* ssp. *wislizeni* may be present in the canopy. The herbaceous layer is well-developed and diverse, and may include significant cover by *Equisetum arvense* - **Populus angustifolia / Salix exigua Woodland (Narrowleaf Cottonwood / Coyote Willow Woodland) [Map Class 76]**



21b Lanceleaf or narrowleaf cottonwood woodlands in narrow tributary canyons with a shrub understory dominated by *Betula occidentalis*. These stands have a high water table and a flashy flood regime; other commonly associated species include *Phragmites australis, Equisetum laevigatum, Maianthemum stellatum* and *Agrostis stolonifera* - **Populus angustifolia / Betula occidentalis Woodland (Narrowleaf Cottonwood / Water Birch Woodland) [Map Class 76]**



22a (1) Evergreen forests or woodlands (occasionally shrublands in burned areas) occupying upland habitats, where the canopy dominant is the tree-like tall shrub *Cercocarpus ledifolius*. Individuals of *Pseudotsuga menziesii*, *Pinus edulis*, *Juniperus scopulorum*, *Juniperus osteosperma* or *Pinus ponderosa* may be present, but if any of these species provides more than 10% canopy cover, go to 20b **(23)**

22b Evergreen forests or woodlands, including "pygmy" forests, occupying upland habitats, where the canopy dominants include trees in the genera *Pinus*, *Pseudotsuga*, or *Juniperus*. If *Cercocarpus ledifolius* is present, it is clearly an understory species beneath a canopy (at least 10% cover) of *Pinus ponderosa* or *Pseudotsuga menziesii*, or shares dominance with *Pinus edulis* and/or *Juniperus osteosperma* **(25)**

23a (22) Curl-leaf mountain mahogany woodlands with an understory dominated by herbaceous species. The most common dominant species include *Pseudoroegneria spicata* (has at least 1% cover) and *Petradoria pumila*. The substrate is often calcareous - **Cercocarpus ledifolius / Pseudoroegneria spicata Woodland (Curl-leaf Mountain-mahogany / Bluebunch Wheatgrass Shrubland) [Map Class 22]**



23b Curl-leaf mountain mahogany woodlands with an understory dominated by shrubs such as *Artemisia* or *Prunus virginiana* **(24)**

24a (23) Curl-leaf mountain mahogany woodlands with an understory dominated by *Prunus virginiana*. *Amelanchier* spp. *Mahonia repens, Symphoricarpos oreophilus, Juniperus communis* and *Paxistima myrsinites* are often present. The substrate is generally Uinta Mountain Group quartzite - **Cercocarpus ledifolius / Prunus virginiana Shrubland (Curl-leaf Mountain-mahogany / Chokecherry Shrubland) [Map Class 22]**





24b Curl-leaf mountain mahogany woodlands found at the highest elevations of the park, on rocky soils, with an understory dominated by *Artemisia tridentata ssp. vaseyana* or *Artemisia tridentata ssp. wyomingensis.* Other shrubs present include *Amelanchier alnifolia, Cercocarpus montanus, Ribes cereum, Paxistima myrsinites,* and *Symphoricarpos oreophilus*. The herbaceous layer is variable in cover and commonly includes the graminoids *Poa secunda* and *Achnatherum nelsonii*; and the forbs *Petradoria pumila, Balsamorhiza sagittata,* and *Allium acuminatum* – **Cercocarpus ledifolius / Artemisia tridentata ssp. vaseyana Woodland (Curl-leaf Mountain-mahogany / Mountain Big Sagebrush Woodland) [Map Class 22]**



25a (23) Evergreen forests and woodlands of higher elevations and sheltered high slopes, dominated by the tall tree species *Pinus ponderosa* or *Pseudotsuga menziesii* **(26)**

25b Evergreen forests and woodlands of a variety of habitats, but including low-elevation and hot sites, dominated by the shorter tree species *Pinus edulis, Pinus flexilis, Juniperus scopulorum* and/or *Juniperus osteosperma* **(36)**

26a (25) Evergreen woodlands on level to moderate slopes with a canopy dominated by *Pinus ponderosa*. *Pinus edulis* and/or *Juniperus* spp. may form at least a sparse subcanopy **(27)**

26b Evergreen woodlands usually on steep to very steep slopes with a canopy dominated by *Pseudotsuga menziesii* **(29)**

27a (26) Ponderosa pine woodlands generally with an open to very open canopy; the primary characteristic of stands is exposed bedrock and/or boulders of Uinta Mountain Group, Lodore Formation, Weber sandstone, or Mowry Shale. *Pinus edulis* and *Juniperus* spp. often form a subcanopy in the spaces between ponderosa pine crowns. The understory may include shrubs, grasses, and perennial forbs, but is generally sparse and patchy. In some instances, pine needle litter may obscure the bedrock, but species diversity and cover is controlled by the availability of bedrock cracks – **Pinus ponderosa Rockland Woodland (Ponderosa Pine / Rockland Woodland).** Stands where the subcanopy contains Rocky Mountain Juniper are called **Pinus ponderosa / Juniperus scopulorum Woodland (Ponderosa Pine / Rocky Mountain Juniper Woodland) [Map Class 2]**



27b Ponderosa pine woodlands with a developed understory of grasses, forbs and/or shrubs **(28)**

28a (27) Ponderosa pine woodlands on developed soils of gentle slopes or rolling terrain, often with an open canopy and a shrub understory dominated by low to high cover of *Artemisia tridentata* (either ssp. *wyomingensis* or ssp. *vaseyana*. Other shrubs often present include *Purshia tridentata, Paxistima myrsinites, Mahonia repens* and *Amelanchier* spp. *Pinus edulis* and *Juniperus* spp. are often present in the subcanopy – **Pinus ponderosa / Artemisia tridentata Woodland (Ponderosa Pine / Mountain Big Sagebrush Woodland) [Map Class 2]**



28b Ponderosa pine woodlands on developed soils or on sandstone pavement, with a developed shrub understory dominated by *Cercocarpus ledifolius*. *Pinus edulis* and *Juniperus* spp. are often present in the subcanopy – **Pinus ponderosa / Cercocarpus ledifolius Woodland (Ponderosa Pine / Curl-leaf Mountain-mahogany Woodland) [Map Class 2]**



29a (25) Douglas-fir forests and woodlands with an understory dominated by shrubs **(30)**

29b Douglas-fir forests and woodlands with an understory dominated by grasses **(35)**

30a (29) Douglas-fir forests and woodlands with a tall-shrub understory dominated by species such as *Cercocarpus ledifolius, Cercocarpus montanus* and/or *Amelanchier alnifolia* **(31)**

30b Douglas-fir forests and woodlands with a short-shrub understory dominated by species such as *Symphoricarpos oreophilus, Mahonia repens* and/or *Juniperus communis* **(33)**

31a (30) Douglas-fir forests and woodlands with a mesic tall shrub understory. The dominant tall shrub species include Amelanchier alnifolia and Prunus virginiana. Symphoricarpos oreophilus has low cover relative to the tall shrubs, and Paxistima myrsinites and Mahonia repens are common short-shrub species. These stands occupy the most sheltered sites on north-facing slopes and benches - **Pseudotsuga menziesii / Amelanchier alnifolia Forest (Douglas-fir / Saskatoon Serviceberry**

Forest) [Map Class 1]



31b Douglas-fir forest and woodlands with an understory dominated by *Cercocarpus* spp. **(32)**

32a (31) Douglas-fir forests and woodlands occurring in a mosaic with *Cercocarpus ledifolius* woodlands, in areas where *Pseudotsuga menziesii* trees provide more than 10% canopy cover. The cover of *Cercocarpus ledifolius* is generally higher than that of Douglas-fir, except in stands where tree canopy closure has shaded out some of the mountain mahogany - **Pseudotsuga menziesii / Cercocarpus ledifolius Woodland (Douglas-fir / Curl-leaf Mountain-mahogany Woodland) [Map Class 1]**



32b Douglas-fir forests and woodlands occurring on the steep, rocky upper slopes of canyon walls with an understory dominated by *Cercocarpus montanus*. Other shrub species present may include *Amelanchier* spp., *Cercocarpus intricatus, Philadelphus microphyllus, Symphoricarpos oreophilus,* and occasionally more mesic shrubs such as *Prunus virginiana.* A subcanopy of scattered *Juniperus osteosperma* and *Pinus edulis* trees may be present with nearly as much cover as Douglas-fir. The herbaceous layer is generally dominated by *Poa fendleriana* – **Pseudotsuga menziesii / Cercocarpus montanus Woodland (Douglas-fir / Mountain-mahogany Woodland) [Map Class 1]**



33a (30) Dry Douglas-fir forests and woodlands with a short shrub understory dominated by *Juniperus communis* or *Mahonia repens* **(34)**

33b Mesic Douglas-fir forests and woodlands with a short shrub understory dominated by *Symphoricarpos oreophilus*. The cover of snowberry often exceeds 10%, but may be less than 5% in stands with a generally sparse understory. Taller shrubs such as *Prunus virginiana, Artemisia tridentata* ssp. *vaseyana* and *Amelanchier* spp. do not have enough cover to form a stratum, although they are often present. The herbaceous layer is usually well-developed, with a diversity of both grasses and forbs present - **Pseudotsuga menziesii / Symphoricarpos oreophilus Forest (Douglasfir / Mountain Snowberry Forest) [Map Class 1]**



34a (33) Dry Douglas-fir forests and woodlands with a sparse understory in which the short shrub *Juniperus communis* is conspicuous. *Mahonia repens* may be present in trace amounts - **Pseudotsuga menziesii / Juniperus communis Forest (Douglas-fir / Common Juniper Forest) [Map Class 1]**



34b Mesic Douglas-fir forests and woodlands with a short shrub understory dominated by *Mahonia repens. Juniperus communis* and *Amelanchier* spp. are absent, although *Prunus virginiana* may have significant cover - **Pseudotsuga menziesii / Mahonia repens Woodland (Douglas-fir / Creeping Oregon-grape Forest) [Map Class 1]**



35a (29) Douglas-fir woodlands found steep sheltered or north-facing slopes of upper canyon walls, with an understory dominated by the grass *Poa fendleriana. Pseudoroegneria spicata* is absent. *Pinus ponderosa* may be present with up to 1/3 the cover of Douglas-fir, and scattered *Pinus edulis* and/or *Juniperus osteosperma* may form a subcanopy. Scattered *Cercocarpus intricatus* shrubs may be present - **Pseudotsuga menziesii / Poa fendleriana Woodland (Douglas-fir / Muttongrass Woodland) [Map Class 1]**



35b Douglas-fir woodlands found steep sheltered or north-facing slopes of canyon walls, with an herbaceous understory dominated by *Pseudoroegneria spicata*, often with *Poa fendleriana* as a codominant. Shrubs are present but do not constitute a layer; common species include *Symphoricarpos oreophilus* and *Artemisia tridentata ssp. vaseyana*. Scattered *Pinus edulis* and *Juniperus osteosperma* are present in the subcanopy – **Pseudotsuga menziesii / Pseudoroegneria spicata Woodland (Douglas-fir / Bluebunch Wheatgrass Woodland) [Map Class 1]**

[NO PHOTO AVAILABLE]

36a (25) Evergreen woodlands dominated by *Pinus flexilis*, with an understory dominated by the shrub *Juniperus communis* - **Pinus flexilis / Juniperus communis Woodland (Limber Pine / Common Juniper Woodland) [Map Class 3]**



36b Evergreen woodlands of various elevations, substrates and aspects, dominated by a combination of any of these species: *Pinus edulis, Juniperus scopulorum*, and/or *Juniperus osteosperma* **(37)**

37a (36) Evergreen woodlands in uplands or riparian zones with a canopy dominated by *Juniperus scopulorum* **(38)**

37b Evergreen woodlands in upland settings with a canopy dominated by *Juniperus osteosperma*,

with or without *Pinus edulis* **(39)**

38a (37) Open upland stands of Rocky Mountain juniper woodlands with a well-developed shrub understory dominated by either *Artemisia tridentata ssp. wyomingensis* or *ssp. vaseyana*. *Amelanchier utahensis* may be present; other shrubs present may also include *Symphoricarpos oreophilus, Cercocarpus montanus, Prunus virginiana, Purshia tridentata, Mahonia repens,* and *Paxistima myrsinites*. Herbaceous species present may include *Poa fendleriana, Hesperostipa comata, Achnatherum lettermanii, Koeleria macrantha, Carex rossii,* and *Eriogonum umbellatum* - **Juniperus scopulorum / Artemisia tridentata Woodland (Rocky Mountain Juniper / Basin Big Sagebrush Woodland) [Map Class 20]**



38b Stands of Rocky Mountain juniper woodlands located in valley bottoms, floodplains, high terraces or alluvial fans. The canopy often includes deciduous riparian species such as *Acer negundo* or *Populus* spp. The understory is variable, depending on elevation above the water table and degree of disturbance, but often has diverse, well-developed shrub and herbaceous layers consisting of both riparian and upland species - **Juniperus scopulorum Temporarily Flooded Woodland Alliance (Rocky Mountain Juniper Temporarily Flooded Woodland Alliance) [Map Class 19]**



39a (38) Juniper or pinyon-juniper woodlands with a sparse understory (less than 5% total cover in the shrub and herbaceous layers) or an understory with a predominantly herbaceous understory

(grasses and/or forbs). If shrubs are present, they generally provide less than 5% cover **(40)**

39b Juniper or pinyon-juniper woodlands with an understory dominated by shrubs (generally with more than 5% cover). A well-developed herbaceous layer may or may not be present **(50)**

40a (37) Juniper or pinyon-juniper woodlands with a sparse understory (less than 5% total cover in the shrub and herbaceous layers) **(41)**

40b Juniper or pinyon-juniper woodlands with a predominantly herbaceous understory. If shrubs are present, they generally provide less than 5% cover **(42)**

41a (40) Juniper woodlands with a sparse understory. *Pinus edulis* is usually absent, or rarely has a few percent cover. Soils tend to have low water-holding capacity (e.g. shale, eolian sand) and/or the stands occur at lower elevations within the monument (below 1800 meters). Biological soil crusts may cover a high percentage of the ground - **Juniperus osteosperma / Sparse Understory Woodland (Utah Juniper / Sparse Understory Woodland) [Map Classes 8 and 13]**



41b Woodlands with a sparse understory and a canopy that includes at least 5% cover of both *Pinus edulis* and *Juniperus osteosperma*. If other tree canopy species are present, they have less than 5% cover. Stands tend to be located on rocky, colluvial slopes, on exposed bedrock, in eolian sands, or a closed canopy that has shaded out understory shrubs and herbaceous species - **Pinus edulis -Juniperus osteosperma / Sparse Understory Woodland (Two-needle Pinyon - Utah Juniper / Sparse Understory Woodland) [Map Classes 8 and 13]**



42a (40) Juniper or pinyon-juniper woodlands with a predominantly herbaceous understory dominated by *Leymus salinus* **(43)**

42b Juniper or pinyon-juniper woodlands with a predominantly herbaceous understory dominated by other forbs or grasses, including *Pseudoroegneria, Poa, Bromus, Pleuraphis, Petradoria* or *Hesperostipa* **(44)**

43a Woodland with an herbaceous understory dominated by *Leymus salinus* and with a canopy containing significant cover by both *Pinus edulis* and *Juniperus osteosperma.* Sites tend to be on rocky slopes, sometimes overlying shale substrates - **Pinus edulis - Juniperus osteosperma / Leymus salinus Woodland (Two-needle Pinyon - Juniper / Salinas Lyme Grass Woodland) [Map Class 10]**



43b Juniper woodlands with an herbaceous understory dominated by *Leymus salinus.* If *Pinus edulis* is present, it is with trace cover. Sites tend to be on shale substrates - **Juniperus osteosperma / Leymus salinus Woodland (Utah Juniper / Salinas Lyme Grass Woodland) [Map Class 10]**



44a (42) Juniper or pinyon-juniper woodlands with a predominantly herbaceous understory dominated by *Pseudoroegneria spicata* and sometimes co-dominated by *Poa secunda or Koeleria macrantha,* with or without low-growing cushion forbs such as *Stenotus, Phlox,* and *Petradoria*. *Hesperostipa comata* or *Pleuraphis jamesii* are often present, but with less cover **(45)**

44b Juniper or pinyon-juniper woodlands with a predominantly herbaceous understory dominated by other forbs or grasses, including *Hesperostipa, Poa, Bromus, Petradoria* or *Pleuraphis* (46)

45a (44) Juniper woodlands with a mostly herbaceous understory dominated by *Pseudoroegneria spicata*. If *Pinus edulis* is present, it is with trace cover. Other species occurring commonly in the understory include *Pleuraphis jamesii* or *Leptodactylon pungens*. The substrate is variable - **Juniperus osteosperma / Pseudoroegneria spicata Woodland (Utah Juniper / Bluebunch Wheatgrass Woodland) [Map Class 10]**



45b Pinyon-juniper woodlands with a diverse, sometimes sparse, mostly herbaceous understory dominated by *Pseudoroegneria spicata*. Other herbaceous species that are nearly always present include *Poa secunda, Poa fendleriana, Achnatherum hymenoides, Koeleria macrantha* and the "cushion plants" *Stenotus acaulis, Phlox hoodii, Petradoria pumila*, and *Phlox multiflora*. *Artemisia nova* may be present with less than 5% cover. The substrate is nearly always derived from limestone, including Madison Limestone, Round Valley Limestone, the limestone unit of

the Park City Formation and the Bishop Conglomerate - **Pinus edulis - Juniperus osteosperma / Pseudoroegneria spicata - Cushion Plant Woodland (Two-needle Pinyon - Utah Juniper / Bluebunch Wheatgrass - Cushion Plant Woodland) [Map Class 10]**



46a (44) Juniper or less often, pinyon-juniper woodlands with an herbaceous understory dominated by *Hesperostipa comata* - **Juniperus osteosperma / Hesperostipa comata Woodland (Utah Juniper / Needle-and-Thread Woodland) [Map Class 10]**



46b Juniper or pinyon-juniper woodlands with a predominantly herbaceous understory dominated by other forbs or grasses, including *Bromus, Poa, Petradoria* or *Pleuraphis* **(47)**

47a (46) Juniper or (rarely) pinyon-juniper woodlands with an herbaceous understory dominated by *Bromus tectorum*. Native bunchgrasses may be present with low cover, and there may be a well-developed biological soil crust - **Juniperus osteosperma / Bromus tectorum Semi-natural Woodland (Utah Juniper / Cheatgrass Semi-natural Woodland) [Map Class 10]**



47b Juniper or pinyon-juniper woodlands with a predominantly herbaceous understory dominated by other forbs or grasses, including *Poa, Petradoria* or *Pleuraphis* **(48)**

48a (47) Pinyon-juniper woodlands with an herbaceous understory clearly dominated by *Petradoria pumila*. "Cushion" species such as *Phlox, Pseudoroegneria, Poa secunda* or *Stenotus* may only have very low cover. The substrate is usually sandstone, but occasionally may be limestone - **Pinus edulis -Juniperus osteosperma / Petradoria pumila Woodland (Two-needle Pinyon - Utah Juniper / Grassy Rock-goldenrod Woodland) [Map Class 10]**



48b Juniper or pinyon-juniper woodlands with a predominantly herbaceous understory dominated by the grasses, *Poa fendleriana* or *Pleuraphis jamesii* **(49)**

49a (48) Juniper or (rarely) pinyon-juniper woodlands with an herbaceous understory dominated by *Pleuraphis jamesii*. These stands are usually at lower elevations within the monument, and if other grass species are present, it is with less cover than that of *Pleuraphis* - **Juniperus osteosperma / Pleuraphis jamesii Woodland (Utah Juniper / James' Galleta Woodland) [Map Class 10]**



49b Pinyon-juniper woodlands with an herbaceous understory dominated by *Poa fendleriana* - **Pinus edulis - Juniperus spp. / Poa fendleriana Woodland (Two-needle Pinyon - Juniper / Muttongrass Woodland) [Map Class 10]**



50a (39) Juniper or pinyon-juniper woodlands with a shrub understory dominated by one of the subspecies of *Artemisia tridentata* (ssp. *tridentata*, ssp. *vaseyana*, or ssp. *wyomingensis*. *Grayia spinosa* may be present to codominant in the understory **(51)**

50b Juniper or pinyon-juniper woodlands with an understory dominated by other species of shrubs, including *Cercocarpus, Amelanchier, Artemisia nova, Glossopetalon, Ephedra* or *Purshia* **(54)**

51a (50) Juniper woodlands on sandy toe slopes at the base of canyon walls with a mix of *Grayia spinosa* and either *Artemisia tridentata ssp. tridentata* (on sandy toe slopes) or *Artemisia tridentata ssp. wyomingensis* (on rocky canyon walls). Other shrubs are present with only a few percent cover; *Chrysothamnus viscidiflorus, Ephedra viridis, Philadelphus microphyllus, Opuntia polyacantha*,

and *Rhus trilobata.* The herbaceous later is generally well developed and is dominated by Bromus tectorum, with *Hesperostipa comata* and *Achnatherum hymenoides* being the most consistent native grasses – **Juniperus osteosperma / Artemisia tridentata – Grayia spinosa Woodland (Utah Juniper / Big Sagebrush - Spiny Hopsage Woodland) [Map Class 19]**





51b Juniper or pinyon-juniper woodlands with an understory dominated by *Artemisia tridentata* (ssp. *tridentata*, ssp. *vaseyana*, or ssp. *wyomingensis* and no significant component of *Grayia spinosa* **(52)**

52a (51) Juniper woodlands in small dry ravines with an understory of *Artemisia tridentata* ssp. *tridentata*. Most stands of this type are on the floors of small side canyons where trees from the canyon wall have invaded the basin big sagebrush community on the canyon floor. The herbaceous layer ranges from sparse to dense, but *Bromus tectorum* is often dominant - **Juniperus osteosperma / Artemisia tridentata ssp. tridentata Woodland (Utah Juniper / Basin Big Sagebrush Woodland) [Map Class 19]**



52b Juniper or pinyon-juniper woodlands located in upland situations with shrub understories dominated by *Artemisia tridentata* ssp. vaseyana or ssp. *wyomingensis* **(53)**

53a (52) Open-canopied juniper woodlands (*Pinus edulis* is absent from the canopy) of low elevations and/or soils with poor water-holding capacity and with a shrub understory dominated by *Artemisia tridentata* ssp. *wyomingensis*. The herbaceous layer may be sparse or well-developed - **Juniperus osteosperma / Artemisia tridentata ssp. wyomingensis Woodland (Utah Juniper / Wyoming Big Sagebrush Woodland) [Map Class 16]**



53b Pinyon-juniper woodlands of higher elevations or rocky sites; the shrub layer is dominated by either *Artemisia tridentata* ssp. *vaseyana* or ssp. *wyomingensis* - **Pinus edulis - Juniperus spp. / Artemisia tridentata (ssp. wyomingensis, ssp. vaseyana Woodland (Two-needle Pinyon - Juniper / Big Sagebrush Woodland) [Map Class 16]**



54a (50) Juniper or pinyon-juniper woodlands with a shrub understory dominated by species of *Cercocarpus* (e.g., *intricatus, ledifolius, montanus*) **(55)**

54b Juniper or pinyon-juniper woodlands with an understory dominated by other species of shrubs, including *Amelanchier, Artemisia nova, Ephedra, Glossopetalon* or *Purshia* **(58)**

55a (54) Woodlands at high elevations (above 2000 meters) where the canopy is co-dominated by *Pinus edulis, Juniperus osteosperma* and *Cercocarpus ledifolius*, or *Cercocarpus ledifolius* forms a shrub understory beneath a pinyon-juniper canopy. Other common shrub elements include *Artemisia tridentata* ssp. *wyomingensis*, and the herbaceous layer is usually well-developed and diverse - **Pinus edulis - Juniperus osteosperma / Cercocarpus ledifolius Woodland (Two-needle Pinyon - Utah Juniper / Curl-leaf Mountain-mahogany Woodland) [Map Class 17]**



55b Juniper or pinyon-juniper woodlands across a range of elevations with either *Cercocarpus intricatus* or *Cercocarpus montanus* as the dominant understory shrub **(56)**

56a (55) Open to moderately-closed canopy pinyon-juniper woodlands on fractured sandstone outcrops with a shrub understory dominated by *Cercocarpus intricatus*. Total shrub cover may be 10% or less. Other commonly occurring shrubs (some may be co-dominant with *Cercocarpus intricatus*) include *Glossopetalon spinescens* var. *meionandrum, Fendlerella utahensis, Ephedra viridis* and *Amelanchier utahensis*. Plants tend to be rooted in cracks in the bedrock, which is well-exposed - **Pinus edulis - Juniperus osteosperma / Cercocarpus intricatus Woodland (Two-needle Pinyon - Utah Juniper / Littleleaf Mountain-mahogany Woodland) [Map Class 14]**



56b Juniper or pinyon-juniper woodlands on varied substrates with an understory dominated by *Cercocarpus montanus*, although a mix of shrubs may occur with the mountain mahogany **(57)**

57a (56) Juniper woodlands (*Pinus edulis* is absent or has trace cover only) with an understory dominated by *Cercocarpus montanus*. Substrates are variable, including both shale and sandstone, but the vegetation is generally open and bedrock may be well-exposed. Associated shrubs vary on shale sandstone substrates, but include *Artemisia tridentata, Amelanchier utahensis, Ephedra viridis, Symphoricarpos oreophilus,* or *Atriplex canescens* - **Juniperus osteosperma / Cercocarpus montanus Woodland (Utah Juniper / Mountain-mahogany Woodland) [Map Class 9]**



57b Pinyon-juniper woodlands, usually at higher elevations than the last, with an understory of mixed mountain shrubs among which *Cercocarpus montanus* is conspicuous and often dominant. Other shrubs (sometimes co-dominant) include *Amelanchier utahensis, Symphoricarpos oreophilus, Ephedra viridis* or *Artemisia tridentata*. If *Cercocarpus intricatus* is present it is with no more than 1% cover. The herbaceous layer is variable, but is often well-developed - **Pinus edulis - Juniperus spp. / Cercocarpus montanus - Mixed Shrubs Woodland (Two-needle Pinyon - Juniper / Mountain-mahogany - Mixed Shrubs Woodland) [Map Class 9]**



58a (54) Juniper or pinyon-juniper woodlands with an understory dominated by *Artemisia nova* **(59)**

58b Pinyon-juniper woodlands with an understory dominated by *Amelanchier, Glossopetalon, Ephedra* or *Purshia* **(60)**

59a (58) Juniper woodlands on various substrates; if *Pinus edulis* is present, it is with trace cover. The understory is dominated by *Artemisia nova*. Other shrubs present include *Cercocarpus montanus* or *Amelanchier tridentata*. The herbaceous layer is generally diverse, but total cover is usually less than 10% - **Juniperus osteosperma / Artemisia nova Woodland (Utah Juniper / Black Sagebrush Woodland) [Map Class 15]**



59b Woodlands on limestone or Glen Canyon sandstone substrates whose canopy contains both *Juniperus osteosperma* and *Pinus edulis* and where the understory is dominated by a sparse to moderately dense cover of *Artemisia nova*. Cushion plant community elements are often present (e.g., *Pseudoroegneria spicata, Poa secunda, Phlox* spp., *Stenotus acaulis, Petradoria pumila*) - **Pinus edulis - Juniperus osteosperma / Artemisia nova Woodland (Two-needle Pinyon - Utah Juniper / Black Sagebrush Woodland) [Map Class 15]**



60a (58) Pinyon-juniper woodlands on thin soils over limestone or sandstone bedrock, with an understory dominated by the shrub *Purshia tridentata*. *Artemisia nova* is nearly always present and may be codominant - **Pinus edulis - Juniperus osteosperma / Purshia tridentata Woodland (Two-needle Pinyon - Utah Juniper/ Antelope Bitterbrush Woodland) [Map Class 15]**



60b Juniper or pinyon-juniper woodlands on steep, rocky slopes or on Mowry shale with an understory dominated by *Amelanchier, Glossopetalon,* or *Ephedra* **(61)**

61a (60) Pinyon-juniper woodlands on steep, rocky slopes or on Mowry shale, with an understory dominated by *Amelanchier utahensis*. Other shrubs and herbaceous species vary, as does the total cover, which ranges from sparse on Mowry Shale to moderately dense on north-facing colluvial slopes - **Pinus edulis - Juniperus osteosperma / Amelanchier utahensis Woodland (Two-needle Pinyon - Utah Juniper / Utah Serviceberry Woodland) [Map Class 9]**





61b Juniper or pinyon-juniper woodlands on steep, loose, shifting colluvium derived from limestones and sandstones of the Weber, Morgan, Round Valley and Madison formations. The understory is dominated by *Ephedra viridis* and/or *Glossopetalon spinescens var. meionandrum* **(62)**

62a (61) Sparse pinyon-juniper woodlands with an usually sparse understory dominated by *Ephedra viridis,* usually with few other shrubs present except for occasional *Fraxinus anomala, Atriplex* spp., or *Cercocarpus intricatus*. 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 herbaceous layer is sparse and poorly developed because of the active slopes, but a few stands have as much as 10% cover by grasses such as *Pleuraphis jamesii, Koeleria macrantha, Achnatherum hymenoides, Pseudoroegneria spicata,* and *Poa secunda* – **Pinus edulis – Juniperus osteosperma / Ephedra viridis Woodland (Two-needle Pinyon - Utah Juniper / Mormon-tea Woodland) [Map Class 11]**





62b Sparse juniper woodlands (scattered *Pinus edulis* may be present) with an understory dominated by a mix of *Glossopetalon spinescens var. meionandrum* and *Ephedra viridis*, as well as a minor component of *Amelanchier utahensis, Brickellia microphylla, Cercocarpus intricatus, Gutierrezia sarothrae, Eriogonum corymbosum,* and *Fraxinus anomala.* Trees are stunted and vegetation is rooted in bedrock cracks with a thin layer of active colluvium over the surface – **Juniperus osteosperma / Glossopetalon spinescens Woodland (Utah Juniper / Spiny Greasebush Woodland) [Map Class 11]**





Key III: Shrubland Associations of Dinosaur National Monument

1a Tall or short shrublands occupying wetlands, riparian areas, floodplains, canyon floors, alcoves, or other habitats that are either wet or periodically flooded, including the dry streambeds of arroyos. Characteristic genera include *Betula, Rhus, Ericameria, Salix,* and *Tamarix* **(2)**

1b Tall, short, or dwarf-shrublands occupying upland habitats or dry, high terraces in the broad valleys of the major rivers. Characteristic genera include *Arctostaphylos, Amelanchier, Artemisia, Atriplex, Ceanothus, Cercocarpus, Chrysothamnus, Ephedra, Ericameria, Eriogonum, Grayia, Krascheninnikovia, Philadelphus, Prunus, Sarcobatus,* or *Tetradymia* **(10)**

2a (1) Tall shrublands dominated by the exotic species *Tamarix ramosissima*. Native deciduous tree species such as *Acer negundo* or *Populus deltoides* ssp. *wislizeni* may form a minor emergent component of the canopy. The understory density and composition depends on the degree of canopy closure; more closed shrublands have less understory cover - **Tamarix spp. Temporarily Flooded Shrubland (Saltcedar Semi-natural Shrubland) [Map Classes 80 and 85]**





2b Tall or short shrublands in wetlands or dry washes, dominated by broadleaf mesic or wetland species, including *Salix* spp., *Rhus trilobata, Betula occidentalis,* or *Ericameria nauseosa* **(3)**

3a (2) Tall shrublands dominated by one or more species of *Salix* **(4)**

3b Tall or short shrublands dominated by species other than *Salix* **(7)**

4a (3) Tall shrublands in wet meadows, less often on the banks of tributary streams, dominated by a mix of willows, including *Salix monticola*. The understory is generally dense and diverse, of both forbs and graminoids (including Equisetum), but graminoids usually dominate -**Salix monticola / Mesic Graminoids Shrubland (Mountain Willow / Mesic Graminoids Shrubland) [Map Class 95]**

[NO PHOTO AVAILABLE]

4b Tall shrublands on the banks of the main rivers and some of the larger perennial tributaries, dominated by sandbar willow **(5)**

5a (4) Coyote willow shrublands with a sparse or poorly developed understory due to the frequency and severity of flooding; usually on the lowest stream terraces - **Salix exigua / Barren Shrubland (Coyote Willow / Barren Shrubland) [Map Class 95]**



5b Coyote willow shrublands with a dense herbaceous understory **(6)**

6a (5) Coyote willow shrublands with an herbaceous understory dominated by graminoids such as *Elymus repens, Agrostis stolonifera, Phalaris arundinacea, Phragmites australis* and/or *Equisetum* spp. - **Salix exigua / Mesic Graminoids Shrubland (Coyote Willow / Mesic Graminoids Shrubland) [Map Class 95]**



6b Coyote willow shrublands with an herbaceous understory dominated by mesic forbs such as *Glycyrrhiza lepidota, Apocynum cannabinum, Euthamia occidentalis,* and *Asclepias speciosa* - **Salix exigua / Mesic Forbs Shrubland (Coyote Willow / Mesic Forbs Shrubland) [Map Class 95]**



7a (3) Sparse short shrubland occupying the braided, sandy or gravelly beds of intermittent tributary streams; shrubs are mixed but rubber rabbitbrush is generally conspicuous - **Ericameria nauseosa Desert Wash Shrubland (Rubber Rabbitbrush Desert Wash Shrubland) [Map Class 31]**



7b Tall or short shrublands on the banks of perennial streams or rivers **(8)**

8a (7) Tall shrublands on middle to upper stream terraces dominated by threeleaf sumac. Some stands may be impenetrably dense and almost a monoculture of sumac, others may be mixed with other mesic shrubs such as *Salix exigua* - **Rhus trilobata Intermittently Flooded Shrubland (Threeleaf Sumac Intermittently Flooded Shrubland) [Map Class 92]**



8b Tall shrublands in tributary canyons dominated by *Betula occidentalis* **(9)**

9a (8) Water birch-dominated shrublands with a high water table and an understory dominated by mesic graminoids, including scouring rush (*Equisetum* spp.) - **Betula occidentalis / Mesic Graminoids Shrubland (Water Birch / Mesic Graminoids Shrubland) [Map Class 79]**



9b Water birch-dominated shrublands with a moderately high water table and an understory that is not well developed or which lacks diagnostic species - **Betula occidentalis Shrubland (Water Birch Shrubland) [Map Class 79]**



10a (1) Short shrublands occurring at high elevations (above 2300 meters) on the ridges of Zenobia Peak, sometimes in areas recovering from fire, and dominated by *Ceanothus velutinus*. Minor associates may include Symp*horicarpos oreophilus, Cercocarpus ledifolius* or *Prunus virginiana* - **Ceanothus velutinus Shrubland (Tobaccobrush Shrubland) [Map Class 54]**



10b Short or tall shrublands in a variety of situations and elevations. Characteristic genera include *Arctostaphylos, Amelanchier, Artemisia, Atriplex, Cercocarpus, Chrysothamnus, Ephedra, Ericameria, Eriogonum, Grayia, Krascheninnikovia, Philadelphus, Prunus, Sarcobatus,* or *Tetradymia* **(11)**

11a (10) *Prunus virginiana*-dominated shrublands occurring in small upland seepage areas, in areas where snow collects in the lee of ridges, or less often on the margins of rock fields or the rocky banks of rivers. Some stands are in burned areas, as chokecherry readily re-sprouts following fire. Minor shrubs present may include *Sambucus, Rosa woodsii, Rhus trilobata* and *Amelanchier alnifolia* - **Prunus virginiana - (Prunus americana Shrubland (Chokecherry - (American Plum) Shrubland) [Map Class 54]**



11b Short or tall shrublands in a variety of situations. Characteristic genera include *Arctostaphylos, Amelanchier, Artemisia, Atriplex, Cercocarpus, Chrysothamnus, Ephedra, Ericameria, Eriogonum, Grayia, Krascheninnikovia, Philadelphus, Sarcobatus* or *Tetradymia* **(12)**

12a (11) Short, usually dense shrublands on exposed ledges on the south rim of the Yampa Plateau, dominated by *Arctostaphylos patula*, usually with a conspicuous component of *Artemisia tridentata* ssp. *vaseyana* or *Artemisia tridentata* ssp. *wyomingensis* - **Arctostaphylos patula - Artemisia tridentata (ssp. vaseyana, ssp. wyomingensis) Shrubland (Greenleaf Manzanita - (Big Sagebrush) Shrubland) [Map Class 56]**



12b Short or tall shrublands in a variety of situations and elevations. Characteristic genera include *Artemisia, Amelanchier, Atriplex, Cercocarpus, Chrysothamnus, Ephedra, Ericameria, Eriogonum, Grayia, Krascheninnikovia, Philadelphus, Sarcobatus, or Tetradymia* **(13)**

13a (12) Dwarf, somewhat sparse shrublands on shale substrates at low elevations (below 2000 meters) dominated by *Artemisia arbuscula* ssp. *longiloba*. There is usually a significant grass understory (greater than 5% cover) consisting of *Pseudoroegneria spicata, Elymus lanceolatus* and/or *Hesperostipa comata* - **Artemisia arbuscula ssp. longiloba / Pseudoroegneria spicata Shrub Herbaceous Vegetation (Alkali Sagebrush / Streamside Wild Rye Herbaceous Vegetation) [Map Class 31]**



13b Short or tall shrublands in a variety of situations and elevations. Characteristic genera include *Artemisia* (other than *arbuscula*), *Amelanchier, Atriplex, Cercocarpus, Chrysothamnus, Ephedra, Ericameria, Eriogonum, Grayia, Krascheninnikovia, Philadelphus, Sarcobatus* or *Tetradymia* **(14)**

14a (13) Short shrublands in the valley of the Green River below Split Mountain occurring as inclusions within the general sagebrush landscape, with a shrub canopy dominated by *Tetradymia canescens* with a sparse understory monopolized by *Opuntia fragilis* -**Tetradymia canescens Shrubland (Gray Horsebrush Shrubland) [Map Class 31]**



14b Short or tall shrublands in a variety of situations and elevations. Characteristic genera include *Artemisia, Amelanchier, Atriplex, Cercocarpus, Chrysothamnus, Ephedra, Ericameria, Eriogonum, Grayia, Krascheninnikovia, Philadelphus,* or *Sarcobatus* **(15)**

15a (14) Sparse shrublands or shrub-herbaceous communities on colluvial slopes at moderate elevations (1800-2200 meters), or at low elevations near the Dinosaur Quarry on Mowry Shale and dominated by *Eriogonum corymbosum* and *Gutierrezia sarothrae* with a healthy understory of bunchgrasses, including *Pseudoroegneria spicata* and *Hesperostipa comata* - **Eriogonum corymbosum Dwarfshrubland Alliance (Wild Buckwheat Dwarf Shrubland Alliance) [Map Class 44]**



15b Short or tall shrublands in a variety of situations and elevations. Characteristic genera include *Artemisia, Amelanchier, Atriplex, Cercocarpus, Chrysothamnus, Ephedra, Ericameria, Grayia, Krascheninnikovia, Philadelphus,* or *Sarcobatus* **(16)**

16a (15) Mixed shrublands on north-facing colluvial slopes of the Yampa River Canyon, in which *Philadelphus microphyllus, Ephedra viridis, Chrysothamnus viscidiflorus* and *Artemisia tridentata* ssp. *wyomingensis*. The herbaceous understory is likewise mixed, but may have high cover by moss and by *Bromus tectorum* - **Philadelphus microphyllus - Ephedra viridis Shrubland (Littleleaf Mock Orange - Mormon-tea Shrubland) [Map Class 53]**



16b Short or tall shrublands in a variety of situations and elevations. Characteristic genera include *Artemisia, Amelanchier, Atriplex, Cercocarpus, Chrysothamnus, Ephedra, Ericameria, Grayia, Krascheninnikovia,* or *Sarcobatus* **(17)**

17a (16) Mixed shrublands on sandy and gravelly benches, slopes and terraces in the Browns Park Formation, with a canopy characterized by a mix of *Grayia spinosa, Sarcobatus vermiculatus* and *Artemisia tridentata ssp. wyomingensis*. Not every stand will have all three shrub species, but stands with spiny hopsage will belong to this association. *Atriplex confertifolia* may be a minor component of the community. The herbaceous element usually includes *Achnatherum hymenoides,* although depending on the degree of grazing, *Hesperostipa comata* or *Bromus*

tectorum may be more abundant - **Grayia spinosa / Achnatherum hymenoides Shrubland (Spiny Hopsage / Indian Ricegrass Shrubland) [Map Class 47]**



17b Short or tall shrublands in a variety of situations and elevations. Characteristic genera include *Artemisia, Amelanchier, Atriplex, Cercocarpus, Chrysothamnus, Ephedra, Ericameria, Krascheninnikovia* or *Sarcobatus* **(18)**

18a (17) Shrublands characterized by species of *Artemisia* (e.g., *nova, tridentata*) **(19)**

18b Shrublands characterized by species of *Amelanchier, Atriplex, Cercocarpus, Chrysothamnus, Ericameria, Ephedra, Krascheninnikovia* or *Sarcobatus* **(43)**

19a (18) Short shrublands characterized by *Artemisia nova.* Although *Artemisia tridentata* ssp. *wyomingensis* or ssp. *vaseyana* may be present, they constitute less than a third of the total shrub cover **(20)**

19b Short or tall shrublands characterized by *Artemisia tridentata* ssp. *tridentata, Artemisia tridentata* ssp. *vaseyana* or *Artemisia tridentata* ssp. *wyomingensis*, or hybrids of these subspecies, or sometimes a combination of these subspecies **(21)**

20a (19) Sparse to moderately dense black sagebrush shrublands, typically on limestone, with *Pseudoroegneria spicata* as a conspicuous element of the herbaceous layer, often with a minor element of *Eriogonum microthecum*. Other herbaceous species present often include *Poa secunda, Koeleria macrantha, Phlox* spp., *Stenotus acaulis, Eriogonum umbellatum* and *Leptodactylon pungens* - **Artemisia nova / Pseudoroegneria spicata Shrubland (Black Sagebrush / Bluebunch Wheatgrass Shrubland) [Map Class 40]**



20b Sparse to open black sagebrush shrublands on a variety of substrates (including shale barrens), where the shrub canopy is mixed with other species such as *Atriplex confertifolia* or *Cercocarpus montanus*, or the understory lacks a diagnostic species -**Artemisia nova Shrubland (Black Sagebrush Shrubland) [Map Class 40]**



21a (19) Tall shrublands of *Artemisia tridentata* ssp. *tridentata* or sometimes mixed with lesser cover of *Artemisia tridentata* ssp. *wyomingensis*, occupying swales, riparian terraces, valley floors or drainage bottoms. If *Sarcobatus vermiculatus* occupies 1/3 or more of the shrub canopy, go to couplet 70 **(22)**

21b Short shrublands of *Artemisia tridentata* ssp. *vaseyana*, *Artemisia tridentata* ssp. *wyomingensis* or a hybrid of the two subspecies **(25)**

22a (21) *Artemisia tridentata* ssp. *tridentata* shrublands, often with a component of *Ericameria nauseosa* or *Chrysothamnus viscidiflorus*, and an understory overwhelmingly dominated by *Bromus tectorum*. Occasionally, shrubs such as *Grayia spinosa* or *Sarcobatus vermiculatus* may be present with less than 5% cover. If native bunchgrasses are present, they constitute less than 30% of the herbaceous cover -**Artemisia tridentata - (Ericameria nauseosa) / Bromus tectorum Semi-natural Shrubland (Basin Big Sagebrush - (Rubber Rabbitbrush) / Cheatgrass Semi-natural Shrubland) [Map Class 37]**



22b *Artemisia tridentata* ssp. *tridentata* shrublands with an understory dominated by native species **(23)**

23a (22) *Artemisia tridentata* ssp. *tridentata* shrublands with an understory dominated by *Sporobolus airoides*, usually with few other species present - **Artemisia tridentata ssp. tridentata / Sporobolus airoides Shrubland (Basin Big Sagebrush / Alkali Sacaton Shrubland) [Map Class 37]**



23b *Artemisia tridentata* ssp. *tridentata* shrublands with an understory dominated by *Hesperostipa comata* or *Leymus cinereus* **(24)**

24a (23) *Artemisia tridentata* ssp. *tridentata* shrublands with an understory dominated by *Hesperostipa comata*. Other herbaceous species are usually present, but needle-and-thread is clearly dominant

- Artemisia tridentata ssp. tridentata / Hesperostipa comata Shrubland (Basin Big Sagebrush / Needle-and-Thread Shrubland) [Map Class 37]



24b *Artemisia tridentata* ssp. *tridentata* shrublands with an understory dominated by *Leymus cinereus. Sarcobatus vermiculatus* may be a minor element in the shrub stratum -**Artemisia tridentata ssp. tridentata / Leymus cinereus Shrubland (Basin Big Sagebrush / Great Basin Wildrye Shrubland) [Map Class 37]**



25a (21) Shrublands on the montane plateaus within the monument, dominated by *Artemisia tridentata* ssp. *vaseyana* or *Artemisia tridentata* ssp. *wyomingensis* with at least 5% cover by *Amelanchier utahensis* and also usually with at least 5% cover by *Symphoricarpos oreophilus.* The herbaceous layer is diverse, but generally lacks a diagnostic species with measurable cover, except for *Poa fendleriana,* which may have up to 15% cover - **Artemisia tridentata (ssp. vaseyana, ssp wyomingensis) - Amelanchier utahensis Shrubland (Big Sagebrush - Utah Serviceberry Shrubland) [Map Class 54]**



25b *Artemisia tridentata* ssp. *vaseyana* or ssp. *wyomingensis* shrublands with various other shrubs and varied understories, in which *Amelanchier utahensis* is either absent or provides much less than 5% cover **(26)**

26a (25) Sagebrush shrublands, generally occurring above 2100 meters, dominated by *Artemisia tridentata* ssp. *vaseyana*, often with a shrub component of *Symphoricarpos oreophilus* **(27)**

26b Sagebrush shrublands, generally occupying elevations below 2400 meters, dominated by *Artemisia tridentata* ssp. *wyomingensis* **(34)**

27a (26) Mountain sagebrush shrublands with an herbaceous understory dominated by the forb *Balsamorhiza sagittata*. Other shrubs present with low cover include *Purshia tridentata* or *Cercocarpus montanus*. Native grasses are present to co-dominant, including *Poa fendleriana, Hesperostipa comata* or *Pseudoroegneria spicata*. Other forbs present with more than trace cover include *Phlox* spp. and *Eriogonum umbellatum* - **Artemisia tridentata ssp. vaseyana / Balsamorhiza sagittata Shrubland (Mountain Big Sagebrush / Arrowleaf Balsamroot Shrubland) [Map Class 31]**



27b Mountain sagebrush shrublands with an herbaceous understory dominated by grass species. *Balsamorhiza sagittata*, if present, has less than 5% cover **(28)**

28a (27) Mountain sagebrush shrublands in mesic uplands, sometimes in swales or near springs, with *Leymus cinereus* or *Pascopyrum smithii* dominating the herbaceous layer **(29)**

28b Mountain sagebrush shrublands with grass-dominated understories in drier sites. *Leymus cinereus* is absent or has trace cover **(30)**

29a (28) Mountain sagebrush shrublands in mesic upland sites, sometimes in swales or near springs, with *Leymus cinereus* dominating the herbaceous layer - **Artemisia tridentata ssp. vaseyana / Leymus cinereus Shrubland (Mountain Big Sagebrush / Great Basin Wildrye Shrubland) [Map Class 31]**



29b Mountain sagebrush shrublands in swales or on gentle, sheltered slopes, with *Pascopyrum smithii* dominating the herbaceous layer - **Artemisia tridentata ssp. vaseyana / Pascopyrum smithii Shrubland (Mountain Big Sagebrush / Western Wheatgrass Shrubland) [Map Class 31]**



30a (28) Mountain sagebrush shrublands on gentle to moderate slopes with an understory dominated by *Achnatherum lettermanii*. These are often sites that have experienced significant grazing pressure; associated herbaceous species may indicate chronic disturbance and include *Nassella, Poa secunda* or *Eriogonum umbellatum*. Symphoricarpos oreophilus is frequently present in the shrub

layer - **Artemisia tridentata ssp. vaseyana / Achnatherum lettermanii Shrubland (Mountain Big Sagebrush / Letterman's Needlegrass Shrubland) [Map Class 31]**



30b Mountain sagebrush shrublands on various slopes and land use histories, with understories dominated by other grass species, including *Poa, Hesperostipa,* or *Pseudoroegneria spicata* **(31)**

31a (30) Mountain sagebrush shrublands, sometimes with a minor component of *Symphoricarpos oreophilus,* and an herbaceous understory dominated by *Hesperostipa comata,* or co-dominated by *Hesperostipa comata* with other grass species that are not as strong indicators, such as *Elymus elymoides* or *Poa fendleriana* - **Artemisia tridentata ssp. vaseyana / Hesperostipa comata Shrubland (Mountain Big Sagebrush / Needle-and-Thread Shrubland) [Map Class 31]**



31b Mountain sagebrush shrublands with or without *Symphoricarpos,* with understories dominated by other grass species, including *Poa* or *Pseudoroegneria spicata* **(32)**

32a (31) Mountain sagebrush shrublands with an herbaceous understory dominated by *Pseudoroegneria spicata,* or co-dominated by *Pseudoroegneria* with other grass species that are not such strong indicators, such as *Poa fendleriana, Koeleria macrantha, Poa secunda, Hesperostipa comata,* or *Pascopyrum smithii* - **Artemisia tridentata ssp. vaseyana / Pseudoroegneria spicata Shrubland (Mountain Big Sagebrush / Bluebunch Wheatgrass Shrubland) [Map Class 31]**



32b Mountain sagebrush shrublands with understories dominated by species of *Poa* **(33)**

33a (32) Mountain sagebrush shrublands with an herbaceous understory dominated by *Poa fendleriana*. *Amelanchier utahensis* is absent from the shrub layer. Other grasses may be present, but they will have less than1/3 the cover of *Poa fendleriana* - **Artemisia tridentata ssp. vaseyana / Poa fendleriana Shrubland (Mountain Big Sagebrush / Muttongrass Shrubland) [Map Class 31]**



33b Mountain sagebrush shrublands with an herbaceous understory dominated by *Poa secunda*. Other grass species, if present, have less than 1/3 the cover of *Poa secunda* - **Artemisia tridentata ssp. vaseyana / Poa secunda Shrubland (Mountain Big Sagebrush / Curly Bluegrass Shrubland) [Map Class 31]**



34a (26) Wyoming sagebrush shrublands with either a sparse understory (rarely exceeding 5%) or one dominated by weedy species such as *Bromus tectorum, Alyssum desertorum, Descurainia* spp. or *Salsola tragus. Opuntia* spp. often appear as dwarf-shrubs in disturbed sites **(35)**

34b Wyoming sagebrush shrublands with varying degrees of disturbance, but with a relatively well-developed understory (> than 5% cover) dominated by native grasses and forbs **(37)**

35a (34) Low elevation Wyoming sagebrush shrublands occurring at 1500-1800m with a strong presence to co-dominance of *Atriplex confertifolia*. A thin veneer of gravel or cobble covers the fine-textured soils which are derived mainly from the Mancos, Morrison or Browns Park formations - **Artemisia tridentata ssp. wyomingensis – Atriplex confertifolia Shrubland (Wyoming Big Sagebrush - Shadscale Shrubland) [Map Class 31]**





35b Wyoming sagebrush shrublands with sparse understory and an absence or low relative cover of *Atriplex confertifolia* (36)

36a (35) Wyoming sagebrush shrublands with a naturally sparse understory because of shale or gravel substrates, or thin soils. The total herbaceous layer covers less than 5%, but the species present are native and not indicative of chronic disturbance - **Artemisia tridentata ssp. wyomingensis / Sparse Understory Shrubland (Wyoming Big Sagebrush / Sparse Understory Shrubland) [Map Class 31]**



36b Wyoming sagebrush shrublands with a sparse understory but the species are weedy, or a denser understory dominated by weedy species, such as *Bromus tectorum, Alyssum desertorum, Descurainia* spp. or *Salsola tragus* - **Artemisia tridentata ssp. wyomingensis / Disturbed Understory Semi-natural Shrubland (Wyoming Big Sagebrush / Disturbed Understory Semi-natural Shrubland) [Map Class 31]**



37a (34) Wyoming sagebrush shrublands with an herbaceous understory dominated by *Balsamorhiza sagittata.* The only grasses with significant cover are *Poa pratensis* or *Poa fendleriana* - **Artemisia tridentata ssp. wyomingensis / Balsamorhiza sagittata Shrubland (Wyoming Big Sagebrush / Arrowleaf Balsamroot Shrubland) [Map Class 31]**



37b Wyoming sagebrush shrublands with an herbaceous understory dominated by grass species, in which *Balsamorhiza sagittata* is absent or has less than 5% cover **(38)**

38a (37) Wyoming sagebrush shrublands or shrub-herbaceous communities in mesic sites such as swales or gentle sheltered slopes with an herbaceous understory dominated by *Pascopyrum smithii.* If other grasses are present, they have less than 1/3 the cover of *Pascopyrum smithii* - **Artemisia tridentata ssp. wyomingensis / Pascopyrum smithii Shrub Herbaceous Vegetation (Wyoming Big Sagebrush / Western Wheatgrass Shrub Herbaceous Vegetation) [Map Class 31]**



38b Wyoming sagebrush shrublands in a variety of situations with an herbaceous understory dominated by more xeric grasses, including *Poa, Elymus, Pseudoroegneria, Hesperostipa, Leymus* or *Pleuraphis* **(39)**

39a (38) Wyoming sagebrush shrublands with an understory dominated by *Hesperostipa comata.* This is the most common type of sagebrush shrubland at DINO. Other grasses commonly present include *Bromus tectorum, Achnatherum hymenoides, Poa secunda* and *Poa fendleriana,* but not of these will have more than 1/3 the cover of *Hesperostipa comata* - **Artemisia tridentata ssp. wyomingensis / Hesperostipa comata Colorado Plateau Shrubland (Wyoming Big Sagebrush / Needle-and-Thread Colorado Plateau Shrubland) [Map Class 31]**



39b Wyoming sagebrush shrublands with an herbaceous understory dominated by other grasses, including *Poa, Elymus, Pseudoroegneria, Leymus* or *Pleuraphis* **(40)**

40a (39) Sparse Wyoming sagebrush shrublands occurring on shale slopes at lower elevations (Yampa Bench or lower), often with *Atriplex confertifolia* in the canopy, and with an understory dominated by *Leymus salinus*. If other grass species are present, they have less than 1/3 the cover of *Leymus salinus* - **Artemisia tridentata ssp. wyomingensis / Leymus salinus Shrubland (Wyoming Big Sagebrush / Salinas Lyme Grass Shrubland) [Map Class 31]**



40b Wyoming sagebrush shrublands occurring on a variety of substrates with an herbaceous understory dominated by other grasses, including *Poa, Elymus, Pseudoroegneria* or *Pleuraphis* **(41)**

41a (40) Wyoming sagebrush shrublands occurring at lower elevations (below 1800 meters), usually on shale but rarely on sandstones or eolian sands, with an herbaceous understory dominated by *Pleuraphis jamesii. Atriplex confertifolia* is often present in the shrub layer. If other grass species are present that are stronger indicators, they have less than 1/3 the cover of *Pleuraphis*. Grasses with moderate or low indicator value may be co-dominant with *Pleuraphis* - **Artemisia tridentata ssp. wyomingensis / Pleuraphis jamesii Shrubland (Wyoming Big Sagebrush / James' Galleta Shrubland) [Map Class 31]**



41b Wyoming sagebrush shrublands occurring on a variety of substrates and elevations with an herbaceous understory dominated by other grasses, including *Poa, Elymus* or *Pseudoroegneria* **(42)**

42a (41) Wyoming sagebrush shrublands on shale at lower to middle elevations, with *Elymus elymoides* as the dominant understory species - **Artemisia tridentata ssp. wyomingensis / Elymus elymoides Shrubland (Wyoming Big Sagebrush / Bottlebrush Shrubland) [Map Class 31]**



42b Wyoming sagebrush shrublands occurring on a variety of substrates and elevations with an herbaceous understory dominated by other grasses, including *Poa* or *Pseudoroegneria* **(42)**

43a (42) Wyoming sagebrush shrublands occurring at middle elevations on a variety of substrates and with an understory dominated by *Pseudoroegneria spicata.* The shrub layer often includes *Purshia tridentata, Symphoricarpos oreophilus, Holodiscus dumosus* or *Ephedra viridis*. If *Amelanchier utahensis* is present, it has less than 5% cover. The herbaceous layer may contain many grass species (including *Poa secunda, Koeleria macrantha, Hesperostipa comata, Achnatherum hymenoides, Poa fendleriana* and *Bromus tectorum*), and some will be co-dominant with *Pseudoroegneria,* which is considered the strongest indicator species at DINO - **Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrubland (Wyoming Big Sagebrush / Bluebunch Wheatgrass Shrubland) [Map Class 31]**



43b Wyoming sagebrush shrublands occurring on at varying elevations with an herbaceous understory dominated by either *Poa fendleriana* or *Poa secunda* **(44)**

44a (43) Wyoming sagebrush shrublands occurring on fine-textured, shale-derived soils at 1675-2300m elevation with an herbaceous understory dominated by *Poa secunda. Atriplex confertifolia* may be present to relatively abundant, and stands dominated by *Atriplex confertifolia* or *Sarcobatus vermiculatus* are often adjacent. If other grass species are present, they have less than ½ the cover of *Poa secunda,* except *Bromus tectorum,* which may have significant cover in wet years - **Artemisia tridentata ssp. wyomingensis / Poa secunda Shrubland (Wyoming Big Sagebrush / Curly Bluegrass Shrubland) [Map Class 31]**



44b Wyoming sagebrush shrublands occurring on at varying elevations with an herbaceous understory dominated by *Poa fendleriana*. If other grass species are present, they have less than ½ the cover of *Poa fendleriana* - **Artemisia tridentata ssp. wyomingensis / Poa fendleriana Shrubland (Wyoming Big Sagebrush / Muttongrass Shrubland) [Map Class 31]**



45a (18) Shrublands characterized by species of *Atriplex* (e.g., *canescens, confertifolia, corrugata, gardneri*) **(46)**

45b Shrublands characterized by other species of shrub, including *Amelanchier, Cercocarpus, Chrysothamnus, Ericameria, Ephedra, Krascheninnikovia* or *Sarcobatus* **(53)**

46a (45) Shrublands occurring on sandy valley toe slopes or Pleistocene river terraces dominated by *Atriplex canescens.* Other shrubs present usually include *Grayia spinosa* and *Chrysothamnus viscidiflorus.* The understory is dominated by the grass *Achnatherum hymenoides*, and other grasses present (usually with no more than a few percent cover) include *Sporobolus cryptandrus* and the exotic *Bromus tectorum* – **Atriplex canescens / Achnatherum hymenoides Shrubland (Fourwing Saltbush / Indian Ricegrass Shrubland) [Map Class 31]**





46b Sparse shrublands on shale substrates dominated by other species of *Atriplex* (e.g., *confertifolia, corrugata, gardneri*) **(47)**

47a (46) Sparse dwarf shrublands on shale substrates dominated by *Atriplex corrugata* or *Atriplex gardneri*, sometimes with a minor element of *Atriplex confertifolia* present **(48)**

47b Low shrublands on shale or other harsh substrates dominated by *Atriplex confertifolia.* The mat saltbushes are absent or have only trace cover, but *Artemisia tridentata* ssp. *wyomingensis* may be co-dominant **(49)**

48a (47) Sparse dwarf shrublands at low elevations, usually on badlands of Mancos Shale where *Atriplex corrugata* is dominant, or co-dominant with *Atriplex confertifolia* and/or *Atriplex gardneri*. *Artemisia tridentata* ssp. *wyomingensis* or *Picrothamnus desertorum* may be present with low cover. The understory is usually extremely sparse - **Atriplex corrugata Dwarf-shrubland (Mat Saltbush Dwarf-shrubland) [Map Class 59]**



48b Sparse dwarf shrublands at low elevations, usually on badlands of Mancos or Morrison shale, where *Atriplex gardneri* is dominant, or co-dominant with *Atriplex confertifolia*. *Atriplex corrugata* is absent or has no more than trace cover - **Atriplex gardneri Dwarf-shrubland (Gardner's Saltbush Dwarf-shrubland) [Map Class 59]**



49a (47) Sparse shrublands of *Atriplex confertifolia* mixed with *Krascheninnikovia lanata* and/or *Artemisia tridentata* ssp. *wyomingensis*, often on Moenkopi Shale. The understory is sparse, except where *Bromus tectorum* has become established - **Atriplex confertifolia - Krascheninnikovia lanata Shrubland (Shadscale - Winter-fat Shrubland) [Map Class 44]**



49b Shadscale shrublands with a variety of associated species, but *Krascheninnikovia* is absent or has only trace cover **(50)**

50a (49) Sparse shrublands of *Atriplex confertifolia* on various substrates, often mixed with other species, such as *Ephedra viridis, Picrothamnus desertorum, Tetradymia spinosa,* or *Artemisia tridentata* ssp. *wyomingensis*. The herbaceous understory is diverse and composed mostly of native species, but clearly diagnostic species don't occur with more than trace cover - **Atriplex confertifolia Great Basin Shrubland (Shadscale Great Basin Shrubland) [Map Class 44]**

50b Shadscale shrublands with a more developed herbaceous understory **(51)**

51a (50) A sparse shrubland or shrub herbaceous community whose shrub layer is dominated by *Atriplex confertifolia*, and with a well-developed herbaceous understory dominated by *Achnatherum hymenoides* with or without *Poa fendleriana* **- Atriplex confertifolia / Achnatherum hymenoides Shrubland (Shadscale / Indian Ricegrass Shrubland) [Map Class 44]**



51b Shadscale shrublands with an herbaceous understory dominated by other grasses, including *Hesperostipa* or *Pleuraphis* **(52)**

52a (51) Shadscale shrublands with an herbaceous understory dominated by *Pleuraphis jamesii,* usually

with *Bromus tectorum* as a co-dominant - **Atriplex confertifolia / Pleuraphis jamesii Shrubland (Shadscale / James' Galleta Shrubland) [Map Class 44]**



52b Shadscale shrublands with an herbaceous understory dominated by *Hesperostipa comata*, usually with lesser cover by other grasses such as *Poa fendleriana* or *Pleuraphis jamesii* -**Atriplex confertifolia / Hesperostipa comata Shrubland (Shadscale / Needle-and-Thread Shrubland) [Map Class 44]**

53a (45) Sparse shrublands on sandy or rocky slopes or burned sites dominated by *Chrysothamnus viscidiflorus* **(54)**

53b Shrublands of varying densities and situations, characterized by species of *Amelanchier*, *Cercocarpus, Ericameria, Ephedra, Krascheninnikovia* or *Sarcobatus* **(55)**

54a (53) Sparse shrublands on burned or sandy sites, where the herbaceous understory contains *Hesperostipa comata*, although other grasses may have higher cover - **Chrysothamnus viscidiflorus / Hesperostipa comata Shrubland (Green Rabbitbrush / Needle-and-Thread Shrubland) [Map Class 31]**



54b Sparse mixed shrublands on barren or rocky sites in which *Chrysothamnus viscidiflorus* is

conspicuous; the understory may be sparse or of mixed species - **Chrysothamnus viscidiflorus Talus Shrubland (Green Rabbitbrush Talus Shrubland) [Map Class 54]**



55a (53) Sparse to moderately dense shrublands on burned sites or barren gypsiferous shale characterized by species of *Ephedra* **(56)**

55b Shrublands of varying densities and situations, characterized by species of *Amelanchier, Cercocarpus, Ericameria, Krascheninnikovia* or *Sarcobatus* **(57)**

56a (55) Sparse shrublands of barren, gypsiferous shale within the Moenkopi Formation, characterized by *Ephedra torreyana* with a component of *Atriplex confertifolia.* Patches of grasses such as *Poa fendleriana* may be present, but the groundcover is generally dominated by gypsiferous lichens - **Ephedra torreyana - (Atriplex spp.) / Nonvascular Gypsum Sparse Vegetation (Torrey's Joint-fir - (Saltbush) / Nonvascular Gypsum Sparse Vegetation) [Map Class 44]**



56b Shrublands now characterized by *Ephedra viridis*, but which were formerly sagebrush shrublands or pinyon-juniper woodlands that burned. Scattered young *Artemisia tridentata* plants may be present. The understory is dominated by *Bromus tectorum,* although *Hesperostipa comata* is usually also present - **Ephedra viridis / Bromus tectorum Semi-natural Shrubland (Mormon-tea / Cheatgrass Semi-natural Shrubland) [Map Class 31]**



57a (55) Dwarf-shrublands of lower elevations characterized by *Krascheninnikovia lanata. Atriplex confertifolia* is absent **(58)**

57b Shrublands of varying densities and situations, characterized by species of *Amelanchier, Cercocarpus, Ericameria* or *Sarcobatus* **(59)**

58a (57) Dwarf shrublands characterized by an open canopy of *Krascheninnikovia lanata* and an understory of grasses dominated by *Hesperostipa comata*. Other grasses are present, but none has greater cover than *Hesperostipa* - **Krascheninnikovia lanata / Hesperostipa comata Dwarf-shrubland (Winter-fat / Needle-and-Thread Dwarf-shrubland) [Map Class 44]**



58b Dwarf shrublands characterized by an open canopy of *Krascheninnikovia lanata* and an herbaceous layer dominated by *Poa secunda* and *Bromus tectorum* - **Krascheninnikovia lanata / Poa secunda Dwarf-shrubland (Winter-fat / Curly Bluegrass Dwarf-shrubland) [Map Class 44]**



59a (57) Shrublands at middle to upper elevations on rocky outcrops and slopes and dominated by species of *Cercocarpus*, with *Artemisia tridentata* present to co-dominant **(60)**

59b Shrublands at varying elevations and situations, characterized by species of *Amelanchier*, *Ericameria*, or *Sarcobatus* **(61)**

60a (59) Shrublands located on shallow soils over outcrops of Weber Sandstone and dominated by *Cercocarpus intricatus*. Shrub cover is at least 20%, tree cover is less than 10%, and the understory is diverse but not dense - **Cercocarpus intricatus Montane Shrubland (Littleleaf Mountain-mahogany Montane Shrubland) [Map Class 14]**



60b Shrublands on colluvial slopes with a mixed canopy of *Cercocarpus montanus* and *Artemisia tridentata* (either may be dominant, but each has at least 10% cover; rarely *Artemisia* is absent), and an herbaceous understory of mixed forbs and grasses usually including *Pseudoroegneria spicata* or *Poa secunda. Symphoricarpos oreophilus* often occurs as a short shrub, but if *Amelanchier* spp. has more than 5% cover, go to couplet 62. Other herbaceous species usually present include *Phlox* spp., *Stenotus acaulis, Poa fendleriana, Hesperostipa comata, Balsamorhiza sagittata* and *Petradoria pumila* - **Cercocarpus montanus / Pseudoroegneria spicata Shrubland (Mountain-mahogany / Bluebunch Wheatgrass Shrubland) [Map Class 54]**



61a (59) Shrublands or shrub herbaceous communities in a variety of situations dominated by *Ericameria nauseosa* **(62)**

61b Shrubland characterized by species of *Amelanchier* or *Sarcobatus* **(65)**

62a (61) Sparse rubber rabbitbrush shrublands on sands or in gravelly dry washes **(63)**

62b Sparse to moderately dense rubber rabbitbrush shrublands in other situations **(64)**

63a (62) Areas of loose, sometimes blowing sands, sometimes in burns, with a sparse shrub canopy of *Ericameria nauseosa* with a sparse understory of sandy species such as *Achnatherum hymenoides, Artemisia dracunculus* and *Sporobolus cryptandrus* - **Ericameria nauseosa Sand Deposit Sparse Shrubland (Rubber Rabbitbrush Sand Deposit Sparse Shrubland) [Map Class 31]**



63b Sparse shrublands of *Ericameria nauseosa* located on the banks or beds of gravelly dry washes. *Chrysothamnus viscidiflorus, Chrysothamnus linifolius, Artemisia tridentata* or *Ephedra viridis* may also be present - **Ericameria nauseosa Desert Wash Shrubland (Rubber Rabbitbrush Desert Wash Shrubland) [Map Class 103]**



64a (62) *Ericameria nauseosa* shrublands in burned sagebrush or pinyon-juniper stands, now with an understory dominated by *Bromus tectorum*. Scattered sagebrush or juniper trees may be present, but with much less than 10% cover. Other herbaceous species are present, many of them indicating disturbance, including *Heterotheca villosa, Salsola tragus, Cleome serrulata* or *Elymus elymoides* - **Ericameria nauseosa / Bromus tectorum Semi-natural Shrubland (Rubber Rabbitbrush / Cheatgrass Semi-natural Shrubland) [Map Class 31]**



64b Burned sites dominated by *Ericameria nauseosa* with an understory dominated by Pascopyrum smithii - **Ericameria nauseosa / Pascopyrum smithii Shrubland (Rubber Rabbitbrush / Western Wheatgrass Shrubland) [Map Class 31]**



65a (61) Mixed mountain shrublands where *Amelanchier* spp. is dominant or is among the dominant shrub species **(66)**

65b Low elevation or bottomland/bench communities characterized by *Sarcobatus vermiculatus*, sometimes co-dominated by *Artemisia tridentata* **(69)**

66a (65) Montane shrublands with a mixed canopy of *Amelanchier* spp., *Artemisia tridentata, Cercocarpus montanus* and *Symphoricarpos oreophilus*. Each shrub usually has at least 5% cover, and often much more. The dwarf-shrub and herbaceous understory is diverse and variable in cover; common species include *Eriogonum umbellatum, Paxistima myrsinites, Mahonia repens, Eriogonum microthecum, Poa fendleriana, Koeleria macrantha, Achnatherum hymenoides, Pseudoroegneria spicata, Balsamorhiza sagittata* and *Stenotus acaulis* - **Amelanchier (utahensis, alnifolia - Cercocarpus montanus Shrubland (Serviceberry - Mountain-mahogany Shrubland) [Map Class 54]**



66b Serviceberry shrublands not matching this description **(67)**

67a (66) Steep colluvial slopes dominated by *Amelanchier utahensis*, usually with lesser cover of other shrubs, including *Philadelphus microphyllus, Holodiscus dumosus* and *Ephedra viridis*. The herbaceous layer is diverse and with good cover; *Pseudoroegneria spicata* is generally present with at least 1% cover - **Amelanchier utahensis / Pseudoroegneria spicata Shrubland (Utah**

Serviceberry / Bluebunch Wheatgrass Shrubland) [Map Class 54]



67b Serviceberry shrublands not matching this description **(68)**

68a (67) Shrublands dominated by *Amelanchier utahensis*, with at least 5% cover of *Symphoricarpos oreophilus* in the short shrub layer (usually more). *Cercocarpus montanus* and *Artemisia tridentata* are absent or have sparse cover. The herbaceous layer is variable, depending on the tall shrub canopy closure - **Amelanchier alnifolia - Symphoricarpos oreophilus Shrubland (Saskatoon Serviceberry / Mountain Snowberry Shrubland) [Map Class 54]**



68b Shrublands dominated by *Amelanchier utahensis* but not matching any of the other types in associated shrubs or understory dominants - **Amelanchier utahensis Shrubland (Utah Serviceberry Shrubland) [Map Class 54]**



69a (65) Sparsely vegetated, short greasewood shrublands in low saline areas characterized by *Sarcobatus vermiculatus* with *Atriplex gardneri* and a sparse understory of weedy forbs and grasses such as *Halogeton glomeratus* and *Ranunculus testiculatus* - **Sarcobatus vermiculatus / Atriplex gardneri Shrubland (Black Greasewood / Gardner's Saltbush Shrubland) [Map Class 37]**



69b Sparse or moderately closed shrublands of *Sarcobatus vermiculatus*, sometimes with *Artemisia tridentata* **(70)**

70a (69) Mixed shrublands with *Sarcobatus vermiculatus* accompanied by *Artemisia tridentata* (either ssp. *tridentata* or ssp. *wyomingensis*), usually on deep soils on higher riparian terraces and valley floors, but also occurs on limestone ridgelines on the Yampa Bench. Either greasewood or sagebrush may be dominant, but each has at least 10% cover. *Atriplex confertifolia* may have low cover. The understory may support both weedy and native species, including *Bromus tectorum, Alyssum desertorum* and *Elymus elymoides* - **Sarcobatus vermiculatus / Artemisia tridentata Shrubland (Black Greasewood / Big Sagebrush Shrubland) [Map Class 37]**





70b Greasewood shrublands not matching the above description **(71)**

71a (70) Shrublands dominated by *Sarcobatus vermiculatus* with an understory dominated by *Sporobolus airoides. Ericameria nauseosa* and *Distichlis spicata* may also occur - **Sarcobatus vermiculatus / Sporobolus airoides Shrubland (Black Greasewood / Alkali Sacaton Shrubland) [Map Class 37]**



71b Shrublands dominated by *Sarcobatus vermiculatus* with either a sparse understory lacking diagnostic species or an understory dominated by exotic weedy species such as *Bromus tectorum, Salsola tragus, Chenopodium album* or *Alyssum desertorum. Artemisia tridentata* ssp. *wyomingensis* may be present with less than 5% cover - **Sarcobatus vermiculatus Disturbed Shrubland (Black Greasewood Disturbed Shrubland) [Map Class 37]**



KEY IV: HERBACEOUS ASSOCIATIONS OF DINOSAUR NATIONAL MONUMENT

1a Herbaceous vegetation occupying mesic sites including wetlands, perennial drainages, floodplains, seeps, and springs **(2)**

1b Herbaceous vegetation occupying xeric and upland sites including drainages, terraces, and benches; community not controlled by water table or surface flow of water **(20)**

2a (1) Sites are seeps emerging from near-vertical cliffs or alcoves embedded in sandstone or limestone cliffs (hanging gardens). *Calamagrostis scopulorum* is usually conspicuous, and occurs with a diversity of forbs and sometimes shrub species **(3)**

2b Sites are associated with gentle to moderate gradients on the active floodplains of streams and rivers, or with seeps in upland situations **(4)**

3a (2) Hanging gardens emerging from the walls of sandstone canyons, either in alcoves or directly from the canyon walls. Forbs and graminoids may both be important, but *Aquilegia micrantha* and *Calamagrostis scopulorum* are nearly always both present. Other species commonly present include *Dodecatheon pulchellum, Zigadenus vaginatus, Cercocarpus intricatus* and/or *Epipactis gigantea* - **Aquilegia micrantha – Calamagrostis scopulorum Herbaceous Vegetation (Mancos Columbine - Ditch Reedgrass Hanging Garden) [Map Class 95]**



3b Hanging gardens dominated by *Calamagrostis scopulorum*. A diversity of forbs is always present, but *Aquilegia micrantha* is rare or absent and forbs are not dominant - **Calamagrostis scopulorum Herbaceous Vegetation (Ditch Reedgrass Hanging Garden) [Map Class 95]**



4a (3) Sites dominated by forb species such as *Heterotheca, Lepidium, Xanthium*, or *Glycyrrhiza* **(5)**

4b Sites are dominated by grasses and/or graminoid species, (including *Equisetum*). Forb species are much less important in terms of total cover **(8)**

5a (4) Low-stature, somewhat sparse vegetation on cobble bars, dominated by hairy goldenaster (*Heterotheca villosa*, always with grasses such as *Aristida purpurea, Sporobolus cryptandrus*, and/or *Hesperostipa comata* - **Heterotheca villosa Herbaceous Vegetation (Hairy Goldenaster Herbaceous Vegetation) [Map Class 67]**



5b Taller vegetation, either on stream terraces or on the river bed as it becomes exposed in late summer **(6)**

6a (4) River terraces or rarely-used overflow channels supporting colonies of the invasive species *Lepidium latifolium* - **Lepidium latifolium Semi-natural Herbaceous Vegetation (Perennial Pepperweed Semi-natural Herbaceous Vegetation) [Map Class 68]**




6b Herbaceous associations growing on otherwise bare sand exposed in the river channel and lowest terraces in mid-summer as flows wane. Most examples are on the Yampa River **(7)**

7a (5) Vegetation consisting primarily of colonies of the exotic forb cocklebur **-Xanthium strumarium Herbaceous Vegetation (Cocklebur Herbaceous Vegetation) [Map Class 101]**

[NO PHOTO AVAILABLE]

7b Vegetation consisting primarily of the native forb wild-licorice. Patches are usually only a few meters in any dimension **- Glycyrrhiza lepidota Herbaceous Vegetation (Wild Licorice Herbaceous Vegetation) [Map Class 101]**




8a (4) Dense, near-monocultures of the tall species common reed (*Phragmites australis*). Stands may be more than three meters tall and are usually growing on low stream terraces or from hillside seeps **- Phragmites australis Western North America Temperate Semi-natural Herbaceous Vegetation (Common Reed Semi-natural Herbaceous Vegetation) [Map Class 95]**



8b Vegetation much shorter, and often on riparian terraces, or if more than one meter tall, growing much less densely as an emergent in overflow channels or other wetland situations **(9)**

9a (8) Drier riparian situations where flooding is rare and the water table is more than a meter below the surface during the growing season, and dominated by either *Elymus* or *Distichlis* **(10)**

9b Wet seep or riparian situations with a high water table and/or a regular flood regime **(11)**

10a (9) Middle or upper terraces dominated by the rhizomatous exotic perennial quackgrass (*Elymus repens*) - **Elymus repens Semi-natural Herbaceous Vegetation (Quackgrass Semi-natural Herbaceous Vegetation) [Map Class 68]**



10b Middle or upper stream terraces dominated by the rhizomatous native saltgrass - **Distichlis spicata Herbaceous Vegetation (Saltgrass Herbaceous Vegetation) [Map Class 73]**



11a (9) Wet or mesic sites dominated by *Spartina* spp. **(12)**

11b Wet or mesic sites dominated by other families of graminoids, such as *Carex, Juncus, Schoenoplectus, Equisetum* or *Eleocharis* **(13)**

12a (11) Intermittently wet sites on stream terraces and on the margins of seep wetlands, dominated by the native rhizomatous *Spartina gracilis*. Most examples are very small in size **-Spartina gracilis Herbaceous Vegetation (Alkali Cordgrass Herbaceous Vegetation) [Map Class 95]**

[NO PHOTO AVAILABLE]

12b Sites that are wet to saturated throughout the growing season, most frequently on the banks of the Yampa or Green rivers at water's edge, and dominated by *Spartina pectinata*. Most stands are long and narrow, paralleling the stream bank - **Spartina pectinata Western Herbaceous Vegetation (Prairie Cordgrass Western Herbaceous Vegetation) [Map Class 95]**



13a (11) Wet sites dominated by species of *Carex* **(14)**

13b Wet sites dominated by graminoids other than sedges, although *Carex* nearly always present **(15)**

14a (13) Freshwater seeps and low spots in overflow channels dominated by woolly sedge - **Carex pellita Herbaceous Vegetation (Woolly Sedge Herbaceous Vegetation) [Map Class 95]**

[NO PHOTO AVAILABLE]

14b Alkaline seeps dominated by *Carex praegracilis* - **Carex praegracilis Herbaceous Vegetation (Clustered Field Sedge Herbaceous Vegetation) [Map Class 95]**



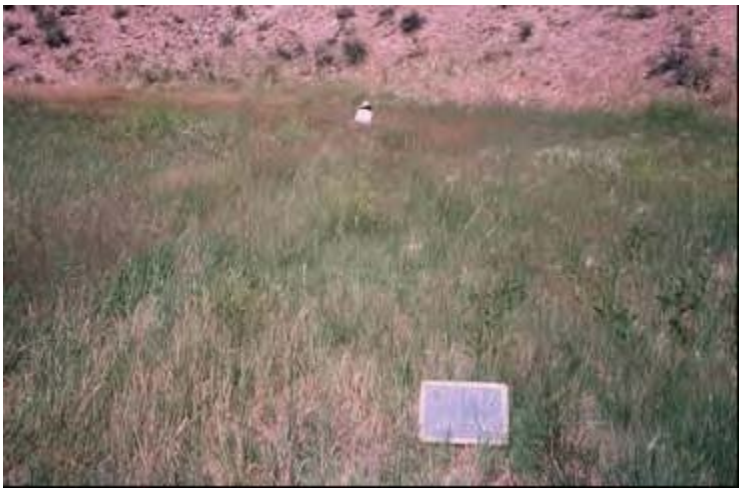
15a (13) Wet sites dominated by species of *Schoenoplectus* **(16)**

15b Wet sites dominated by species of *Juncus, Eleocharis* or *Equisetum* **(17)**

16a (15) Overflow channels or other low spots that have a high water table throughout the growing season, dominated by *Schoenoplectus acutus* - **Schoenoplectus acutus Herbaceous Vegetation (Hardstem Bulrush Herbaceous Vegetation) [Map Class 95]**



16b Overflow channels or other low spots that have a high water table throughout the growing season, dominated by *Schoenoplectus pungens* - S**choenoplectus pungens Herbaceous Vegetation (Common Threesquare Herbaceous Vegetation) [Map Class 95]**



17a (15) Sites on the margins of alkaline or freshwater seeps, or sites that are wet throughout the growing season, are in heavily grazed wetlands, or are on the margins of overflow channels where the water level fluctuates greatly throughout the growing season; the dominant species are *Eleocharis* or *Juncus* **(18)**

17b Sites on the margins of tributary stream channels that are subject to occasional scouring floods, where the dominant vegetation is *Equisetum* **(19)**

18a (17) Sites on the margins of alkaline or freshwater seeps, in heavily grazed wetlands, and on the margins of overflow channels where the water level fluctuates greatly throughout the growing season, dominated by *Juncus balticus* - **Juncus balticus Herbaceous Vegetation (Baltic Rush Herbaceous Vegetation) [Map Class 95]**



18b Sites that are saturated throughout the growing season, either stream margins or areas where water ponds, dominated by *Eleocharis palustris* - **Eleocharis palustris Herbaceous Vegetation (Marsh Spikerush Herbaceous Vegetation) [Map Class 95]**

[NO PHOTO AVAILABLE]

19a (17) Scouring rush communities dominated by Equisetum hyemale and known from very small

patches (less than 0.5 ha along the main stem of the Green River - **Equisetum hyemale Herbaceous Vegetation (Common Scouring-rush Herbaceous Vegetation) [Map Class 95]**




19b Scouring rush communities dominated by Equisetum laevigatum. Usually occurs in small patches in a mosaic of riparian herbaceous, shrubland and woodland types - **Equisetum laevigatum Herbaceous Vegetation (Smooth Horsetail Herbaceous Vegetation) [Map Class 95]**





20a (1) Upland herbaceous communities occurring in highly disturbed situations, dominated by weedy forb species, or in recently burned areas with a diverse but hard-to-characterize mix of grasses and forbs **(21)**

20b Upland herbaceous communities characterized by graminoid species. Forb species are usually present, but rarely with more than a fraction of the cover of the graminoid species. The exception is herbaceous communities on limestone that may be co-dominated by *Pseudoroegneria spicata* and various "cushion" plants **(22)**

21a (20) Weedy annual communities on shale substrates, dominated by *Halogeton glomeratus* or *Salsola* spp. - **Shale Annual Herbaceous Vegetation [Map Class 68]**





21b Recently burned areas supporting a variety of forb and grass species, but without a clearly dominant diagnostic species. Common elements include *Sisymbrium altissimum, Alyssum desertorum, Bromus tectorum, Balsamorhiza sagittata, Gutierrezia sarothrae, Elymus lanceolatus, Silene menziesii, Ephedra viridis, Machaeranthera canescens* and *Heterotheca villosa* - **Post-fire Herbaceous Vegetation [Map Class 68]**



22a (20) Herbaceous communities dominated by *Bromus tectorum*. Native grasses may be present, but form less than a third of the herbaceous canopy - **Bromus tectorum Semi-natural Herbaceous Vegetation (Cheatgrass Semi-natural Herbaceous Vegetation) [Map Class 68]**



22b Herbaceous communities dominated by native bunch or rhizomatous grasses, resulting either from burns or edaphic influences. Forb species are nearly always present, but in most cases have much less cover than grass species **(23)**

23a (22) Grass-dominated communities occurring in mesic situations, either on floodplains or in upland swales, and dominated by *Leymus cinereus* and/or *Pascopyrum smithii* **(24)**

23b Grass-dominated communities occurring in drier upland situations, dominated by species of *Elymus, Pseudoroegneria, Pleuraphis, Poa, Leymus (salinus), Hesperostipa, Muhlenbergia, Achnatherum* or *Sporobolus* **(26)**

24a (23) Swale or floodplain grasslands dominated by *Leymus cinereus. Pascopyrum smithii* may be co-dominant in the understory **(25)**

24b Swale or floodplain grasslands, often in burned areas on the Yampa Plateau, dominated by *Pascopyrum smithii. Leymus cinereus* is absent, although *Lupinus argenteus, Balsamorhiza sagittata, Achnatherum lettermanii* or other bunchgrasses may have significant cover - **Pascopyrum smithii Herbaceous Vegetation (Western Wheatgrass Herbaceous Vegetation) [Map Class 73]**





25a (24) *Leymus cinereus* grasslands, mostly on the Yampa Plateau, with an understory dominated by *Pascopyrum smithii. Poa pratensis* may also be present - **Leymus cinereus - Pascopyrum smithii Herbaceous Vegetation (Great Basin Wildrye - Western Wheatgrass Herbaceous Vegetation) [Map Class 73]**



25b *Leymus cinereus* grasslands, mostly on terraces of the Green and Yampa rivers, with an understory dominated by *Distichlis spicata. Bromus tectorum* may have significant cover - **Leymus cinereus - Distichlis spicata Herbaceous Vegetation (Great Basin Wildrye - Saltgrass Herbaceous Vegetation) [Map Class 73]**



26a (23) Grasslands dominated by species of *Achnatherum* (needlegrass) **(27)**

26b Sites at various elevations, burned or unburned, and dominated by species of *Elymus, Pseudoroegneria, Poa, Leymus (salinus), Pleuraphis, Muhlenbergia, Hesperostipa* or *Sporobolus* **(28)**

27a (26) Grasslands at higher elevations (above 2200 meters), often burned and dominated by *Achnatherum lettermanii*. Re-sprouting shrubs are often present with low cover, as are the skeletons of burned trees - **Achnatherum lettermanii Herbaceous Alliance (Letterman's Needlegrass Herbaceous Alliance) [Map Class 73]**



27b (26) Grasslands on sand sheets dominated by Achnatherum hymenoides. Total vegetation cover is usually 20-25%, with other grasses such as *Hesperostipa comata, Sporobolus cryptandrus*, and *Bromus tectorum* contributing up to half the total cover. Scattered shrubs of *Atriplex canescens* and *Grayia spinosa* are commonly present - **Achnatherum hymenoides Colorado Plateau Herbaceous Vegetation (Indian Ricegrass Colorado Plateau Herbaceous Vegetation) [Map Class 73]**



28a (26) Sparse grasslands (total vegetation cover often less than 25%) occurring on north-facing exposures of Mancos, Morrison, or other shales, dominated by *Leymus salinus.* The dwarf shrubs *Atriplex confertifolia* or *Atriplex gardneri* may be present with low cover, but grass cover is at least twice the shrub cover - **Leymus salinus Shale Sparse Vegetation (Salinas Lyme Grass Shale Sparse Vegetation) [Map Class 73]**



28b Sparse to densely vegetated grasslands occurring on various substrates and dominated by species of *Elymus, Pseudoroegneria, Pleuraphis, Poa, Muhlenbergia, Hesperostipa* or *Sporobolus* **(28)**

29a (28) Sparse grasslands (total vegetation cover often less than 25%) occurring on loose sands or sandy soils derived from Browns Park Formation and limited to the area around the Gates of Lodore. *Gutierrezia sarothrae* is usually present, although with less than 5% cover - **Muhlenbergia pungens Herbaceous Vegetation (Sandhills Muhly Herbaceous Vegetation)) [Map Class 47, 73]**



29b Sparse to densely vegetated grasslands occurring on various substrates and dominated by species of *Elymus, Pseudoroegneria, Pleuraphis, Poa, Hesperostipa* or *Sporobolus* **(30)**

30a (29) Sparse to dense grasslands at low elevations (below 1800 meters) dominated by *Pleuraphis jamesii.* A variety of shrubs may be present, depending on substrate, but the total shrub cover is less than 10% - **Pleuraphis jamesii Herbaceous Vegetation (James' Galleta Herbaceous Vegetation) [Map Class 73]**



30b Sparse to densely vegetated grasslands occurring on various substrates and dominated by species of *Elymus, Pseudoroegneria, Poa, Hesperostipa* or *Sporobolus* **(31)**

31a (30) Sparse grasslands commonly found on sands derived from Glen Canyon or Entrada sandstones at the west end of the monument and dominated by *Sporobolus cryptandrus*. Up to 10% cover of sand-adapted shrubs such as *Ericameria nauseosa, Ephedra viridis* or *Chrysothamnus greenei* may be present, as will sand-loving grasses such as *Achnatherum hymenoides* - **Sporobolus cryptandrus Great Basin Herbaceous Vegetation (Sand Dropseed Great Basin Herbaceous Vegetation) [Map Class 73]**



31b Sparse to densely vegetated grasslands occurring on various substrates and dominated by species of *Elymus, Pseudoroegneria, Poa* or *Hesperostipa* **(32)**

32a (31) Grasslands occurring in areas of burned sagebrush or pinyon-juniper woodland, often with clay loam or silt loam soils, dominated by the semi-rhizomatous grass *Elymus lanceolatus*. These sites often have a relatively high cover of forbs such as *Lupinus argenteus* or *Silene menziesii*. Other grasses (e.g., *Hesperostipa comata, Poa fendleriana, Achnatherum hymenoides*) will be present to co-dominant, although no species will exceed *Elymus lanceolatus* in cover - **Elymus lanceolatus Herbaceous Vegetation (Streamside Wild Rye Herbaceous Vegetation) [Map Class 73]**



32b Sparse to densely vegetated grasslands occurring on various substrates and dominated by species of *Pseudoroegneria, Poa* or *Hesperostipa* **(33)**

33a (32) Grasslands on sandy or silty substrates dominated by *Hesperostipa comata*, sometimes with a significant component of *Achnatherum hymenoides* **(34)**

33b Grasslands often on substrates derived from limestone or less often, sandstone, dominated by *Pseudoroegneria* or a combination of *Pseudoroegneria* and *Poa secunda* or *Pseudoroegneria* and *Leymus salinus* **(35)**

34a (33) Grasslands dominated by *Hesperostipa comata*. Although other grass species are present, *Hesperostipa* is clearly dominant - **Hesperostipa comata Great Basin Herbaceous Vegetation (Needle-and-Thread Great Basin Herbaceous Vegetation) [Map Class 73]**



34b Grasslands dominated by *Hesperostipa comata* with *Achnatherum hymenoides* contributing at least a third of the grass canopy. Many examples are in burned pinyon-juniper or sagebrush stands - **Hesperostipa comata - Achnatherum hymenoides Herbaceous Vegetation (Needle-and-Thread - Indian Ricegrass Herbaceous Vegetation) [Map Class 73]**



35a (33) Rare grasslands located on north-facing colluvial slopes in canyons cut into the Morgan and Round Valley formations, near the base of the cliff where evapotranspiration is low. Mosses form a significant groundcover. The dominant vascular species are *Pseudoroegneria spicata* and *Leymus salinus*, with a low cover of scattered shrubs, including *Ephedra viridis, Rhus trilobata, Symphoricarpos oreophilus,* and *Artemisia tridentata* ssp. *vaseyana* - **Pseudoroegneria spicata - Leymus salinus Herbaceous Vegetation (Bluebunch Wheatgrass - Salinas Lyme Grass Herbaceous Vegetation) [Map Class 73]**



35b More common bluebunch wheatgrass grasslands located on benches and slopes, but not restricted to colluvial slopes **(36)**

36a (35) Grasslands, sometimes sparse, occurring on limestone-derived substrates and characterized by a combination of *Pseudoroegneria spicata, Poa secunda* and "cushion" plants such as *Stenotus acaulis, Phlox* spp., and *Petradoria pumila. Pseudoroegneria* is often, but not always the dominant species; sometimes the cushion plants will have higher cover than grasses, sometimes in grazed sites *Poa secunda* has higher cover than *Pseudoroegneria.* Shrubs have less than 10% total cover and may include *Gutierrezia sarothrae, Tetradymia canescens, Artemisia tridentata,* or *Artemisia nova* - **Pseudoroegneria spicata - Cushion Plants Herbaceous Vegetation (Bluebunch Wheatgrass - Cushion Plants Herbaceous Vegetation) [Map Class 40]**





36b Grasslands, sometimes sparse, occurring on a variety of substrates and dominated by *Pseudoroegneria spicata*, sometimes with *Poa fendleriana* or *Hesperostipa comata* as a co-dominant. If cushion plants are present, it is with trace cover, and *Artemisia tridentata* ssp. *wyomingensis* often has up to 5% cover - **Pseudoroegneria spicata Herbaceous Vegetation (Bluebunch Wheatgrass Herbaceous Vegetation) [Map Class 73]**



INDEX TO THE PLANT ASSOCIATIONS OF DINOSAUR NATIONAL MONUMENT

Acer negundo - Celtis laevigata var. reticulata Woodland 634
Acer negundo / Disturbed Understory Woodland 635
Acer negundo / Equisetum arvense Forest..... 635
Acer negundo / Prunus virginiana Forest..... 636
Acer negundo / Rhus trilobata Forest 636
Achnatherum hymenoides Colorado Plateau Herbaceous Vegetation 710
Achnatherum lettermanii Herbaceous Alliance 709
Alkali Cordgrass Herbaceous Vegetation..... 703
Alkali Sagebrush / Streamside Wild Rye Herbaceous Vegetation 668
Amelanchier (utahensis, alnifolia) - Cercocarpus montanus Shrubland..... 694
Amelanchier alnifolia - Symphoricarpos oreophilus Shrubland..... 695
Amelanchier utahensis / Pseudoroegneria spicata Shrubland..... 694
Amelanchier utahensis Shrubland..... 695
Aquilegia micrantha – Calamagrostis scopulorum Herbaceous Vegetation..... 699
Arctostaphylos patula - Artemisia tridentata (ssp. vaseyana, ssp. wyomingensis) Shrubland ... 668
Artemisia arbuscula ssp. longiloba / Pseudoroegneria spicata Shrub Herbaceous Vegetation .. 668
Artemisia nova / Pseudoroegneria spicata Shrubland..... 671
Artemisia nova Shrubland..... 672
Artemisia tridentata - (Ericameria nauseosa) / Bromus tectorum Semi-natural Shrubland..... 673
Artemisia tridentata (ssp. vaseyana, ssp wyomingensis) - Amelanchier utahensis Shrubland... 674
Artemisia tridentata ssp. tridentata / Hesperostipa comata Shrubland 674
Artemisia tridentata ssp. tridentata / Leymus cinereus Shrubland..... 674
Artemisia tridentata ssp. tridentata / Sporobolus airoides Shrubland..... 673
Artemisia tridentata ssp. vaseyana / Achnatherum lettermanii Shrubland 677
Artemisia tridentata ssp. vaseyana / Balsamorhiza sagittata Shrubland..... 675
Artemisia tridentata ssp. vaseyana / Hesperostipa comata Shrubland..... 677
Artemisia tridentata ssp. vaseyana / Leymus cinereus Shrubland 676
Artemisia tridentata ssp. vaseyana / Pascopyrum smithii Shrubland 676
Artemisia tridentata ssp. vaseyana / Poa fendleriana Shrubland 678
Artemisia tridentata ssp. vaseyana / Poa secunda Shrubland 678
Artemisia tridentata ssp. vaseyana / Pseudoroegneria spicata Shrubland..... 677
Artemisia tridentata ssp. wyomingensis – Atriplex confertifolia Shrubland..... 679
Artemisia tridentata ssp. wyomingensis / Balsamorhiza sagittata Shrubland..... 680
Artemisia tridentata ssp. wyomingensis / Disturbed Understory Semi-natural Shrubland 680
Artemisia tridentata ssp. wyomingensis / Elymus elymoides Shrubland 683
Artemisia tridentata ssp. wyomingensis / Hesperostipa comata Colorado Plateau Shrubland... 681
Artemisia tridentata ssp. wyomingensis / Leymus salinus Shrubland..... 682
Artemisia tridentata ssp. wyomingensis / Pascopyrum smithii Shrub Herbaceous Vegetation . 681
Artemisia tridentata ssp. wyomingensis / Pleuraphis jamesii Shrubland 682
Artemisia tridentata ssp. wyomingensis / Poa fendleriana Shrubland..... 684
Artemisia tridentata ssp. wyomingensis / Poa secunda Shrubland..... 684
Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrubland 683
Artemisia tridentata ssp. wyomingensis / Sparse Understory Shrubland 679
Atriplex canescens / Achnatherum hymenoides Shrubland..... 685
Atriplex confertifolia - Krascheninnikovia lanata Shrubland..... 686

Atriplex confertifolia / Achnatherum hymenoides Shrubland 687
Atriplex confertifolia / Hesperostipa comata Shrubland 688
Atriplex confertifolia / Pleuraphis jamesii Shrubland 688
Atriplex confertifolia Great Basin Shrubland 687
Atriplex corrugata Dwarf-shrubland 686
Atriplex gardneri Dwarf-shrubland 686
Baltic Rush Herbaceous Vegetation 705
Basin Big Sagebrush - (Rubber Rabbitbrush) / Cheatgrass Semi-natural Shrubland 673
Basin Big Sagebrush / Alkali Sacaton Shrubland 673
Basin Big Sagebrush / Great Basin Wildrye Shrubland 674
Basin Big Sagebrush / Needle-and-Thread Shrubland 674
Betula occidentalis / Mesic Graminoids Shrubland 666
Betula occidentalis Shrubland 666
Big Sagebrush - Utah Serviceberry Shrubland 674
Black Greasewood / Alkali Sacaton Shrubland 697
Black Greasewood / Big Sagebrush Shrubland 696
Black Greasewood / Gardner's Saltbush Shrubland 696
Black Greasewood Disturbed Shrubland 697
Black Sagebrush / Bluebunch Wheatgrass Shrubland 671
Black Sagebrush Shrubland 672
Bluebunch Wheatgrass - Cushion Plants Herbaceous Vegetation 714
Bluebunch Wheatgrass - Salinas Lyme Grass Herbaceous Vegetation 714
Bluebunch Wheatgrass Herbaceous Vegetation 715
Box-elder - Netleaf Hackberry Woodland 634
Box-elder / Choke Cherry Forest 636
Box-elder / Disturbed Understory Woodland 635
Box-elder / Field Horsetail Forest 635
Box-elder / Threeleaf Sumac Woodland 636
Bromus tectorum Semi-natural Herbaceous Vegetation 707
Calamagrostis scopulorum Herbaceous Vegetation 699
Carex pellita Herbaceous Vegetation 704
Carex praegracilis Herbaceous Vegetation 704
Ceanothus velutinus Shrubland 667
Cercocarpus intricatus Montane Shrubland 691
Cercocarpus ledifolius / Artemisia tridentata ssp. vaseyana Woodland 642
Cercocarpus ledifolius / Prunus virginiana Shrubland 642
Cercocarpus ledifolius / Pseudoroegneria spicata Woodland 641
Cercocarpus montanus / Pseudoroegneria spicata Shrubland 691
Cheatgrass Semi-natural Herbaceous Vegetation 707
Chokecherry - (American Plum) Shrubland 667
Chrysothamnus viscidiflorus / Hesperostipa comata Shrubland 688
Chrysothamnus viscidiflorus Talus Shrubland 689
Clustered Field Sedge Herbaceous Vegetation 704
Cocklebur Herbaceous Vegetation 701
Common Reed Semi-natural Herbaceous Vegetation 701
Common Scouring-rush Herbaceous Vegetation 706

Common Threesquare Herbaceous Vegetation 704
Cottonwood / Saltgrass Woodland 638
Coyote Willow / Barren Shrubland 663
Coyote Willow / Mesic Forbs Shrubland 664
Coyote Willow / Mesic Graminoids Shrubland 664
Curl-leaf Mountain-mahogany / Bluebunch Wheatgrass Shrubland 641
Curl-leaf Mountain-mahogany / Chokecherry Shrubland 642
Curl-leaf Mountain-mahogany / Mountain Big Sagebrush Woodland 642
Distichlis spicata Herbaceous Vegetation 702
Ditch Reedgrass Hanging Garden 699
Douglas-fir / Bluebunch Wheatgrass Woodland 648
Douglas-fir / Box-elder Woodland 633
Douglas-fir / Common Juniper Forest 646
Douglas-fir / Creeping Oregon-grape Forest 647
Douglas-fir / Curl-leaf Mountain-mahogany Woodland 645
Douglas-fir / Mountain Snowberry Forest 646
Douglas-fir / Mountain-mahogany Woodland 645
Douglas-fir / Muttongrass Woodland 647
Douglas-fir / Saskatoon Serviceberry Forest 645
Elaeagnus angustifolia Semi-natural Woodland 634
Eleocharis palustris Herbaceous Vegetation 705
Elymus lanceolatus Herbaceous Vegetation 712
Elymus repens Semi-natural Herbaceous Vegetation 702
Ephedra torreyana - (Atriplex spp.) / Nonvascular Gypsum Sparse Vegetation 689
Ephedra viridis / Bromus tectorum Semi-natural Shrubland 689
Equisetum hyemale Herbaceous Vegetation 706
Equisetum laevigatum Herbaceous Vegetation 706
Ericameria nauseosa / Bromus tectorum Semi-natural Shrubland 693
Ericameria nauseosa / Pascopyrum smithii Shrubland 693
Ericameria nauseosa Desert Wash Shrubland 665, 692
Ericameria nauseosa Sand Deposit Sparse Shrubland 692
Eriogonum corymbosum Dwarf-shrubland Alliance 669
Fourwing Saltbush / Indian Ricegrass Shrubland 685
Gardner's Saltbush Dwarf-shrubland 686
Glycyrrhiza lepidota Herbaceous Vegetation 701
Gray Horsebrush Shrubland 669
Grayia spinosa / Achnatherum hymenoides Shrubland 671
Great Basin Wildrye - Saltgrass Herbaceous Vegetation 709
Great Basin Wildrye - Western Wheatgrass Herbaceous Vegetation 708
Green Rabbitbrush / Needle-and-Thread Shrubland 688
Green Rabbitbrush Talus Shrubland 689
Greenleaf Manzanita - (Big Sagebrush) Shrubland 668
Hairy Goldenaster Herbaceous Vegetation 700
Hardstem Bulrush Herbaceous Vegetation 704
Hesperostipa comata - Achnatherum hymenoides Herbaceous Vegetation 713
Hesperostipa comata Great Basin Herbaceous Vegetation 713

Heterotheca villosa Herbaceous Vegetation 700
Indian Ricegrass Colorado Plateau Herbaceous Vegetation 710
James' Galleta Herbaceous Vegetation 711
Juncus balticus Herbaceous Vegetation 705
Juniperus osteosperma / Artemisia nova Woodland 659
Juniperus osteosperma / Artemisia tridentata – Grayia spinosa Woodland 656
Juniperus osteosperma / Artemisia tridentata ssp. tridentata Woodland 656
Juniperus osteosperma / Artemisia tridentata ssp. wyomingensis Woodland 656
Juniperus osteosperma / Bromus tectorum Semi-natural Woodland 653
Juniperus osteosperma / Cercocarpus montanus Woodland 658
Juniperus osteosperma / Glossopetalon spinescens Woodland 662
Juniperus osteosperma / Hesperostipa comata Woodland 653
Juniperus osteosperma / Leymus salinus Woodland 651
Juniperus osteosperma / Pleuraphis jamesii Woodland 654
Juniperus osteosperma / Pseudoroegneria spicata Woodland 652
Juniperus osteosperma / Sparse Understory Woodland 650
Juniperus scopulorum / Artemisia tridentata Woodland 649
Juniperus scopulorum Temporarily Flooded Woodland Alliance 649
Krascheninnikovia lanata / Hesperostipa comata Dwarf-shrubland 690
Krascheninnikovia lanata / Poa secunda Dwarf-shrubland 690
Lepidium latifolium Semi-natural Herbaceous Vegetation 700
Letterman's Needlegrass Herbaceous Alliance 709
Leymus cinereus - Distichlis spicata Herbaceous Vegetation 709
Leymus cinereus - Pascopyrum smithii Herbaceous Vegetation 708
Leymus salinus Shale Sparse Vegetation 710
Limber Pine / Common Juniper Woodland 648
Littleleaf Mock Orange - Mormon-tea Shrubland 670
Littleleaf Mountain-mahogany Montane Shrubland 691
Mancos Columbine - Ditch Reedgrass Hanging Garden 699
Marsh Spikerush Herbaceous Vegetation 705
Mat Saltbush Dwarf-shrubland 686
Mormon-tea / Cheatgrass Semi-natural Shrubland 689
Mountain Big Sagebrush / Arrowleaf Balsamroot Shrubland 675
Mountain Big Sagebrush / Bluebunch Wheatgrass Shrubland 677
Mountain Big Sagebrush / Curly Bluegrass Shrubland 678
Mountain Big Sagebrush / Great Basin Wildrye Shrubland 676
Mountain Big Sagebrush / Letterman’s Needlegrass Shrubland 677
Mountain Big Sagebrush / Muttongrass Shrubland 678
Mountain Big Sagebrush / Needle-and-Thread Shrubland 677
Mountain Big Sagebrush / Western Wheatgrass Shrubland 676
Mountain Willow / Mesic Graminoids Shrubland 663
Mountain-mahogany / Bluebunch Wheatgrass Shrubland 691
Muhlenbergia pungens Herbaceous Vegetation 711
Narrowleaf Cottonwood - Rocky Mountain Juniper Woodland 639
Narrowleaf Cottonwood / Coyote Willow Woodland 640
Narrowleaf Cottonwood / Threeleaf Sumac Woodland 640

Narrowleaf Cottonwood / Water Birch Woodland 640
Needle-and-Thread - Indian Ricegrass Herbaceous Vegetation 713
Needle-and-Thread Great Basin Herbaceous Vegetation 713
Pascopyrum smithii Herbaceous Vegetation 708
Perennial Pepperweed Semi-natural Herbaceous Vegetation 700
Philadelphus microphyllus - Ephedra viridis Shrubland 670
Phragmites australis Western North America Temperate Semi-natural Herbaceous Vegetation 701
Pinus edulis - Juniperus osteosperma / Amelanchier utahensis Woodland 661
Pinus edulis - Juniperus osteosperma / Artemisia nova Woodland 660
Pinus edulis - Juniperus osteosperma / Cercocarpus intricatus Woodland 658
Pinus edulis - Juniperus osteosperma / Cercocarpus ledifolius Woodland 657
Pinus edulis – Juniperus osteosperma / Ephedra viridis Woodland 661
Pinus edulis - Juniperus osteosperma / Leymus salinus Woodland 651
Pinus edulis - Juniperus osteosperma / Petradoria pumila Woodland 654
Pinus edulis - Juniperus osteosperma / Pseudoroegneria spicata - Cushion Plant Woodland 653
Pinus edulis - Juniperus osteosperma / Purshia tridentata Woodland 660
Pinus edulis - Juniperus osteosperma / Sparse Understory Woodland 650
Pinus edulis - Juniperus spp. / Artemisia tridentata (ssp. wyomingensis, ssp. vaseyana) Woodland 657
Pinus edulis - Juniperus spp. / Cercocarpus montanus - Mixed Shrubs Woodland 659
Pinus edulis - Juniperus spp. / Poa fendleriana Woodland 655
Pinus flexilis / Juniperus communis Woodland 648
Pinus ponderosa / Artemisia tridentata Woodland 643
Pinus ponderosa / Cercocarpus ledifolius Woodland 644
Pinus ponderosa / Juniperus scopulorum Woodland 643
Pinus ponderosa Rockland Woodland 643
Pleuraphis jamesii Herbaceous Vegetation 711
Ponderosa Pine / Curl-leaf Mountain-mahogany Woodland 644
Ponderosa Pine / Mountain Big Sagebrush Woodland 643
Ponderosa Pine / Rockland Woodland 643
Ponderosa Pine / Rocky Mountain Juniper Woodland 643
Populus angustifolia / Betula occidentalis Woodland 640
Populus angustifolia / Juniperus scopulorum Woodland 639
Populus angustifolia / Rhus trilobata Woodland 640
Populus angustifolia / Salix exigua Woodland 640
Populus deltoides (ssp. wislizeni, ssp. monilifera) / Distichlis spicata Woodland 638
Populus deltoides (ssp. wislizeni, ssp. monilifera) / Disturbed Understory Woodland 639
Populus deltoides ssp. wislizeni / Acer negundo Woodland 637
Populus deltoides ssp. wislizeni / Rhus trilobata Woodland 638
Populus tremuloides / Amelanchier alnifolia - Symphoricarpos oreophilus / Mixed Graminoid Forest 631
Populus tremuloides / Ceanothus velutinus Forest 631
Populus tremuloides / Juniperus communis Forest 631
Populus tremuloides / Prunus virginiana Forest 630
Populus tremuloides / Symphoricarpos oreophilus / Carex rossii Forest 632
Populus tremuloides / Symphoricarpos oreophilus Forest 632

Post-fire Herbaceous Vegetation 707
Prairie Cordgrass Western Herbaceous Vegetation 703
Prunus virginiana - (Prunus americana) Shrubland 667
Pseudoroegneria spicata - Cushion Plants Herbaceous Vegetation 714
Pseudoroegneria spicata - Leymus salinus Herbaceous Vegetation 714
Pseudoroegneria spicata Herbaceous Vegetation 715
Pseudotsuga menziesii – Acer negundo Forest 633
Pseudotsuga menziesii / Amelanchier alnifolia Forest 644
Pseudotsuga menziesii / Cercocarpus ledifolius Woodland 645
Pseudotsuga menziesii / Cercocarpus montanus Woodland 645
Pseudotsuga menziesii / Juniperus communis Forest 646
Pseudotsuga menziesii / Mahonia repens Woodland 647
Pseudotsuga menziesii / Poa fendleriana Woodland 647
Pseudotsuga menziesii / Pseudoroegneria spicata Woodland 648
Pseudotsuga menziesii / Symphoricarpos oreophilus Forest 646
Quackgrass Semi-natural Herbaceous Vegetation 702
Quaking Aspen / Chokecherry Forest 630
Quaking Aspen / Common Juniper Forest 631
Quaking Aspen / Mountain Snowberry / Ross' Sedge Forest 632
Quaking Aspen / Mountain Snowberry Forest 632
Quaking Aspen / Saskatoon Serviceberry - Mountain Snowberry / Mixed Graminoid Forest 631
Quaking Aspen / Tobaccobrush Forest 631
Rhus trilobata Intermittently Flooded Shrubland 665
Rio Grande Cottonwood / Box-elder Woodland 637
Rio Grande Cottonwood / Disturbed Understory Woodland 639
Rio Grande Cottonwood / Threeleaf Sumac Woodland 638
Rocky Mountain Juniper / Basin Big Sagebrush Woodland 649
Rocky Mountain Juniper Temporarily Flooded Woodland Alliance 649
Rubber Rabbitbrush / Cheatgrass Semi-natural Shrubland 693
Rubber Rabbitbrush / Western Wheatgrass Shrubland 693
Rubber Rabbitbrush Desert Wash Shrubland 665, 692
Rubber Rabbitbrush Sand Deposit Sparse Shrubland 692
Russian-olive Semi-natural Woodland 634
Salinas Lyme Grass Shale Sparse Vegetation 710
Salix exigua / Barren Shrubland 663
Salix exigua / Mesic Forbs Shrubland 664
Salix exigua / Mesic Graminoids Shrubland 664
Salix monticola / Mesic Graminoids Shrubland 663
Saltcedar Semi-natural Shrubland 663
Saltgrass Herbaceous Vegetation 702
Sand Dropseed Great Basin Herbaceous Vegetation 712
Sandhills Muhly Herbaceous Vegetation 711
Sarcobatus vermiculatus / Artemisia tridentata Shrubland 696
Sarcobatus vermiculatus / Atriplex gardneri Shrubland 696
Sarcobatus vermiculatus / Sporobolus airoides Shrubland 697
Sarcobatus vermiculatus Disturbed Shrubland 697

Saskatoon Serviceberry / Mountain Snowberry Shrubland 695
Schoenoplectus acutus Herbaceous Vegetation 704
Schoenoplectus pungens Herbaceous Vegetation 704
Serviceberry - Mountain-mahogany Shrubland 694
Shadscale - Winter-fat Shrubland 686
Shadscale / Indian Ricegrass Shrubland 687
Shadscale / James' Galleta Shrubland 688
Shadscale / Needle-and-Thread Shrubland 688
Shadscale Great Basin Shrubland 687
Shale Annual Herbaceous Vegetation 706
Smooth Horsetail Herbaceous Vegetation 706
Spartina gracilis Herbaceous Vegetation 703
Spartina pectinata Western Herbaceous Vegetation 703
Spiny Hopsage / Indian Ricegrass Shrubland 671
Sporobolus cryptandrus Great Basin Herbaceous Vegetation 712
Streamside Wild Rye Herbaceous Vegetation 712
Tamarix spp. Temporarily Flooded Shrubland 663
Tetradymia canescens Shrubland 669
Threeleaf Sumac Intermittently Flooded Shrubland 665
Tobaccobrush Shrubland 667
Torrey's Joint-fir - (Saltbush) / Nonvascular Gypsum Sparse Vegetation 689
Two-needle Pinyon - Juniper / Big Sagebrush Woodland 657
Two-needle Pinyon - Juniper / Mountain-mahogany - Mixed Shrubs Woodland 659
Two-needle Pinyon - Juniper / Muttongrass Woodland 655
Two-needle Pinyon - Juniper / Salinas Lyme Grass Woodland 651
Two-needle Pinyon - Utah Juniper / Black Sagebrush Woodland 660
Two-needle Pinyon - Utah Juniper / Bluebunch Wheatgrass - Cushion Plant Woodland 653
Two-needle Pinyon - Utah Juniper / Curl-leaf Mountain-mahogany Woodland 657
Two-needle Pinyon - Utah Juniper / Littleleaf Mountain-mahogany Woodland 658
Two-needle Pinyon - Utah Juniper / Mormon-tea Woodland 661
Two-needle Pinyon - Utah Juniper / Sparse Understory Woodland 650
Two-needle Pinyon - Utah Juniper / Utah Serviceberry Woodland 661
Two-needle Pinyon - Utah Juniper/ Antelope Bitterbrush Woodland 660
Utah Juniper / Basin Big Sagebrush Woodland 656
Utah Juniper / Big Sagebrush - Spiny Hopsage Woodland 656
Utah Juniper / Black Sagebrush Woodland 659
Utah Juniper / Cheatgrass Semi-natural Woodland 653
Utah Juniper / James' Galleta Woodland 654
Utah Juniper / Mountain-mahogany Woodland 658
Utah Juniper / Needle-and-Thread Woodland 653
Utah Juniper / Salinas Lyme Grass Woodland 651
Utah Juniper / Sparse Understory Woodland 650
Utah Juniper / Spiny Greasebush Woodland 662
Utah Juniper / Wyoming Big Sagebrush Woodland 656
Utah Serviceberry / Bluebunch Wheatgrass Shrubland 695
Utah Serviceberry Shrubland 695

Water Birch / Mesic Graminoids Shrubland 666
Water Birch Shrubland 666
Western Wheatgrass Herbaceous Vegetation 708
Wild Buckwheat Dwarf Shrubland Alliance 669
Wild Licorice Herbaceous Vegetation 701
Winter-fat / Curly Bluegrass Dwarf-shrubland 690
Winter-fat / Needle-and-Thread Dwarf-shrubland 690
Woolly Sedge Herbaceous Vegetation 704
Wyoming Big Sagebrush - Shadscale Shrubland 679
Wyoming Big Sagebrush / Arrowleaf Balsamroot Shrubland 680
Wyoming Big Sagebrush / Bluebunch Wheatgrass Shrubland 683
Wyoming Big Sagebrush / Bottlebrush Shrubland 683
Wyoming Big Sagebrush / Curly Bluegrass Shrubland 684
Wyoming Big Sagebrush / Disturbed Understory Semi-natural Shrubland 680
Wyoming Big Sagebrush / James' Galleta Shrubland 682
Wyoming Big Sagebrush / Muttongrass Shrubland 684
Wyoming Big Sagebrush / Needle-and-Thread Colorado Plateau Shrubland 681
Wyoming Big Sagebrush / Sparse Understory Shrubland 679
Wyoming Big Sagebrush / Western Wheatgrass Shrub Herbaceous Vegetation 681
Xanthium strumarium Herbaceous Vegetation 701

Appendix H

Modified Anderson Land Use-Land Cover Classification

This classification was used to as the primary attribute for areas of developed land within and around Dinosaur National Monument. Every polygon was assigned an Anderson Land Use or Land Cover code in addition to its vegetation or geologic code.

Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
1.0 Water	1.1 Open Water	1.11 Stream/river			
		1.12 Canal/ditch	1.121 Lined canal/ditch		
			1.122 Unlined canal/ditch		
		1.13 Lake/pond			
		1.14 Reservoir			
		1.15 Bay/estuary			
		1.16 Sea/ocean			
	1.2 Perennial Ice/Snow	1.21 Snowfield			
		1.22 Glacier			
2.0 Developed	2.1 Residential	2.11 Single-family residential			
		2.12 Multi-family residential			
	2.2 Non-residential Developed	2.21 Commercial/Light Industry	2.211 Major Retail		
			2.212 Mixed/Minor Retail and Services		
			2.213 Office		
			2.214 Light industry		
		2.22 Heavy Industry	2.221 Petro-chemical Refinery		
		2.23 Communications and Utilities			
		2.24 Institutional	2.241 Schools		
			2.242 Cemeteries		
		2.25 Agricultural Business	2.251 Aquiculture		
			2.252 Confined feeding		
		2.26 Transportation	2.261 Airport		
		2.27 Entertainment/ Recreation	2.271 Golf Course		
			2.272 Urban Parks		
	2.3 Mixed Urban				
3.0 Bare	3.1 Transitional				
	3.2 Quarries/Strip mines/Gravel pits				
	3.3 Bare Rock/Sand				
	3.4 Flats				

Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
	3.5 Disposal				
4.0 Vegetated	4.1 Woody	4.11 Forested	4.111 Deciduous		
			4.112 Evergreen		
			4.113 Mixed		
		4.12 Shrub land	4.121 Deciduous		
			4.122 Evergreen		
			4.123 Mixed		
			4.124 Desert scrub		
		4.13 Orchards/vineyards /groves	4.131 Irrigated Orchard/ vineyards/groves		
			4.132 Citrus		
			4.133 Non-managed Citrus		
		4.14 Mixed Forest/Shrub			
	4.2 Herbaceous	4.21 Natural Herbaceous	4.211 Natural Grassland		
		4.22 Planted/cultivated	4.221 Fallow/Bare Fields		
			4.222 Small Grains	4.2221 Irrigated small grains	
			4.223 Row Crops	4.2231 Irrigated row crops	
				4.2232 Sugar Cane	
			4.224 Planted grasses	4.2241 Pasture/ hay	4.22411 Irrigated Pasture/hay
				4.2242 Other grass	4.22421 Irrigated Other grass
			4.225 Irrigated Planted/ cultivated		
	4.3 Wetlands	4.31 Woody wetlands			
		4.32 Emergent wetlands			

Classification Definitions

1.0 WATER - area covered by water, snow, or ice with less than 25% vegetated or developed cover, unless specifically included in another category

1.1 Open Water - all areas of open water with less than 25% vegetative or developed cover

1.11 Stream/river - a natural body of flowing water. Includes streams and rivers that have been channelized in order to control flooding or erosion or to maintain flow for navigation.

1.12 Canal/ditch - a man-made open waterway constructed to transport water, to irrigate or drain land, to connect two or more bodies of water, or to serve as a waterway for

watercraft. Collection should include the right of ways and associated dikes and levees.

1.121 Lined canal/ditch - a canal or ditch lined with concrete or other impervious material preventing passage of water into underlying strata

1.122 Unlined canal/ditch - a canal or ditch constructed with dirt or other porous material allowing water to drain

1.13 Lake/pond - a non-flowing, naturally-existing, body of water. Includes water impounded by natural occurrences and artificially regulated natural lakes. The delineation of a lake is based on the areal extent of water at the time the imagery was acquired.

1.14 Reservoir - any artificial body of water, unless specifically included in another category. It can lie in a natural basin or a man-constructed basin. The delineation of a reservoir is based on the areal extent of water at the time the imagery was acquired. (The water control structures are classified as Communications/Utilities)

2.0 DEVELOPED - Areas of the earth that have been improved by man. Includes all "built-up" and urban areas of the landscape. Does NOT include mining lands, croplands, or waste-disposal areas (dumps). This land use category takes precedence over a land cover category when the criteria for more than one category are met.

2.1 Residential - lands containing structures used for human habitation

2.11 Single-family Residential - Lands used for housing residents in single-family dwelling units. Includes trailer parks, mobile home parks, and entire "farmsteads" when there is a home in the complex. (If no home is in the complex, it should be classified as Agricultural Business.) Single-family residential buildings located within another category, such as military family housing, should be identified in this category.

2.12 Multi-family Residential - All lands devoted to housing more than one family on a permanent or semi-permanent basis, group living situations, and their associated grounds. Includes apartments, apartment complexes, duplexes, triplexes, attached row houses, condominiums, retirement homes, nursing homes, and residential hotels. Residential buildings located within another category, such as barracks and dormitories, should be identified in this category when possible, (except residential buildings within convents and monasteries - include these with Institutional).

2.2 Non-residential Developed - Any "developed" area or feature that is used for a purpose other than habitation.

2.21 Commercial/Light Industry - structures and associated grounds used for the sale of products and services, for business, or for light industrial activities. Includes all retail and wholesale operations. Include "industrial parks" and other features that cannot be clearly classified as either a retail service or light industry, such as heavy equipment yards, machinery repair, and junkyards.

2.211 Major Retail - This category includes shopping malls, retail "outlet centers," and "superstores" that draw clientele from a regional area. Major retail centers consist of extremely large single buildings or a complex of large buildings and their parking lots. Malls usually house one or two major department stores and numerous small retail stores. Includes outlet centers, "superstores", multi-plex movie theaters, and huge warehouse-type stores. The structures themselves are often several acres in size and have extensive parking lots.

2.212 Mixed/Minor Retail and Services - Includes individual stores and services of various sizes and associated grounds and parking. Includes neighborhood strip malls and shopping centers, veterinarian services, small movie theaters, gas stations and

auto repair shops, garden centers, motels, small auto dealerships, public parking lots, lumber yards, art galleries, farm supply stores, flea-markets, bars and restaurants, grocery stores, and commercial "truck stops". Many small office buildings will have no features to distinguish them from retail stores and will fall in this category.

2.213 Office - structures and their associated grounds and parking, that provide financial, professional, administrative, and informational type services. Includes administrative government offices (e.g., IRS and State Motor Vehicles offices) trade schools, professional medical office complexes, research facilities/centers, and banks. Usually only office buildings in office complexes or in downtown areas will be distinguishable as offices. Small, single-story office buildings may blend in with minor retail.

2.214 Light industry - structures and their associated grounds and facilities that are used primarily to produce or process some finished product; or as a wholesale distribution center. Activities include design, assembly, finishing, packaging, warehousing or shipping of products rather than processing raw materials. The materials used in light industry have generally been processed at least once. They are generally "clean" industries that do not produce lots of waste materials. Use this category as a default for those facilities with semi-truck and trailer activity around loading docks, but that cannot be classified as either retail services or heavy industry. Includes electronic firms, clothing and furniture manufacture, grain elevators, printing plants, commercial bakeries, shipping and distribution centers, sand/gravel sorting facilities, secondary buildings associated with a mining or quarrying site, and generic warehouses.

2.22 Heavy Industry - structures and their associated grounds used for heavy fabrication, manufacturing and assembling parts that are, in themselves, large and heavy; or for processing raw materials such as iron ore, timber, and animal products. Accumulated raw materials are subject to treatment by mechanical, chemical, or heat processing to render them suitable for further processing, or to produce materials from that finished products are created. Heavy industries generally require large amounts of energy and raw materials and produce a significant amount of waste products. Indicators of heavy industry may be stockpiles of raw materials, energy producing sources and fuels, waste disposal areas and ponds, transportation facilities capable of handling heavy materials, smokestacks, furnaces, tanks, and extremely large buildings that are complex in outline and roof structure. Include associated waste piles and waste ponds. Heavy industry is usually located away from residential areas. Includes steel mills, paper mills, lumber mills, cotton gins, chemical plants, cement and brick plants, smelters, rock crushing machinery, and ore-processing facilities associated with mining.

2.23 Communications and Utilities - structures or facilities and associated grounds used for the generation of power and communications, the treatment or storage of drinking water, waste management, flood control, or the distribution and storage of gas and oil not associated with a unique feature. Includes pumping stations (oil, gas, or water), tank farms, power plants, electric substations, sewage treatment facilities and ponds, garbage collection facilities (not the final dumping ground - these are included in Bare), dams, levees, and spillways of appropriate dimensions, filtration plants, and heavy concentrations of antennas or satellite dishes; along with the related operational buildings.

2.24 Institutional - specialized government or private features that meet the educational, religious, medical, governmental, protective, and correctional needs of the public. Parking lots and associated grounds are included with these features. Includes public and private schools (not day care), state capitols, city halls, courthouses, libraries, churches, convents, monasteries, hospitals and training hospitals, post offices, police and fire departments, prisons, and military bases. Only the military-business areas of a military base are classified here; residential, airport, athletic fields, and vegetated areas are classified in the appropriate category.

2.241 Schools/Universities - public and private schools, seminaries, university campuses, and associated lands. Include the entire "core campus" area, along with athletic fields and vegetated areas. This category does not include day care centers or commercial trade schools, both of that are commercial uses.

2.242 Cemeteries - structures and lands devoted to burial of the dead. Includes mausoleums, service areas, and parking lots.

2.25 Agricultural Business - structures and all associated grounds used for raising plants or animals for food or fiber. Includes fish farms and hatcheries, feedlots, poultry farms, dairy farms, temporary shipping and holding pens, animal breeding or training facilities, and greenhouses. (Farmsteads including a dwelling are classified as residential, not agricultural business.)

2.251 Aquiculture site - a set of pools of water and related structures used for producing fish, shellfish, or aquatic plants

2.252 Confined feeding operation - structures and associated pens, storage facilities, waste areas, and ponds that are used for raising meat and dairy cattle, hogs, poultry, or other animals. These features must have a relatively permanent and high animal population density. Temporary holding pens and thoroughbred horse farms usually do not qualify.

2.26 Transportation - Roads, railroads, airports, port facilities, and their associated lands. Roads and railroads include the right-of-way, interchanges, and median strips. Category includes railroad stations, railroad yards, bus stations, highway maintenance yards, school bus parking and service yards, and park-and-ride lots. Port facilities include loading and unloading facilities, docks, locks and, temporary storage areas. Associated warehousing and transfer stations for truck or rail are included only if they appear to be an integral part of the airport or port facility. Nearby but separate warehouses will be classified as light industry.

2.27 Entertainment and Recreational - areas and structures used predominantly for athletic or artistic events, or for leisure activities, and all associated lands and developed parking areas. Includes outdoor amphitheaters, drive-in theaters, campgrounds, zoos, sports arenas (including indoor arenas), developed parks and playgrounds, community recreation centers, museums, amusement parks, public swimming pools, fairgrounds, and ski complexes (not the ski slopes). Marinas with over 25% of water surface covered by docks and boats are included here.

2.271 Golf Course - structures, associated grounds, driving ranges, and interspersed natural areas used for the game of golf.

2.272 Urban Parks - designated open space in urban settings used for outdoor recreation. Include grass fields and associated structures, parking lots, and facilities. Includes city parks, "green-belt" urban parks, and athletic fields not associated with

a school. Does not include undeveloped "open space" on the periphery of urban areas or undeveloped regional, state, or national park areas.

2.3 Mixed Urban - developed areas that have such a mixture of residential and non-residential features where no single feature meets the minimum mapping unit specification. This category is used when more than one-third of the features in an area do not fit into a single category. Often applicable in the central, urban-core area of cities.

3.0 BARE - undeveloped areas of the earth not covered by water that exhibit less than 25% vegetative cover or less than 5% vegetative cover if in an arid area. The earth's surface may be composed of bare soil, rock, sand, gravel, salt deposits, or mud.

3.1 Transitional Bare - areas dynamically changing from one land cover/land use to another, often because of land use activities. Includes all construction areas, areas transitioning between forest and agricultural land, and urban renewal areas that are in a state of transition.

3.2 Quarries/Strip Mines/Gravel Pits - areas of extractive mining activities with significant surface disturbance. Vegetative cover and overburden are removed for the extraction of deposits such as coal, iron ore, limestone, copper, sand and gravel, or building and decorative stone. Current mining activity does not need to be identifiable. Inactive or unreclaimed mines and pits are included in this category until another land cover or land use has been established. Includes strip mines, open-pit mines, quarries, borrow pits, oil and gas drilling sites, and gravel pits with their associated structures, waste dumps, and stockpiles.

3.3 Bare Rock/Sand - includes bare bedrock, natural sand beaches, sand bars, deserts, desert pavement, scarps, talus, slides, lava, and glacial debris.

3.4 Flats - A level landform composed of unconsolidated sediments of mud, sand, gravel, or salt deposits. Includes coastal tidal flats and interior desert basin flats and playas.

3.5 Disposal - designated areas where refuse is dumped or exists, such as landfills, trash dumps, or hazardous-waste disposal sites. Reclaimed disposal areas or those covered with vegetation do not qualify.

4.0 VEGETATED - areas having generally 25% or more of the land or water with vegetation. Arid or semi-arid areas may have as little as 5% vegetation cover.

4.1 Woody Vegetation - land with at least 25% tree and (or) shrub canopy cover

4.11 Forested - land where trees form at least 25% of the canopy cover

4.111 Deciduous Forest - area dominated by trees where 75% or more of the canopy cover can be determined to be trees that loose all their leaves for a specific season of the year.

4.112 Evergreen Forest - area dominated by trees where 75% or more of the canopy cover can be determined to be trees that maintain their leaves all year.

4.113 Mixed Forest - areas dominated by trees where neither deciduous nor evergreen species represent more than 75% of the canopy cover.

4.12 Shrub land - areas where trees have less than 25% canopy cover and the existing vegetation is dominated by plants that have persistent woody stems, a relatively low growth habit, and that generally produce several basal shoots instead of a single shoot. Includes true shrubs, trees that are small or stunted because of environmental conditions, desert scrub, and chaparral. In the eastern US, include former cropland or pasture lands that are now covered by brush to the extent that they are no longer identifiable or usable as cropland or pasture. Clear-cut areas will exhibit a stage of shrub cover during the

regrowth cycle. Some common species that would be classified as shrub land are mountain mahogany, sagebrush, and scrub oaks.

4.121 Deciduous Shrub land - areas where 75% or more of the land cover can be determined to be shrubs that loose all their leaves for a specific season of the year

4.122 Evergreen Shrub land - areas where 75% or more of the land cover can be determined to be shrubs that keep their leaves year round.

4.123 Mixed Shrub land - areas dominated by shrubs where neither deciduous nor evergreen species represent more than 75% of the land cover

4.124 Desert Scrub - land areas predominantly in arid and semi-arid portions of the southwestern U.S. Existing vegetation is sparse and often covers only 5-25% of the land. Example species include sagebrush, creosote, saltbush, black greasewood, and cactus.

4.13 Planted/Cultivated Woody (Orchards/Vineyards/Groves) - areas containing plantings of evenly spaced trees, shrubs, bushes, or other cultivated climbing plants usually supported and arranged evenly in rows. Includes orchards, groves, vineyards, cranberry bogs, berry vines, and hops. Includes tree plantations planted for the production of fruit, nuts, Christmas tree farms, and commercial tree nurseries. Exclude pine plantations and other lumber or pulp wood plantings that will be classified as Forest.

4.131 Irrigated Planted/Cultivated Woody - orchards, groves, or vineyards where a visible irrigation system is in place to supply water

4.14 Mixed Forest/Shrub – areas dominated by forest and shrub where neither species represent more than 75 % of the canopy cover.

4.2 Herbaceous Vegetation - areas dominated by non-woody plants such as grasses, forbs, ferns and weeds, either native, naturalized, or planted. Trees must account for less than 25% canopy cover while herbaceous plants dominate all existing vegetation.

4.21 Natural Herbaceous - areas dominated by native or naturalized grasses, forbs, ferns and weeds. It can be managed, maintained, or improved for ecological purposes such as weed/brush control or soil erosion. Includes vegetated vacant lots and areas where it cannot be determined whether the vegetation was planted or cultivated such as in areas of dispersed grazing by feral or domesticated animals. Includes landscapes dominated by grass-like plants such as bunch grasses, Palouse grass, palmetto prairie areas, and tundra vegetation, as well as true prairie grasses.

4.211 Natural Grasslands - natural areas dominated by true grasses. Includes undisturbed tall-grass and short-grass prairie in the Great Plains of the U.S.

4.22 Planted/Cultivated Herbaceous - areas of herbaceous vegetation planted and/or cultivated by humans for agronomic purposes in developed settings. The majority of vegetation in these areas is planted and/or maintained for the production of food, feed, fiber, pasture, or seed. Temporarily flooded are included in this category. Do not include harvested areas of naturally occurring plants such as wild rice and cattails.

4.221 Fallow/Bare Fields - areas within planted or cultivated regions that have been tilled or plowed and do not exhibit any visible vegetation cover

4.222 Small Grains - areas used for the production of grain crops such as wheat, oats, barley, graham, and rice. Category is difficult to distinguish from cultivated grasses grown for hay and pasture. Indicators of small grains may be a less than 10% slope, annual plowing and seeding, distinctive field patterns and sizes, different timing of green-up and harvest, different harvesting practices, a very “even” texture

and tone, or regional variations discovered during field checks.

4.223 Row Crops - areas used for the production of crops or plants such as corn, soybeans, vegetables, tobacco, flowers and cotton. Fields that exhibit characteristics similar to row crops, but that do not have any other distinguishing features for a more specific category may be included.

4.2231 Irrigated Row Crops - areas used for the production of row crops where a visible irrigation system is in place to supply water

4.224 Cultivated grasses - areas of herbaceous vegetation, including perennial grasses, legumes, or grass-legume mixtures that are planted by humans and used for erosion control, for seed or hay crops, for grazing animals, or for landscaping purposes

4.2241 Pasture/Hay - areas of cultivated perennial grasses and/or legumes (e.g., alfalfa) used for grazing livestock or for seed or hay crops. Pasturelands can have a wide range of cultivation levels. It can be managed by seeding, fertilizing, application of herbicides, plowing, mowing, or baling. Pastureland has often been cleared of trees and shrubs, is generally on steeper slopes than cropland, is intended to graze animals at a higher density than open rangeland, and is often fenced and divided into smaller parcels than rangeland or cropland. Hay fields may be more mottled than small grain fields as they are not plowed annually and may be harvested and baled two or three times a year in some locations.

4.22411 Irrigated Pasture/Hay - areas used as pasture or hay fields where a visible irrigation system is in place to supply water

4.2242 Other planted grasses - areas of other cultivated grass such as turf and sod farms.

4.22421 Irrigated other grasses - areas of other cultivated grasses where a visible irrigation system is in place to supply water

4.225 Irrigated Planted Herbaceous - land that is growing some indistinguishable crop or grass, but is obviously irrigated

4.3 Vegetated Wetland - areas where the water table is at, near, or above the land surface for a significant part of most years and vegetation indicative of this covers more than 25% of the land surface. Wetlands can include marshes, swamps situated on the shallow margins of bays, lakes, ponds, streams, or reservoirs; wet meadows or perched bogs in high mountain valleys, or seasonally wet or flooded low spots or basins. Do not include agricultural land that is flooded for cultivation purposes.

4.31 Woody Wetland - areas dominated by woody vegetation. Includes seasonally flooded bottomland, mangrove swamps, shrub swamps, and wooded swamps including those around bogs. Wooded swamps and southern flood plains contain primarily cypress, tupelo, oaks, and red maple. Central and northern flood plains are dominated by cottonwoods, ash, alder, and willow. Flood plains of the Southwest may be dominated by mesquite, saltcedar, seepwillow, and arrowweed. Northern bogs typically contain tamarack or larch, black spruce, and heath shrubs. Shrub swamp vegetation includes alder, willow, and buttonbush.

4.32 Emergent Herbaceous Wetlands - areas dominated by wetland herbaceous vegetation that is present for most of the growing season. Includes fresh-water, brackish-water, and salt-water marshes, tidal marshes, mountain meadows, wet prairies, and bogs.

Appendix I

Soils Series of Dinosaur National Monument

(NRCS 2007)

Soil Series	Description
Abracon	Alluvium and colluvium; very deep; well drained; fan remnants, hills, mesas; 3-25% slopes; 5,300-6,300’
Anasazi	Alluvium and colluvium; moderately deep; well drained; over residuum derived from sandstone and limestone; cuestas; 3-25% slopes; 5,400-6,400’
Arches	Eolian; very shallow and shallow; excessively drained; overlying sandstone; hills; 5-40% slopes; 5,100-6,000’ elevation
Avalon	Alluvium and colluvium; very deep; well drained; over residuum derived from sandstone and limestone; cuestas; 3-25% slopes; 5,400-6,400’
Bankard Family	Alluvium and colluvium; very deep; excessively drained; derived from various sources; flood plains; 0-8% slopes; 5,000-6,000’
Begay	Eolian; very deep; well drained; over alluvium; fan remnants and hillslopes; 2-15% slopes; 4,800-6,000’ elevation
Berlake	Alluvium and colluvium; very deep; well drained; derived from sandstone; plateaus; 1-15% slope; 7,300-8,000’
Bodry	Alluvium and colluvium; moderately deep; well drained; over residuum derived from weathered shale; hillslopes; 10-40% slopes; 5,000-5,500’
Bondman	Residuum and colluvium; very shallow or shallow; well drained; derived from sandstone; mountains; 5-40% slopes; 6,500-8,500’ elevation.
Borolls	Residuum and colluvium; moderately deep or very deep; well drained; derived from sedimentary rocks; mountains; 25-75% slopes; 6,500-8,500’
Cameo	Alluvium; very deep; well drained; derived from various sources; flood plains; 0-8% slopes; 5,000-6,300’
Chew	Reworked eolian material and residuum; moderately deep; well drained; derived from limestone; hillslopes and shoulders; 10-50% slopes; 5,000-6,800’
Chipeta	Residuum; shallow; well drained; derived from shale; hills; 8-35% slopes; 5,400-6,100’
Clapper	Colluvium; very deep; well drained; many sources; hillslopes; 25-50% slopes; 5,500-6,300’
Clyl	Colluvium; very deep; well drained; many sources; mountain slopes; 15-65%; 7,000-8,000’
Cortyzack	Eolian deposits and slope alluvium; very deep; well drained; derived from sandstone; hills; 3-25% slopes; 6,800-8,200’
Cragnot	Residuum, colluvium, and alluvium; very deep; well drained; derived from limestone; hills and valleys; 6-75% slopes; 6,300-8,500’
Crustown	Residuum; shallow; excessively drained; derived from calcareous sandstone; hillslopes; 1-40% slopes; 5,500-5,750’
Cryochrepts	Colluvium; deep and very deep; well drained; derived from sedimentary rocks; mountains; 50-90% slopes; 6,000-7,400’
Davtone	Alluvium and colluvium; very deep; well drained; derived from sandstone; mountains; 12-35% slopes; 7,000-9,000’
Dearjosh	Residuum and alluvium; very deep; excessively drained; derived from sandstone; cuestas and mesas; 3-15% slopes; 6,200-6,800’
Deaver	Residuum; moderately deep; well drained; derived from shale; hills; 8-45% slopes; 5,400-6,100’
Detra	Slope alluvium; very deep; well drained; derived from sandstone; hills; 1-12% slopes; 6,800-7,800’
Detra Family	Alluvium; very deep; well drained; derived from sandstone; mountains; 3-10% slopes; 7,0008,200’
Duffymont	Slope alluvium and colluvium; very shallow or shallow; well drained; mountain slope and hill; 3-25% slopes; 7,000-8,500’
Eghelm	Alluvium; very deep; well drained; many sources; flood plains; 1-3% slopes; 4,700-4,800’
Emlin	Alluvium; very deep, well drained; derived from limestone and sandstone; structural benches and mountains; 1-12% slopes; 6,600-8,100’
Fluvaquents	Alluvium; very deep; very poorly drained; derived from various sources; flood plains and oxbows; 0-1% slopes; 4,700-6,000’

Forsey	Alluvium or colluvium; very deep; well drained; derived from sandstone; very deep; well drained; mountain slopes; 12-35% slopes; 7,000-9,000’
Grapit	Slope alluvium and colluvium; very deep; well drained; hills and valleys; 12-75% slopes; 6,300-8,500’
Green River	Alluvium; very deep; moderately well drained; many sources; flood plains; 0-2% slopes; 4,700-5,800’
Hackling	Residuum and colluvium; shallow; well drained; derived from interbedded calcareous sandstone and limestone; mountains, fan remnants, structural benches; 5-45% slopes; 5,800-8,400’
Hanksville	Colluvium over residuum; moderately deep; well drained; many sources; hillslopes; 25-50% slopes; 4,800-5,100’
Haploborolls	Colluvium and residuum; very shallow to moderately deep; well drained; derived from sandstone; mountains; 10-40% slopes; 6,400-8,000’
Holter	Alluvium or colluvium; very deep; well drained; derived from limestone and sandstone; mountains; 10-25% slopes; 7,000-8,200’
Iogoon	Alluvium; very deep; moderately well drained; derived from sedimentary rocks; flood plains; 2-5% slopes; 5,000-5,600’
Ironco	Colluvium; very deep; well drained; derived from sandstone; mountains; 25-50% slopes; 7,000-8,000’
Labyrinth	Alluvium; very deep; moderately well drained; derived from limestone; flood plains; 2-5% slopes; 5,000-5,600’
Lakebench	Alluvium and residuum; very deep; well drained; derived from mixed sources; alluvial fans, cuestas, mesas, fan remnants, structural benches; 3-30% slopes; 6,000-7,000’
Layoint	Eolian deposits over residuum; moderately deep; somewhat excessively drained; derived from sandstone; plateaus; 1-8% slopes; 7,300-8,000’
Lodore	Residuum and alluvium; moderately deep; well drained; derived from sandstone; mesas, cuestas, hills; 3-45% slopes; 6,200-7,400’
Mantlemine	Alluvium and residuum; very deep; well drained; derived from interbedded limestone and sandstone; structural benches, alluvial fans, fan remnants, 1-25% slopes; 5,800-7,400’
Marthaspeak	Residuum; moderately deep; somewhat excessively drained; derived from sandstone; mesas, cuestas; 1-45% slopes; 6,200-7,000’
Massadona	Alluvium; very deep; well drained; derived from shale; hills; 2-8% slopes; 4,700-4,900’
Mellenthin	Colluvium over residuum; very shallow or shallow; well drained; derived from limestone and sandstone; fan remnants, structural benches; 3-45% slopes; 5,500-6,500’
Mespun	Eolian deposits; very deep; excessively drained; many sources; hillslopes, fan remnants; 4-25%; 4,800-6,000’
Mido	Alluvium; very deep; excessively drained; many sources; hills; 3-12% slopes; 5,350-5,950’
Mikim	Alluvium; very deep; well drained; many sources; alluvial fans, alluvial flats; 1-4% slopes; 5,000-5,400’
Milok	Eolian material over alluvium and colluvium; very deep; well drained; many sources; fan remnants, hillslopes; 3-65% slopes; 4,800-6,400’
Moosed	Residuum; very shallow or shallow; excessively drained; derived from sandstone; plateaus; 120% slopes; 7,300-8,000’
Mulgon	Colluvium; very deep; well drained; derived from sandstone; mountains; 25-50% slopes; 7,000-9,000’
Notlic	Alluvium; very deep; well drained; derived from sedimentary rocks; alluvial fans; 5-15% slopes; 5,000-5,800’
Paradox	Alluvium; very deep; well drained; many sources; alluvial fans, alluvial flats; 3-8% slopes; 6,000-6,700’
Pensore	Residuum; shallow; well drained; derived from limestone; hills, valleys, mesas; 3-75% slopes; 6,300-8,500’
Polychrome	Colluvium over residuum; moderately deep; well drained; derived from sedimentary rocks; hillslopes; 25-75% slopes; 5,000-6,800’
Redrock Family	Alluvium on slope; very deep, well drained; many sources; cuestas, mesas; 3-15% slopes; 6,350-6,800’
Rizno	Alluvium and colluvium over residuum on slopes; shallow and very shallow; well drained; derived from sandstone and limestone; cuestas; 3-25% slopes; 5,400-6,400’
Roto	Alluvium and colluvium over residuum on slopes; moderately deep; well drained; derived from limestone and sandstone; hills, mesas, cuestas; 3-45% slopes; 6,350-7,500’
Schoonover	Residuum; shallow; well drained; derived from limestone; mountains; 3-25% slopes; 7,000-8,500’

Sheecal	Colluvium over residuum; moderately deep; well drained; hillslopes; 10-80% slopes; 6,500-7,800’
Shotnick	Alluvium; very deep; well drained; many sources; terraces, hill toeslopes, alluvial fans; 2-4% slopes; 4,200-4,900’
Solirec	Eolian deposits over alluvium or colluviums; very deep; well drained; derived from sandstone and shale; fan remnants, hillslopes, mesas; 3-40% slopes; 5,300-6,400’
Splimo	Colluvium over residuum; shallow and very shallow; somewhat excessively drained; many sources; hillslopes; 8-50%; 5,000-6,800’
Stout	Residuum; very shallow and shallow; somewhat excessively drained; derived from limestone; mountains; 5-35% slopes; 6,800-7,800’
Strell	Eolian deposits over sandstone; shallow and very shallow; somewhat excessively drained; many sources; hillslopes, mesas, cuestas; 1-45% slopes; 6,200-7,000’
Strych	Alluvium and colluvium; very deep; well drained; derived from sandstone and limestone; fan remnants, hillslopes, structural benches; 3-65% slopes; 5,000-6,500’
Tipper	Colluvium over residuum; moderately deep; excessively drained; derived from calcareous sandstone; hillslopes; 10-40% slopes; 5,500-5,750’
Torriorthents	Colluvium and residuum; very shallow to moderately deep; well drained; derived from limestone and sandstone; hillslopes, canyons, mountains; 12-75% slopes; 5,000-8,000’
Torripsamments	Alluvium and colluvium over residuum; moderately deep and deep; excessively drained; derived from sandstone; hillslopes; 12-40%; 5,500-6,000’
Tsetaa	Colluvium and alluvium; very deep; excessively drained; derived from sandstone; mountain slopes; 3-45% slopes; 5,400-6,000’
Turzo	Alluvium; very deep; well drained; many sources; alluvial flats; 0-4% slopes; 4,600-4,700’
Uffens	Alluvium, very deep; well drained; many sources; terraces; 0-3% slopes; 4,700-4,900’
Ustic Torrifluvents	Alluvium; very deep; excessively drained; many sources; floodplains, fan remnants; 2-8% slopes; 5,200-5,600’
Ustochrepts	Colluvium; deep or very deep; well drained; many sources; mountains; 50-90% slopes; 5,000-7,400’
Ustorthents	Colluvium and residuum; shallow and moderately deep; well drained; mountains, canyons; 2575% slopes; 6,500-8,500’
Utaline	Alluvium and colluvium; very deep; well drained; many sources; fan remnants; 8-25% slopes; 4,700-5,100’
Windcomb	Alluvium and colluvium of slopes over residuum; shallow or very shallow; well drained; derived from siltstone, limestone, sandstone; cuestas, hillslopes; 3-25% slopes; 5,000-6,400’
Yampa	Alluvium and colluvium; very deep; well drained; derived from mixed calcareous sources; mountains, alluvial fans, fan remnants, structural benches; 3-65% slopes; 6,000-8,000’
Yarts	Alluvium; very deep; well drained; many sources; alluvial flats; 2-8% slopes; 4,900-5,600’
Zillion	Colluvium; very deep; well drained; colluvium derived from limestone and sandstone; mountains; 25-65% slopes; 7,000-8,000’

Appendix J

Map Class Descriptions for Dinosaur National Monument

Introduction

This document provides a visual guide and description of the map classes for the Dinosaur National Monument Vegetation Mapping Project. Thirty-eight vegetation map classes are described in this guide. Eighteen unvegetated geologic map classes and nine land use classes are not included. Two other geologic map classes (101 – Active River Channel and 103 – Alluvial Deposits) support three sparse and rare vegetation types (Xanthium strumarium Herbaceous Vegetation, Glycyrrhiza lepidota Herbaceous Vegetation, and Ericameria nauseosa Desert Wash Shrubland); these are excluded from the guide because there is insufficient information to document them.

Each of the vegetation map classes associated in this guide is documented by:

- ground photographs
- 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 throughout the mapping area
- polygon statistics report (polygon number, size, area and proportion)
- accuracy assessment results for each map class

One vegetation map class (#99, H-HANG) is associated only with point data and documents springs, seeps and hanging gardens. Because it occurs primarily on vertical canyon walls, no photo signature is available, so this map class receives an abbreviated description.

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.

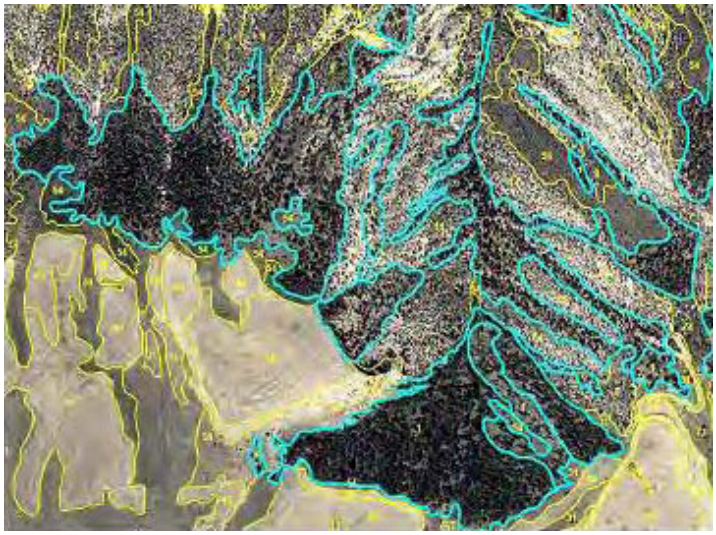
TABLE OF CONTENTS

Upland Forest and Woodland 737
1 Douglas-fir Forest (W-DOFI) 737
2 Ponderosa Pine Woodland (W-POPI) 739
3 Limber Pine Woodland (W-LIPI) 741
4 Aspen Forest (W-ASPE) 742
8 Pinyon – Juniper / Sparse Understory Woodland (W-PJSP) 742
9 Pinyon - Juniper / True Mountain Mahogany Woodland (W-PJMM) 745
10 Pinyon-Juniper / Herbaceous Woodland (W-PJHE) 747
11 Pinyon - Juniper / Mixed Desert Shrub Woodland (W-PJMD) 749
13 Pinyon - Juniper / Soil Crust Woodland (W-PJSC) 751
14 Pinyon-Juniper/Littleleaf Mountain Mahogany Shrubland and Woodland (W-PJLM) 753
15 Pinyon - Juniper / Black Sagebrush Woodland (W-PJBS) 755
16 Pinyon - Juniper / Sagebrush Woodland (W-PJWS) 756
17 Pinyon - Juniper / Curl-leaf Mountain Mahogany Woodland (W-PJCM) 758
19 Pinyon - Juniper / Basin Big Sagebrush Woodland (W-PJBB) 759
20 Rocky Mountain Juniper / Sagebrush Woodland (W-JSBB) 760
22 Curl-leaf Mountain Mahogany Woodland (W-CELE) 762
Upland Shrubland 764
31 Sagebrush-Rabbitbrush / Mixed Grass Shrubland (S-SAGE) 764
32 Sagebrush – Antelope Bitterbrush Shrubland (S-SAPT) 767
37 Bottomland Shrubland (S-BOTT) 768
40 Black Sagebrush Dwarf-Shrubland (S-BSCU) 770
44 Mixed Desert Shrubland (S-MXDD) 772
47 Sagebrush – Spiny Hopsage – Black Greasewood Shrubland (S-WSSG) 774
53 Canyon Wall Mixed Shrubland (S-CANY) 775
54 Mixed Mountain Shrubland (S-MXDM) 777
56 Greenleaf Manzanita Shrubland (S-MANZ) 780
59 Mat Saltbush Shrubland (S-MATS) 781
Upland Herbaceous Vegetation 782
67 Cobble Bar Mixed Herbaceous Vegetation (H-COBB) 782
68 Weedy Herbaceous Vegetation (H-WEED) 783
73 Native Grassland Herbaceous Vegetation (H-GRAS) 785
Riparian Forest and Woodland 787
76 Broadleaf Cottonwood Woodland (W-COTT) 787
79 Narrow Canyon Mesic Woodland (W-NARR) 789
80 Box Elder Woodland (W-BOEL) 791
83 Box Elder / Netleaf Hackberry Woodland (W-BOHA) 793
Riparian / Wetland Shrubland 794
85 Tamarisk Thicket and Russian Olive Woodland (S-TARU) 794
92 Threeleaf Sumac Riparian Thicket (S-SUMA) 796
Riparian / Wetland Herbaceous 797
95 Mixed Wetland/Riparian Vegetation (C-MXDW) 797

Upland Forest and Woodland

1 Douglas-fir Forest (W-DOFI)

Associations:
Pseudotsuga menziesii / Amelanchier alnifolia Forest
Pseudotsuga menziesii / Cercocarpus ledifolius Woodland
Pseudotsuga menziesii / Cercocarpus montanus Woodland
Pseudotsuga menziesii / Juniperus communis Forest
Pseudotsuga menziesii / Mahonia repens Forest
Pseudotsuga menziesii / Poa fendleriana Woodland
Pseudotsuga menziesii / Pseudoroegneria spicata Woodland
Pseudotsuga menziesii / Symphoricarpos oreophilus Forest
Pseudotsuga menziesii Woodland Alliance



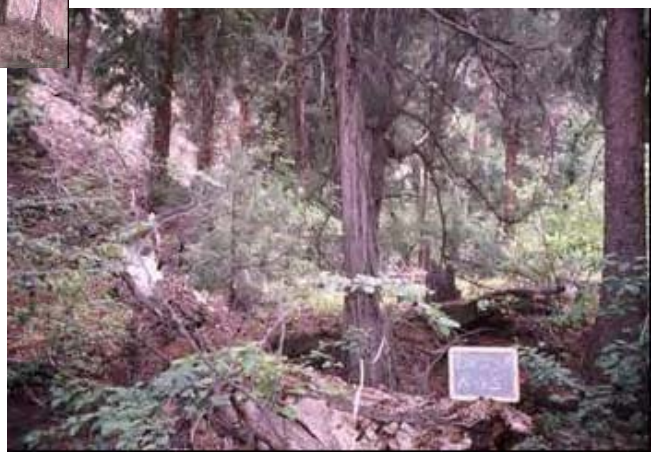
Common species:
Pseudotsuga menziesii
Juniperus scopulorum
Cercocarpus ledifolius
Cercocarpus montanus
Amelanchier spp.
Mahonia repens
Symphoricarpos oreophilus
Paxistima myrsinites
Poa fendleriana
Pseudoroegneria spicata

Project Specifics:
Frequency = 778 total polygons
681 polygons in DINO, 97 polygons in the environs
Total area = 5273.6 acres /2134.2 ha (1.3%)
4542.3 acres / 1838.2 ha DINO
731.4 acres / 296 ha environs
Average polygon size = 6.8 acres / 2.7 ha
User's accuracy = 81% ± 11%
Producer's accuracy = 100%

Interpretation:
This map class appears as small to medium, linear or triangular polygons at the base of cliffs or immediately below canyon rims. 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 reproductive layer or subcanopy. Closed stands appear mottled black. Adjacent polygons are often mapped as Mixed Mountain Shrubland (54).

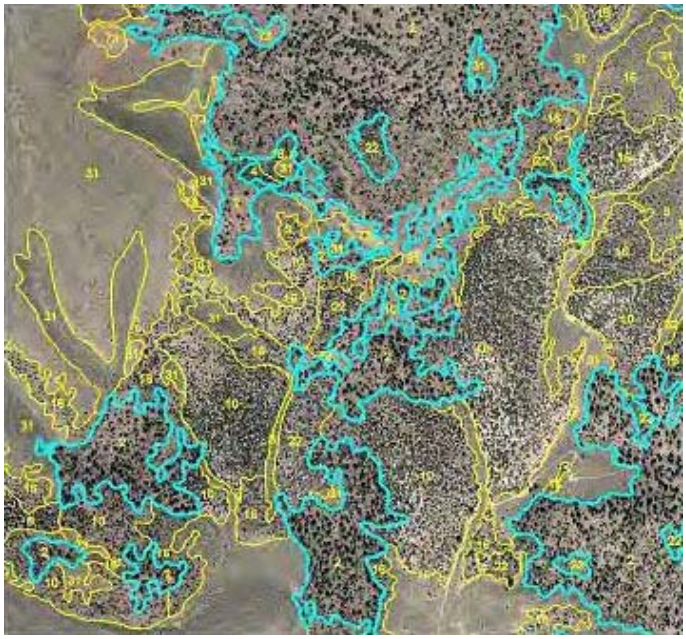
Distribution/Ecology/Composition:
This map class, along with Limber Pine Woodland (3) represents a community that is a relict of cooler and wetter points in the Holocene. It occurs primarily on steep, north and northeast-facing slopes below the rims of the main canyons and their major tributaries. Canopy density ranges from very open to closed. A few stands occur on gentle slopes at the base of sheltering sandstone cliffs. Douglas-fir is generally dominant, but ponderosa pine, Rocky Mountain or Utah juniper or pinyon pine may be co-dominant or form a subcanopy. The stands are generally fairly xeric and grasses or short shrubs such as *Paxistima myrsinites* or *Symphoricarpos oreophilus* dominate the understory of most stands. Some rich stands include taller mountain shrubs in the understory, notably *Cercocarpus ledifolius*. This map class may occur in a mosaic with polygons of Mixed Mountain Shrubland (54), or Pinyon-Juniper / Littleleaf Mountain Mahogany Shrubland and Woodland (14).





2 Ponderosa Pine Woodland (W-POPI)

Associations:
Pinus ponderosa / Artemisia tridentata ssp. vaseyana Woodland
Pinus ponderosa / Cercocarpus ledifolius Woodland
Pinus ponderosa / Juniperus scopulorum Woodland
Pinus ponderosa / Rockland Woodland



Common species:
Pinus ponderosa
Pinus edulis
Juniperus (*osteosperma, scopulorum*)
Cercocarpus (*intricatus, montanus, ledifolius*)
Amelanchier (*alnifolia, utahensis*)
Purshia tridentata
Artemisia tridentata (ssp. *vaseyana, wyomingensis*)
Poa fendleriana
Danthonia unispicata
Elymus elymoides

Project Specifics:
Frequency = 478 total polygons
170 polygons in DINO, 308 polygons in the environs
Total area = 9961.8 acres / 4031.4 ha (2.5%)
1491.7 acres / 603.7 ha DINO
8470 acres / 3427.7 ha environs
Average polygon size = 20.8 acres / 8.4 ha
User's accuracy = 100%
Producer's accuracy = 88% ± 11%

Interpretation:
This map class occurs in regular or irregularly shaped, small to medium-sized polygons usually corresponding to the summits of high ridges in the mapping area. Slopes are gentle to moderate. Stands are generally open, so the matrix color is usually that of the exposed bedrock, pink for the Uinta Mountain Group and white for Weber Sandstone. The matrix color may sometimes be modified to tan by the presence of needle litter. 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 a shrub layer and / or conifer subcanopy. Adjacent polygons may include Douglas-fir Forest (1) Curl-leaf Mountain Mahogany Woodland (22) or Pinyon-Juniper / Littleleaf Mountain Mahogany Shrubland and Woodland (14). It is sometimes difficult to distinguish stands of this map class from Douglas-fir stands; mixed Douglas-fir and ponderosa pine stands are mapped as Douglas-fir Forest (1). Small polygons of Sagebrush-Rabbitbrush / Mixed Grass Shrubland (31) occur as inclusions within large polygons of this map unit.

Distribution/Ecology/Composition:
Ponderosa pine woodlands are restricted to the summits of ridges at higher elevations in the mapping area, in areas with shallow soils. Most stands occur on Split Mountain, Zenobia Peak or Douglas Mountain, on Weber Sandstone or Uinta Mountain Group quartzite. There is one isolated, low-elevation group of polygons on Mowry Shale in Deerlodge Park. Canopies are open because most stands are on shallow soils over bedrock and the trees are forced to root in cracks. There is nearly always a subcanopy of pinyon pine and/or Rocky Mountain juniper. On some exposures of Uinta Mountain Group quartzite, this map class occurs as very open stands in a matrix of curl-leaf mountain mahogany. In other stands, the understory is generally open, but may include a low cover of shrubs such as *Cercocarpus* spp., *Amelanchier* spp., or *Artemisia tridentata* ssp. *vaseyana*. Forbs are generally sparse, but grasses consistently provide at least a few percent cover, especially muttongrass or curly bluegrass. Many stands show

evidence of repeated ground fires in the form of scarred tree trunks or charcoal on the ground surface.



3 Limber Pine Woodland (W-LIPI)



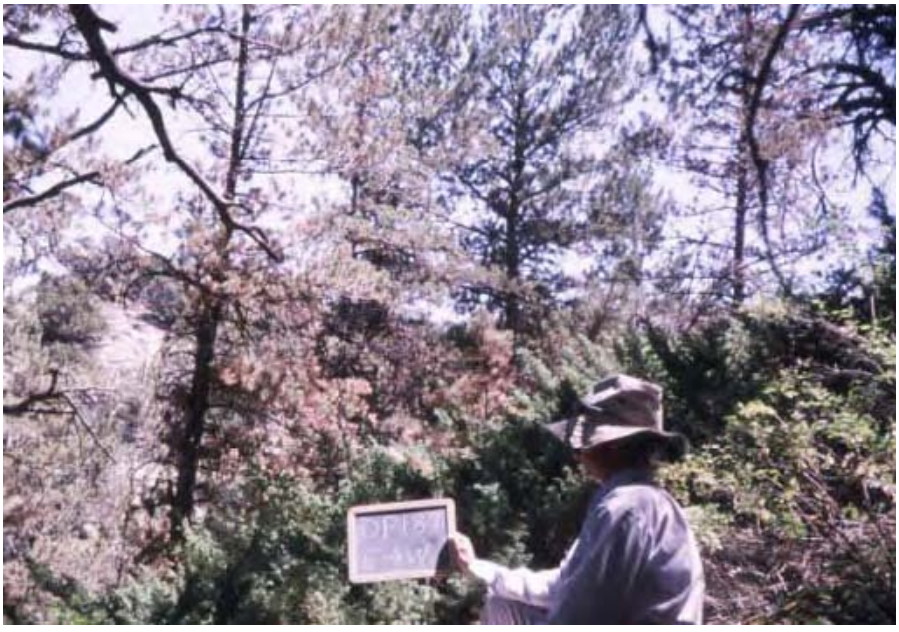
Associations:
Pinus flexilis / Juniperus communis Woodland

Common species:
Pinus flexilis
Juniperus communis
Paxistima myrsinites
Poa fendleriana

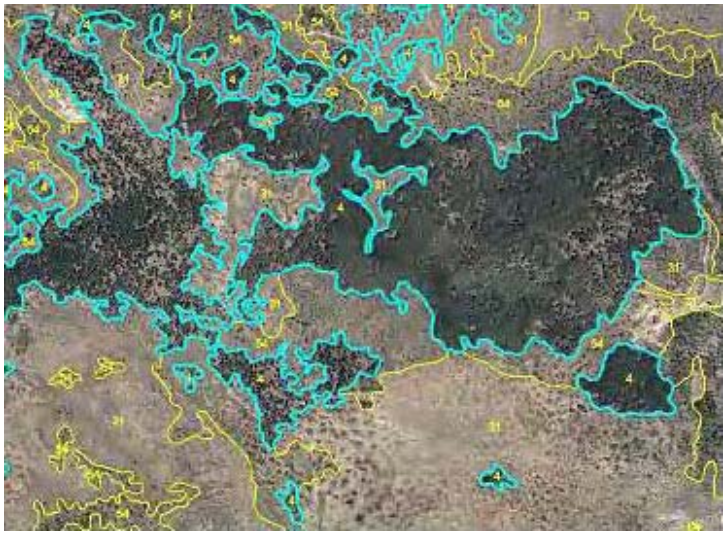
Project Specifics:
Frequency = 4 total polygons
0 polygons in DINO, 4 polygons in the environs
Total area = 9.8 acres / 4.0 ha (<<1%)
0 acres / 0 ha DINO
9.8 acres / 4.0 ha environs
Average polygon size = 2.4 acres / 1.0 ha
User's accuracy = N/A
Producer's accuracy = N/A

Interpretation:
This map class is known from one stand in a ravine near the southern border of the park. The appearance on the photos is similar to an old-growth pinyon-juniper stand, with large, rounded-crowned but medium-statured trees. Shadows indicate a taller tree than most pinyon-juniper stands.

Distribution/Ecology/Composition:
This type was found only in a single location, at the head of Stuntz Draw on BLM land just south of the NPS boundary. It is likely a relict stand from the early Holocene, when limber pine and blue spruce were widespread within the monument. Many of the mature trees are severely affected by pine bark beetle, which is also killing pinyon pine in the mapping area. This stand may soon become extinct; no seedlings or saplings were noted in the sampled plot.



4 Aspen Forest (W-ASPE)



Associations:
Populus tremuloides / Amelanchier alnifolia - Symphoricarpos oreophilus / Mixed Graminoid Forest
Populus tremuloides / Ceanothus velutinus Forest
Populus tremuloides / Juniperus communis Forest
Populus tremuloides / Prunus virginiana Forest
Populus tremuloides / Symphoricarpos oreophilus / Carex rossii Forest
Populus tremuloides / Symphoricarpos oreophilus Forest

Common species:
Populus tremuloides
Acer glabrum
Ceanothus velutinus
Prunus virginiana
Rosa woodsii
Symphoricarpos oreophilus
Amelanchier spp.
Mahonia repens
Paxistima myrsinites
Juniperus communis
Carex rossii
Achnatherum lettermanii

Project Specifics:
Frequency = 209 total polygons
91 polygons in DINO, 118 polygons in the environs
Total area = 616.2 acres / 249.4 ha (0.2%)
264.2 acres / 107 ha DINO
352 acres / 142.5 ha environs
Average polygon size = 2.9 acres / 1.2 ha
User's accuracy = 100%
Producer's accuracy = 85% ± 10%

Interpretation:
This map class occurs in small to medium, regular to elongate polygons, scattered through the higher elevations in the central part of the mapping area. Most stands are closed canopy and are recognizable because of the uniform canopy height, uniform rough texture, medium green color and tall stature. Open stands are recognizable primarily because they occur near closed-canopy stands and have the same color and height. Adjacent polygons may be mapped as Mixed Mountain Shrubland (54) or Ponderosa Pine Woodland (2). Some stands in the Zenobia Peak area burned in the past 20 years and were mapped based on field sampling; otherwise, these stands are indistinguishable from those of Mixed Mountain Shrubland (54).

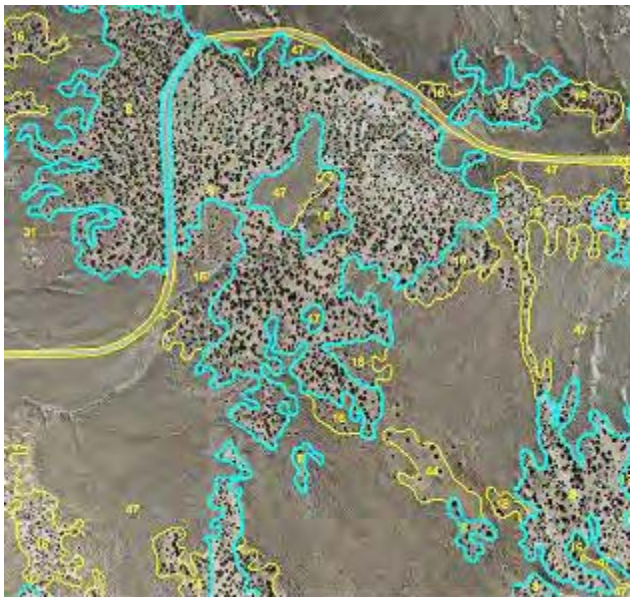
Distribution/Ecology/Composition:
Persistent stands of aspen occur on level to moderately steep slopes on the higher elevations of Douglas Mountain, Zenobia Peak, Wild Mountain, Blue Mountain and the Yampa Plateau. Stands are mostly on sheltered, north-facing slopes where snow accumulates. A few stands are associated with the margins of talus fields; presumably the talus traps both moisture and cold air that favor aspen over other woody species. The tree canopy may be open or closed, but few conifers are present other than pinyon or Rocky Mountain juniper, or rarely, ponderosa pine. The subcanopy is likewise variable, because stands range from xeric to mesic. Xeric stands may have an understory that includes sagebrush, common juniper, Woods' rose, Oregon grape and bunchgrasses. Mesic stands are more diverse, and generally have a substantial shrub layer (of serviceberry, chokecherry, tobacco-brush, snowberry and mountain-lover).




DP519
W→E


DP211
NW→SE

8 Pinyon - Juniper / Sparse Understory Woodland (W-PJSP)



Associations:
Pinus edulis - Juniperus osteosperma / Sparse Understory Woodland (in part; see also map class 13)
Juniperus osteosperma / Sparse Understory Woodland (in part; see also map class 13)

Common species:
Pinus edulis
Juniperus osteosperma

Project Specifics:
Frequency = 1722 total polygons
956 polygons in DINO, 766 polygons in the environs
Total area = 27893.8 acres / 11288 ha (7%)
17607.1 acres / 7125.4 ha DINO 10286.7 acres / 4162.9 ha environs
Average polygon size = 16.2 acres / 6.6 ha
User's accuracy = 57% ± 11%
Producer's accuracy = 84% ± 10%

Interpretation:
This map class occurs in small to medium regular polygons. Closed-canopy pinyon-juniper stands (density class "A") are mapped as this map class unless sampling indicates otherwise. The signature of these stands is variable because of the diverse reasons for a sparse understory (see description below). In open canopy stands, the signature is small, regular dark green dots in a matrix of the bedrock color (white, pink, or variegated). The matrix is a bright color, not dulled by vegetation or litter. Some polygons of this type may be mapped as Pinyon-Juniper / Herbaceous Woodland (10), or may contain inclusions of that map unit.

Distribution/Ecology/Composition:
Polygons of this map class are scattered throughout the mapping area. This map class includes three of the four major types of pinyon-juniper woodland with total understory cover of less than 5%: (1) Closed-canopy stands that have no understory because of light and water competition from the mature canopy trees; (2) Open stands on rocky slopes that have little understory because most of the ground surface is rock; and (3) Open stands on Chinle, Moenkopi, and other shale substrates with low water-holding capacity. Most stands are at low to moderate elevations. Biological crusts are absent or rudimentary. Other than pinyon pine and/or juniper, there are no consistent species to signal this community. If cushion plants or bluebunch wheatgrass are present, then the community will be mapped as Pinyon-Juniper / Herbaceous Woodland (10), even if the cover is considered "sparse". Litter may cover much of the ground surface.





9 Pinyon - Juniper / True Mountain Mahogany Woodland (W-PJMM)



Associations:
Juniperus osteosperma / Cercocarpus montanus Woodland
Pinus edulis - Juniperus osteosperma / Amelanchier utahensis Woodland
Pinus edulis - Juniperus spp. / Cercocarpus montanus - Mixed Shrubs Woodland

Common species:
Pinus edulis
Juniperus osteosperma
Cercocarpus montanus
Ephedra viridis
Fraxinus anomala
Artemisia tridentata (ssp. vaseyana, wyomingensis)
Achnatherum hymenoides

Project Specifics:
Frequency = 1097 total polygons
680 polygons in DINO, 417 polygons in the environs
Total area = 16462.7 acres / 6662.3 ha (4.1%)
10980.5 acres / 4443.7 ha DINO
5482.2 acres / 2218.6 ha environs
Average polygon size = 15.0 acres / 6.1 ha
User's accuracy = 70% ± 14%
Producer's accuracy = 61% ± 14%

Interpretation:
Polygons are small to medium, regular on most landforms but linear where they occur on hogbacks. Stands are open to moderately closed, on north-facing or otherwise cooler, rocky, moderate to very steep slopes. The trees are recognizable as small, dark green dots; the shrubs appear as a gray brown to reddish brown pebbly texture. 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 include polygons of Mixed Mountain Shrubland (54); this map class may also appear as inclusions within polygons of map class 9.

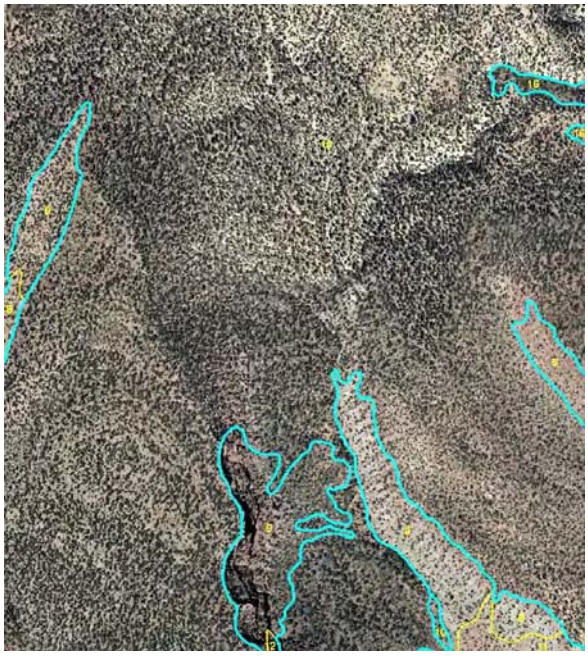
Distribution/Ecology/Composition:
This class occurs on benchlands, hogbacks and rocky, north facing slopes of the Moenkopi Formation, mostly at moderately high elevations. It is relatively common on Blue Mountain. The substrate is generally loamy soils derived from sandstones, or shale slopes heavily modified by sandstone boulders falling from outcrops above. The surface of the Gartra Formation is nearly always this type, as are the upper, north-facing, rockfall-modified Moenkopi Shale slopes below the Gartra. There is often a well-developed biological soil crust. The herbaceous understory is generally sparse, but the shrubs *Cercocarpus montanus* and *Ephedra viridis* form a consistent shrub layer with 5-15% cover.





10 Pinyon-Juniper / Herbaceous Woodland (W-PJHE)

Associations:
Juniperus osteosperma / Bromus tectorum Semi-natural Woodland
Juniperus osteosperma / Hesperostipa comata Woodland
Juniperus osteosperma / Leymus salinus Woodland
Juniperus osteosperma / Pleuraphis jamesii Woodland
Juniperus osteosperma / Pseudoroegneria spicata Woodland
Pinus edulis - Juniperus osteosperma / Petradoria pumila Woodland
Pinus edulis - Juniperus osteosperma / Pseudoroegneria spicata - Cushion Plant Woodland
Pinus edulis - Juniperus spp. / Leymus salinus Woodland
Pinus edulis - Juniperus spp. / Poa fendleriana Woodland



Common species:
Pinus edulis
Juniperus osteosperma
Hesperostipa comata
Leymus salinus
Poa fendleriana
Poa secunda
Pseudoroegneria spicata
Artemisia tridentata (ssp. vaseyana, wyomingensis)
Phlox (hoodii, multiflora)
Petradoria pumila
Stenotus acaulis

Project Specifics:
Frequency = 2254 total polygons
1381 polygons in DINO, 873 polygons in the environs
Total area = 69020.6 acres / 27931.8 ha (17.3%)
44044.3 acres / 17824.2 ha DINO
24976.3 acres / 10107.6 ha environs
Average polygon size = 30.6 acres / 12.4 ha
User's accuracy = 73% ± 8%
Producer's accuracy = 70% ± 8%

Interpretation:
This map class occurs in medium to large, regularly shaped polygons. It is among the most common and widely distributed pinyon-juniper types in the mapping area, occurring on all aspects on moderately deep to deep soils that are mainly derived from sandstone or limestone. Communities with a cushion plant understory have shallow soils and the unvegetated ground surface may be covered by limestone chips. Slopes vary from level to moderately steep. The understory appears as a uniform smooth tan to light brown color. Adjacent map units often include Native Grassland (73) or Sagebrush-Rabbitbrush / Mixed Grass Shrubland (31).

Distribution/Ecology/Composition:
This common woodland type is distributed throughout the middle elevations of the mapping area. Communities with a cushion plant understory are restricted to summits or hills and ridgelines on shallow, rocky soils derived from either Madison or Round Valley limestone. Most communities are recognized by having less than 5% cover by shrubs and more than 5% cover by native bunchgrasses or perennial forbs In woodlands with a cushion plant understory, the rocky surface restricts total herbaceous cover. Shrubs and grasses in those communities are sparse; most of the understory consists of mat forbs such as *Petradoria*, *Phlox, Tetraneuris, Cryptantha,* and *Eriogonum*.

Many stands mapped as this class are probably close to the 5% understory cover cutoff, and may contain inclusions of Pinyon-Juniper / Sparse Understory Woodland (8). Muttongrass, needle-andthread grass, bluebunch wheatgrass and curly bluegrass are the most common

grasses encountered. Substrates vary from sandy to loamy, but are generally deeper and less rocky than shrub-dominated stands. Some stands are on moderate, north facing slopes (on Park City Formation limestone). Stand canopies vary from open to moderately closed, and not all stands include pinyon pine.





11 Pinyon - Juniper / Mixed Desert Shrub Woodland (W-PJMD)

Associations:
Juniperus osteosperma / Glossopetalon spinescens Woodland
Pinus edulis - Juniperus osteosperma / Ephedra viridis Woodland

Common species:
Pinus edulis
Juniperus osteosperma
Eriogonum spp.
Ephedra spp.
Glossopetalon spinescens
Atriplex confertifolia
Achnatherum hymenoides



Project Specifics:
Frequency = 97 total polygons
68 polygons in DINO, 29 polygons in the environs
Total area = 5260.9 acres / 2129.0 ha (1.3%)
5118.5 acres / 2071.4 ha DINO
142.4 acres / 57.6 ha environs
Average polygon size = 54.2 acres / 21.9 ha
User's accuracy = 88% ± 13%
Producer's accuracy = 68% ± 16%

Interpretation:
vegetated exposures of marine shales, or steep, south-facing walls of Yampa, Whirlpool and Split Mountain canyons. Slopes are moderate to steep. The reflectance off the nearly unvegetated geological surface is bright, but close inspection reveals scattered tiny gray specks representing the desert shrubs. The trees appear as scattered small regular dark dots. This map class may sometimes be difficult to distinguish from adjacent polygons of Pinyon-Juniper / Sparse Understory Woodland (8), since the understory of both these map units is relatively sparse.

Distribution/Ecology/Composition:
This map class describes open woodlands with a sparse mixture of xeric shrubs in the understory, which may include *Atriplex confertifolia*, *Atriplex canescens, Ephedra viridis*, or *Grayia spinosa*. Sagebrush is a minor component or absent. Most stands are very open because of the limited ability of the substrate to absorb or retain moisture. The best-developed examples occur on exposures of Morgan Formation on the south-facing Green River canyon wall below the confluence,



as well as on slopes or hogbacks of Morrison, Moenkopi or Chinle shales. There are few herbaceous species in the understory, although there may be a well-developed non-vascular community on the gentlest slopes.

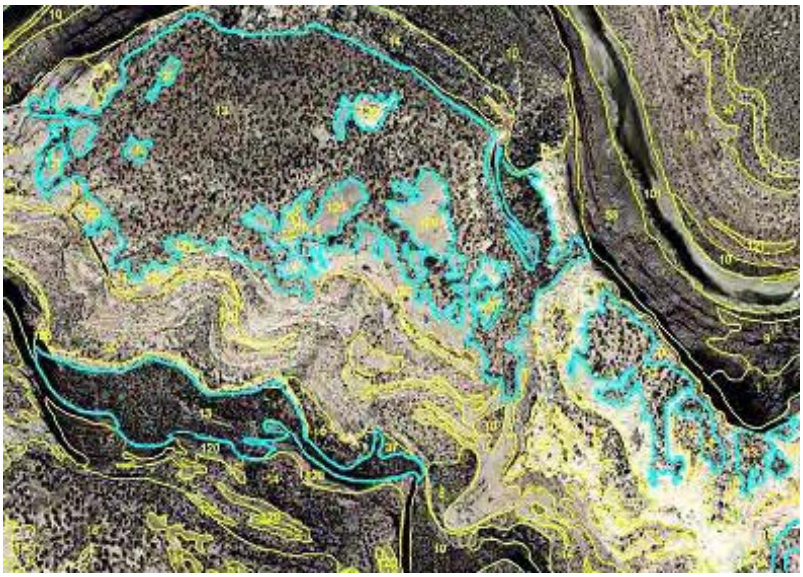


13 Pinyon - Juniper / Soil Crust Woodland (W-PJSC)

Associations:
Juniperus osteosperma / Sparse Understory Woodland (in part; see map class 8)
Pinus edulis – Juniperus osteosperma / Sparse Understory Woodland (in part; see map class 8)

Common species:
Pinus edulis
Juniperus osteosperma
Collema tenax (lichen)
Dark cyanobacteria

Project Specifics:
Frequency = 769 total polygons
572 polygons in DINO, 197 polygons in the environs
Total area = 11249.3 acres / 4552.4 ha (2.8%)
9002.4 acres / 3643.2 ha DINO
2246.8 acres / 909.3 ha environs
Average polygon size = 14.6 acres / 5.9 ha
User's accuracy = 83% ± 10%
Producer's accuracy = 70% ± 11%



Interpretation:
Polygons of this common map class range from small to medium in size. Most examples are on level, rolling, or moderate slopes covered by eolian sand or loess, especially on either side of the Yampa Canyon in the middle of the monument and around the west end of Split Mountain in the vicinity of the Racetrack. In some areas the sand deposits are thick and extensive, completely obscuring the underlying bedrock. In others, the community occupies depressions in Weber sandstone. The matrix often has a yellowish-brown appearance, with small brown blotches. The pinyon and juniper trees tend to have larger than average crowns and the trees are more widely and unevenly spaced in these stands than in surrounding woodlands on more stable substrates. This map class includes examples where the surface crust has broken and is now blowing sand with very early stages of crust development. Adjacent polygons on Weber sandstone may be mapped as Pinyon-Juniper / Littleleaf Mountain Mahogany Shrubland and Woodland (14); polygons elsewhere may occur in a mosaic of different pinyon-juniper and sagebrush communities.

Distribution/Ecology/Composition:
This map class describes pinyon-juniper woodlands on fine sandy or silty substrates with very little vascular understory but a high cover of ground lichens, dark cyanobacteria and mosses. This is the fourth of the four sparse understory woodland types. Most stands occur on eolian sands derived from Weber, Glen Canyon or Entrada sandstones. The smaller polygons occur as pockets on Weber ledges in a matrix of Pinyon-Juniper / Littleleaf Mountain Mahogany Shrubland and Woodland (14). The larger polygons occur on level to gently sloping benchlands where eolian sands or loess accumulate. In some areas, the sands have blown out, erasing most of the nonvascular cover. Destabilized examples may have a surface of mostly blowing sand with very little mature crust evident. Most stands have sparse cover of Mormon tea, snakeweed, Indian ricegrass, cats-eye) totaling less than 5%, while the nonvascular ground cover is at least 10% and usually much higher.



14 Pinyon-Juniper/Littleleaf Mountain Mahogany Shrubland and Woodland (W-PJLM)

Associations:
Cercocarpus intricatus Montane Shrubland
Pinus edulis - Juniperus osteosperma / Cercocarpus intricatus Woodland
Cercocarpus intricatus Slickrock Sparse Vegetation (probable)

Common species:
Pinus edulis
Juniperus osteosperma
Cercocarpus intricatus
Ephedra viridis
Achnatherum hymenoides
Poa fendleriana

Project Specifics:
Frequency = 1607 total polygons
1375 polygons in DINO, 232 polygons in the environs
Total area = 19861.7 acres / 8037.8 ha (5%)
17380.4 acres / 7033.6 ha DINO
2481.3 acres / 1004.1 ha environs
Average polygon size = 12.4 acres / 5.0 ha
User's accuracy = 90% ± 7%
Producer's accuracy = 83% ± 8%



Interpretation:
This common map class occurs in small to large polygons. Most examples are on slopes and highlands where sandstone bedrock is exposed. The signature is predominantly that of the underlying rock - white or red; the trees appear as tiny black dots, with even tinier scattered black specks representing the littleleaf mountain mahogany. Some stands have very few trees. This type often contains small inclusions of either Pinyon-Juniper / Soil Crust Woodland (13), Pinyon-Juniper / True Mountain Mahogany Woodland (9) or other pinyon-juniper woodland map classes.

Distribution/Ecology/Composition:
This type is restricted to outcrops of Weber, Entrada or Glen Canyon sandstone and Round Valley limestone. It is uncommon on exposures of Morgan Formation, Frontier Sandstone or Uinta Mountain Group. An unusual shrub community of relatively dense *Cercocarpus intricatus* plants occurs on some of the summits of the Blue Mountain massif. *Cercocarpus intricatus* Slickrock Sparse Vegetation probably occurs in this map class, although no stands were documented. Elevation, aspect, and slope have little effect on the community. The canopy is open to sparse and the total vegetative cover is often low because most plants are rooted in cracks in the bedrock and are generally dwarfed. Although *Juniperus osteosperma* and *Cercocarpus intricatus* are the most consistent species, other common elements include *Pinus edulis, Ephedra viridis, Glossopetalon spinescens, Stenotus acaulis, Petradoria pumila, Phlox* spp. and *Petrophyton cespitosum.*

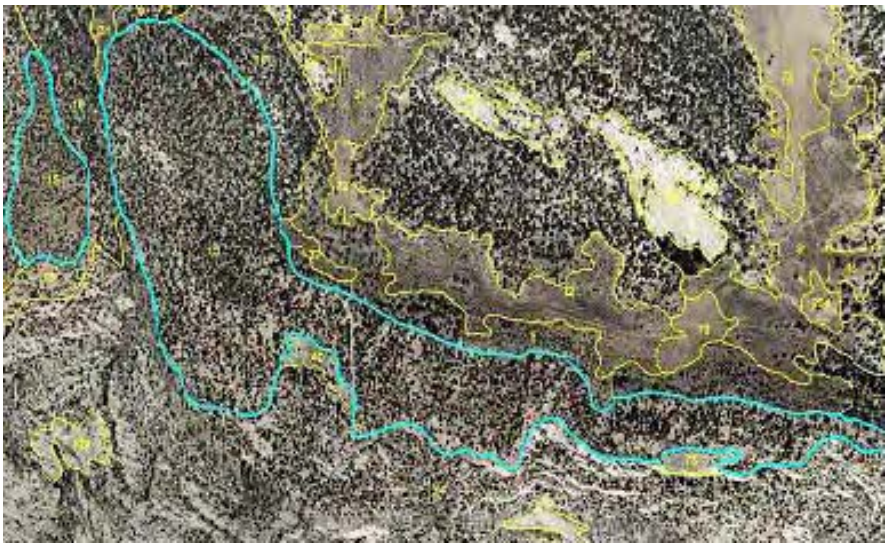





DP816
S N

15 Pinyon - Juniper / Black Sagebrush Woodland (W-PJBS)

Associations:
Juniperus osteosperma / Artemisia nova Woodland
Pinus edulis - Juniperus osteosperma / Artemisia nova Woodland
Pinus edulis - Juniperus osteosperma / Purshia tridentata Woodland

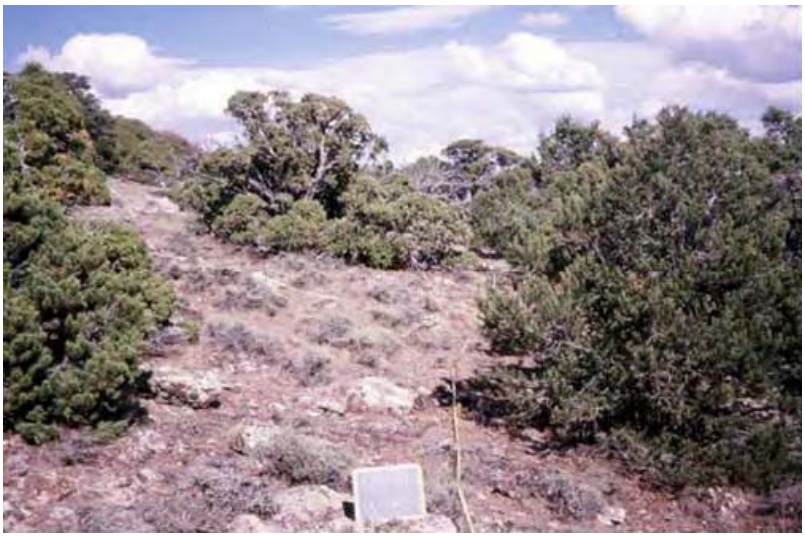


Common species:
Pinus edulis
Juniperus osteosperma
Artemisia nova
Artemisia tridentata
Purshia tridentata
Phlox (austromontana, hoodii)
Stenotus acaulis
Pseudoroegneria spicata

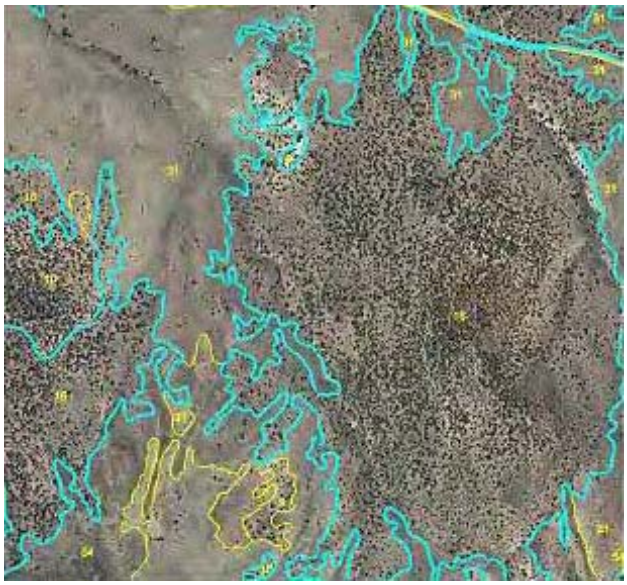
Project Specifics:
Frequency = 247 total polygons
127 polygons in DINO, 120 polygons in the environs
Total area = 4340.7 acres / 1756.6 ha (1.1%)
2524.1 acres / 1021.5 ha DINO
1816.6 acres / 735.1 ha environs
Average polygon size = X acres / Y ha
User's accuracy = 74% ± 12%
Producer's accuracy = 70% ± 12%

Interpretation:
This map class occurs mostly in small to medium, regular polygons primarily on benches and rises of limestone substrates. Stands appear very similar to surrounding Pinyon-Juniper / Herbaceous Woodland (10) polygons. However, on close inspection, the very fine speckled texture created by the black sagebrush shrubs is evident in these open-canopy stands. Polygons may contain inclusions of map units 10, Pinyon-Juniper / Sagebrush Woodland (16), or Sagebrush-Rabbitbrush / Mixed Grass Shrubland (31).

Distribution/Ecology/Composition:
This is an uncommon type, occurring in scattered polygons on slopes and ridges of Round Valley and Madison and limestones, Bishop Conglomerate, and the basal limestone unit of the Park City Formation. It also occurs on benches of Glen Canyon sandstone and on higher elevation or north-facing exposures of Morrison shale, including the hogbacks between the Visitor Center and the housing area on the Colorado side of the monument. Most stands are on gentle to moderate slopes. Many stands include bluebunch wheatgrass, muttongrass or curly bluegrass, as well as phlox and *Petradoria*. If other species of sagebrush are present, they have less cover than black sage. In some stands, antelope bitterbrush is present to co-dominant.



16 Pinyon - Juniper / Sagebrush Woodland (W-PJWS)



Associations:
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. vaseyana, wyomingensis)
Ephedra viridis
Eriogonum microthecum
Pseudoroegneria spicata
Poa fendleriana

Project Specifics:
Frequency = 3661 total polygons
1452 polygons in DINO, 2209 polygons in the environs
Total area = 34800.6 acres / 14083.3 ha (8.7%)
15018.2 acres / 6077.7 ha DINO
19782.3 acres / 8005.7 ha environs
Average polygon size = 9.5 acres / 3.9 ha
User's accuracy = 57% ± 9%
Producer's accuracy = 75% ± 9%

Interpretation:
This very common map class occurs in small to very large, regular polygons located throughout the park except at the highest elevations, on deep residual or eolian soils. Slopes range from level to moderately steep, on all aspects and geologic substrates. The signature is characterized by evenly spaced round dark green dots with scattered to dense gray speckles visible between tree crowns. Adjacent polygons and inclusions often described as Sagebrush-Rabbitbrush / Mixed Grass Shrubland (31) and Pinyon-Juniper / Herbaceous Woodland (10).

Distribution/Ecology/Composition:
This is the most abundant woodland type at Dinosaur, occurring throughout the mapping area on all slopes, aspects and substrates with deep, loamy soils. The canopy may be just juniper or juniper with pinyon pine and an understory dominated by either mountain or Wyoming sagebrush (minimum 5% cover). This map class also includes wooded shrublands dominated by sagebrush with pinyon and/or juniper trees totaling at least 10% cover. Shrubs other than sagebrush are sparse, but there is often a well-developed herbaceous layer. Common grasses with significant cover include muttongrass, curly bluegrass, needle-andthread and Indian ricegrass. Annual and perennial forbs are usually present with low cover. In sites with deep soils, these woodlands are part of a fire cycle; when they burn, they generally convert either to Native Grassland (73) or the rabbitbrush form of Sagebrush-Rabbitbrush / Mixed Grass Shrubland (31). Very hot fires will result in a large percentage of Annual

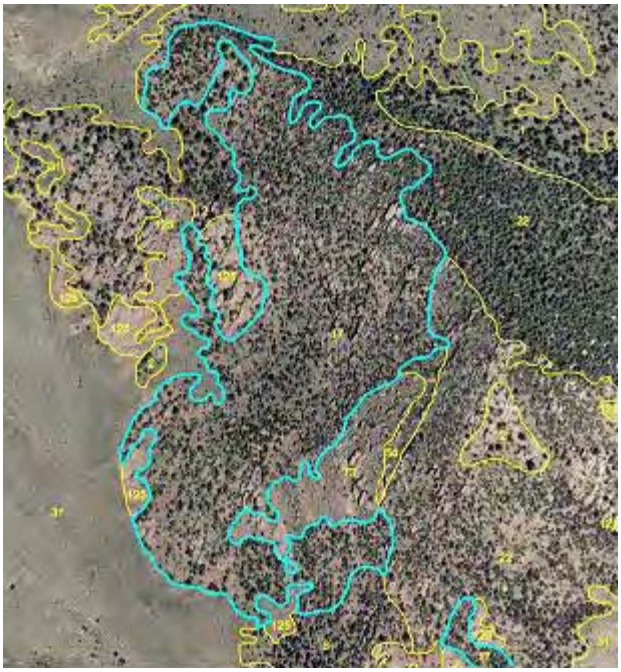


Weedy Herbaceous Vegetation (68). Over time, sagebrush and later, pinyon and juniper, will re-establish their dominance.





17 Pinyon - Juniper / Curl-leaf Mountain Mahogany Woodland (W-PJCM)



Associations:
Pinus edulis - Juniperus osteosperma / Cercocarpus ledifolius Woodland

Common species:
Pinus edulis
Juniperus osteosperma
Juniperus scopulorum
Cercocarpus ledifolius
Artemisia tridentata (ssp. vaseyana, wyomingensis)

Project Specifics:
Frequency = 37 total polygons
15 polygons in DINO, 22 polygons in the environs
Total area = 558.7 acres / 226.1 ha (0.1%)
212.6 acres / 86.0 ha DINO
346.1 acres / 104.1 ha environs
Average polygon size = 15.1 acres / 6.1 ha
User's accuracy = 69% ± 21%
Producer's accuracy = 75% ± 21%

Interpretation:
Polygons of this rare type are small to medium in size, and most are on upper slopes. The large, flat, gray-green crowns of curl-leaf mountain mahogany are plainly visible among the rounded, dark green crowns of the pinyon. Adjacent polygons may include Douglas Fir Forest (1), Curl-leaf Mountain Mahogany Woodland (22), or Mixed Mountain Shrubland (54).

Distribution/Ecology/Composition:
This type occurs primarily on Zenobia Peak and other ridges surrounding Zenobia Basin on Douglas Mountain. Stands tend to be in rocky sites protected from fire, or at least have not burned in a long time. Fire tends to convert these stands to pure curl-leaf mountain mahogany. Most stands are open, with a mixed canopy of *Pinus edulis, Juniperus* spp. and *Cercocarpus ledifolius*. The understory may include *Artemisia tridentata* ssp. *vaseyana*, *Petradoria pumila*, or *Poa fendleriana.*



19 Pinyon - Juniper / Basin Big Sagebrush Woodland (W-PJBB)

Associations:
Juniperus osteosperma / Artemisia tridentata - Grayia spinosa Woodland
Juniperus osteosperma / Artemisia tridentata ssp. tridentata Woodland

Common species:
Juniperus osteosperma
Artemisia tridentata ssp. *tridentata*
Ericameria nauseosa
Grayia spinosa
Bromus tectorum
Elymus elymoides

Project Specifics:
Frequency = 91 total polygons
59 polygons in DINO, 32 polygons in the environs
Total area = 287.8 acres / 116.5 ha (0.1%)
197.1 acres / 79.8 ha DINO
90.7 acres / 36.7 ha environs
Average polygon size = 3.2 acres / 1.3 ha
User's accuracy = 92% ± 13%
Producer's accuracy = 73% ± 19%



Interpretation:
This rare type is restricted to the floors of narrow ravines away from the major canyons as well as minor alluvial fans within the canyons. The canopy is usually open and composed of mature to old trees, with an open to closed understory of basin big sagebrush visible as a dark gray layer. Most polygons are narrow and linear or fan-shaped, and adjacent to stands of basin big sagebrush without a tree canopy, or pinyon-juniper stands occupying canyon walls.



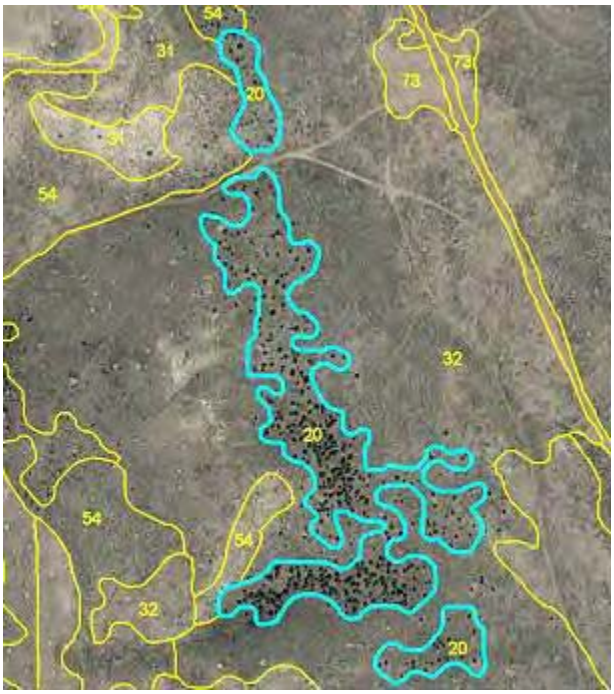
Distribution/Ecology/Composition:
This type occurs on narrow upland valley floors with loamy eolian soils, or on alluvial fans fed by intermittent tributary drainages. The juniper trees have sparse to moderate cover, and are included in the community because they have come down from the adjacent wooded valley walls to invade the *Artemisia tridentata* spp. *tridentata* shrubland on the valley floor. The understory is poorly developed and often contains exotic annual species such as cheatgrass or tumbleweed.

20 Rocky Mountain Juniper / Sagebrush Woodland (W-JSBB)

Associations:
Juniperus scopulorum / Artemisia tridentata Woodland

Common species:
Juniperus scopulorum
Artemisia tridentata ssp. *tridentata*
Artemisia tridentata ssp. *wyomingensis*
Purshia tridentata
Petradoria pumila

Project Specifics:
Frequency = 7 total polygons
3 polygons in DINO, 4 polygons in the environs
Total area = 19.4 acres / 7.9 ha (<<1%)
9.2 acres / 3.7 ha DINO
10.2 acres / 4.1 ha environs
Average polygon size = 2.8 acres / 1.1 ha
User's accuracy = N/A
Producer's accuracy = N/A



Interpretation:
This type was mapped on an as-encountered basis only. Other stands probably occur within the Pinyon-Juniper / Sagebrush Map Unit (16) and may have been mapped as this type, or as Pinyon-Juniper / Big Sagebrush Woodland (19).

Distribution/Ecology/Composition:
This community occurs primarily in very small stands on the toeslopes of alluvial fans as they enter the Yampa and Green Rivers. The sagebrush is usually, but not always, Artemisia tridentata ssp. tridentata. One outlier plot was mapped on the Yampa Plateau on the evidence of a sample plot.



21 Rocky Mountain Juniper / Threeleaf Sumac Woodland (W-JSRT)

Associations:
Juniperus scopulorum Temporarily Flooded Woodland Alliance

Common species:
Juniperus scopulorum
Acer negundo
Rhus trilobata
Artemisia tridentata ssp. tridentata
Cornus sericea
Glycyrrhiza lepidota

Project Specifics:
Frequency = 1 total polygons
1 polygons in DINO, 0 polygons in the environs
Total area = 0.4 acres / 0.2 ha (<<1%)
0.4 acres / 0.2 ha DINO
0 acres / 0 ha environs
Average polygon size = 0.4 acres / 0.2 ha
User's accuracy = N/A
Producer's accuracy = N/A



Interpretation:
This rare riparian type was mapped on an as-encountered basis only. Most polygons are elongate to linear. Additional stands within the mapping area may have been mapped as other pinyon-juniper types. Most examples are smaller than the 0.5 hectare minimum mapping unit.

Distribution/Ecology/Composition:
This community occurs on the banks and upper terraces of the Green and Yampa Rivers. Juniper forms an open canopy over a dense understory of threeleaf sumac or red-osier dogwood, sometimes mixed with chokecherry. The shrub understory will sometimes be apparent as a brighter green matrix.

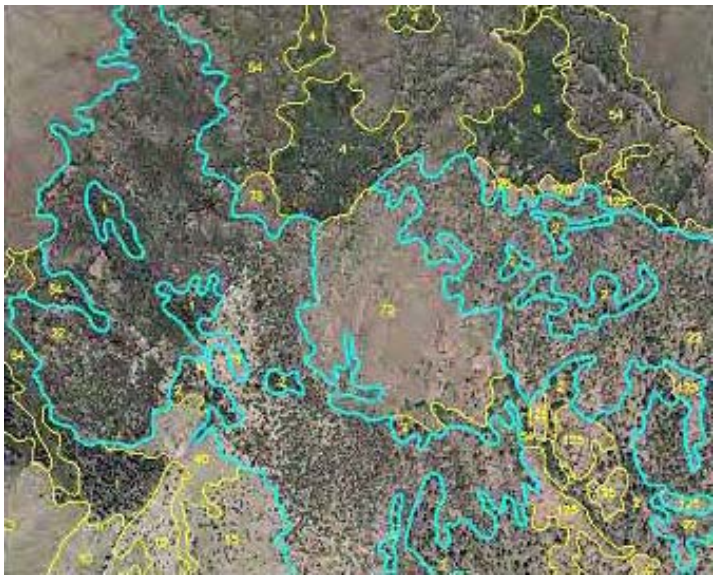


22 Curl-leaf Mountain Mahogany Woodland (W-CELE)

Associations:
Cercocarpus ledifolius / Artemisia tridentata ssp. vaseyana Woodland
Cercocarpus ledifolius / Prunus virginiana Shrubland
Cercocarpus ledifolius / Pseudoroegneria spicata Shrubland
Cercocarpus ledifolius Woodland Alliance

Common species:
Cercocarpus ledifolius
Paxistima myrsinites
Symphoricarpos oreophilus
Amelanchier alnifolia
Mahonia repens
Achnatherum lettermanii

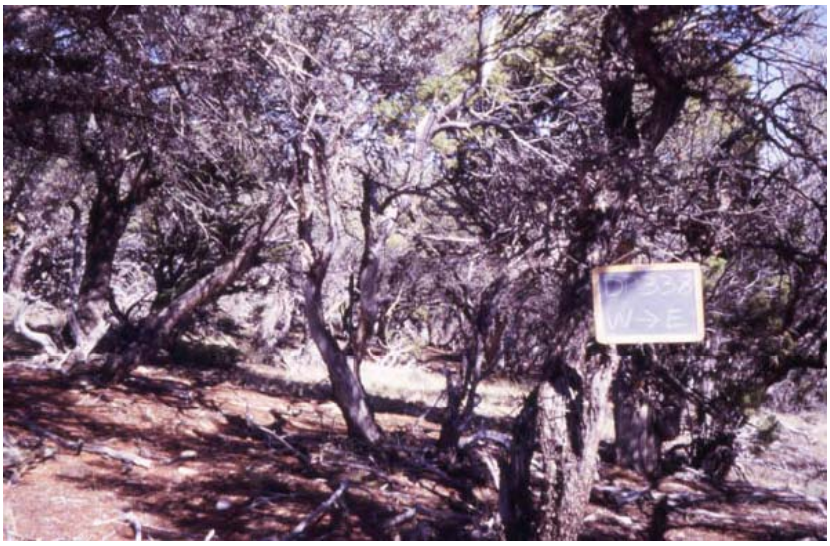
Project Specifics:
Frequency = 263 total polygons
60 polygons in DINO, 203 polygons in the environs
Total area = 4650.9 acres / 1882.1 ha (1.2%)
978.7 acres / 396.1 ha DINO
3672.1 acres / 1486.1 ha environs
Average polygon size = 17.7 acres / 7.2 ha
User's accuracy = 92% ± 9%
Producer's accuracy = 81% ± 12%



Interpretation:
This map unit occurs in small to medium regular and irregular polygons. This community sometimes forms a solid understory in areas with an open ponderosa pine canopy; some openings among the ponderosas are large enough to map as polygons of this unit. The lower stature of the mountain mahogany is apparent from the lack of shadow - the individual plants appear "flat" when compared with ponderosa pine. The canopy color is a medium gray-green and individual canopies are irregularly shaped, unlike pinyon and juniper, which tend to appear as very dark rounded dots.

Distribution/Ecology/Composition:
This type is best developed on Douglas Mountain (Bishop Conglomerate), especially around Zenobia Peak and the other ridges surrounding Zenobia Basin. Isolated stands occur on Roundtop Mountain and along the Harper's Corner road. This map class represents a woodland community with a canopy of *Cercocarpus ledifolius*. Stands with a history of fire in the past few decades take the form of tall shrublands. Mesic stands include chokecherry as a dominant shrub; dry stands have mostly bunchgrasses in the understory (*Danthonia unispicata, Pseudoroegneria spicata*). Most stands are small patches in a matrix of PJ woodland and/or Douglas-fir or ponderosa pine woodlands.



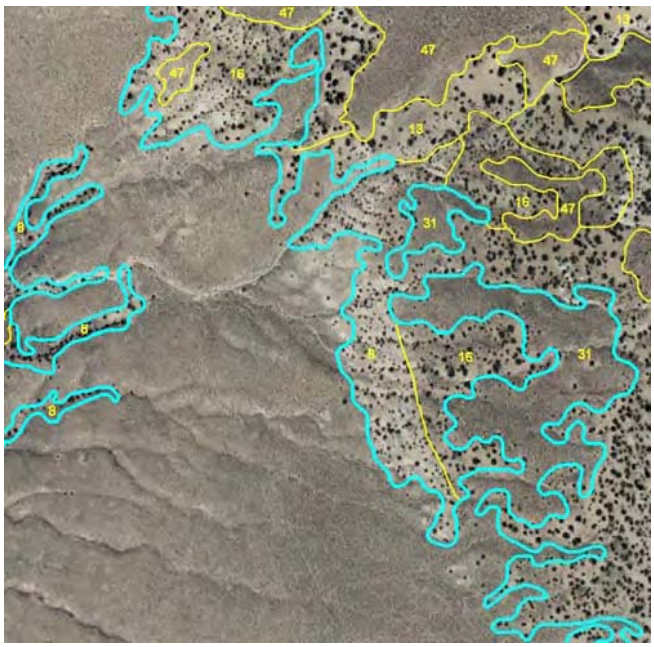


Upland Shrubland

31 Sagebrush-Rabbitbrush / Mixed Grass Shrubland (S-SAGE)

Associations:
Artemisia arbuscula ssp. longiloba / Elymus lanceolatus Shrubland
Artemisia tridentata (ssp. vaseyana, ssp. wyomingensis) - Amelanchier utahensis Shrubland
Artemisia tridentata ssp. vaseyana / Achnatherum lettermanii Shrubland
Artemisia tridentata ssp. vaseyana / Balsamorhiza sagittata Shrubland
Artemisia tridentata ssp. vaseyana / Hesperostipa comata Shrubland
Artemisia tridentata ssp. vaseyana / Leymus cinereus Shrubland
Artemisia tridentata ssp. vaseyana / Pascopyrum smithii Shrubland
Artemisia tridentata ssp. vaseyana / Poa fendleriana Shrubland
Artemisia tridentata ssp. vaseyana / Poa secunda Shrubland
Artemisia tridentata ssp. vaseyana / Pseudoroegneria spicata Shrubland
Artemisia tridentata ssp. wyomingensis - Atriplex confertifolia Shrubland
Artemisia tridentata ssp. wyomingensis / Balsamorhiza sagittata Shrubland
Artemisia tridentata ssp. wyomingensis / Disturbed Understory Semi-natural Shrubland
Artemisia tridentata ssp. wyomingensis / Elymus elymoides Shrubland
Artemisia tridentata ssp. wyomingensis / Hesperostipa comata Colorado Plateau Shrubland
Artemisia tridentata ssp. wyomingensis / Leymus salinus Shrubland
Artemisia tridentata ssp. wyomingensis / Pascopyrum smithii Shrub Herbaceous Vegetation
Artemisia tridentata ssp. wyomingensis / Pleuraphis jamesii Shrubland
Artemisia tridentata ssp. wyomingensis / Poa fendleriana Shrubland
Artemisia tridentata ssp. wyomingensis / Poa secunda Shrubland
Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrubland
Artemisia tridentata ssp. wyomingensis / Sparse Understory Shrubland
Atriplex canescens / Achnatherum hymenoides Shrubland
Ephedra viridis / Bromus tectorum Semi-natural Shrubland
Ericameria nauseosa / Bromus tectorum Semi-natural Shrubland
Ericameria nauseosa / Pascopyrum smithii Shrubland
Ericameria nauseosa Sand Deposit Sparse Shrubland
Krascheninnikovia lanata / Hesperostipa comata Dwarf-shrubland
Krascheninnikovia lanata / Poa secunda Dwarf-shrubland
Tetradymia canescens Shrubland

Common species:
*Artemisia tridentata (*ssp. *vaseyana, wyomingensis)*
Ericameria nauseosa
Symphoricarpos oreophilus
Ephedra viridis
Balsamorhiza sagittata
Achnatherum hymenoides
Hesperostipa comata
Poa fendleriana
Poa secunda
Pseudoroegneria spicata
Bromus tectorum
Heterotheca villosa
Atriplex confertifolia
Sphaeralcea coccinea
Pleuraphis jamesii
Tetradymia canescens
Opuntia fragilis



Project Specifics:
Frequency = 5368 total polygons
2395 polygons in DINO, 2973 polygons in the environs
Total area = 78320.1 acres / 31695.1 ha (19.7%)
26634.1 acres / 10778.5 ha DINO
51685.9 acres / 20916.6 ha environs
Average polygon size = 14.6 acres / 5.9 ha
User's accuracy = 69% ± 6%
Producer's accuracy = 79% ± 5%

Interpretation:
This is the dominant shrubland type, common and abundant throughout the mapping area. It consists of small to large, regular polygons on level to moderately sloping terrain. Some polygons occur in areas that have burned. The matrix color is generally light to medium gray green (depending on the density of the herbaceous layer), with an evenly speckled texture. Higher shrub density results in a darker gray color, although never as dark as created by Bottomland Shrubland (37). Stands dominated by rabbitbrush have scattered green specks that are not as large as greasewood shrubs or as gray as the sagebrush shrubs. Some polygons reveal a yellowish tinge of cheatgrass between the speckles upon close inspection, while others have the tan of native bunchgrasses. There may be a low number of larger, dark green dots that represent invading pinyon and juniper trees. Polygons may contain small inclusions of Bunchgrass Grassland (73) or Mixed Mountain Shrubland (54). Adjacent polygons are nearly always a pinyon-juniper type. Uplands surrounding the Gates of Lodore have a sparse, post-fire shrub community composed primarily of *Artemisia tridentata, Ericameria nauseosa* and *Bromus tectorum*. Sagebrush – shadscale stands occur on eroding slopes of Moenkopi or Chinle shales or on tablelands of Mancos or Morrison shale modified by Pleistocene alluvial deposits; in these stands, the photo signature is that of the underlying shale, modified by a grayish cast created by litter.

Distribution/Ecology/Composition:
This map unit occurs throughout the mapping area on level to moderate slopes with deep, loamy soils, except for sagebrush – shadscale stands which occur on flat benches of Mancos Shale modified by Pleistocene alluvium or in sheltered draws and ridgelines in Moenkopi or Chinle shale badlands. There is an active relationship between this group of associations and fire; burned stands in the uplands generally convert to Bunchgrass Grassland (73), with most succeeding back to sagebrush within 30 years. A few stands became rabbitbrush-dominated after burns. Mature stands may be experiencing invasion by pinyon and juniper trees, but as long as the tree cover is less than 10%, this type is mapped as a sagebrush shrubland. The dominant sagebrush is Wyoming big sagebrush, mountain big sagebrush, or a hybrid of the two. Basin big sagebrush may occur as a minor inclusion in draws and ravines, in patches too small to map. Snowberry is often present as a sub-dominant shrub at higher elevations, rabbitbrush at lower elevations. If serviceberry or antelope bitterbrush are present, they comprise less than 1/3 of the shrub canopy. The dominant bunchgrasses respond to substrate, elevation and grazing history, but may include bluebunch wheatgrass, needle-and-thread, Indian ricegrass, or curly bluegrass. The herbaceous layer may also be a mix of several grass species, with cheatgrass often dominant in areas that have been historically overgrazed. Higher elevation stands have a high cover of balsamroot, and burned stands tend to have a greater diversity of herbaceous species. Some stands will transition to Pinyon-Juniper / Sagebrush Woodland in the absence of fire; this cycle may take several hundred years to complete.











32 Sagebrush – Antelope Bitterbrush Shrubland (S-SAPT)

Associations:
Artemisia tridentata (ssp. vaseyana, ssp. wyomingensis) - Amelanchier utahensis Shrubland
Artemisia tridentata ssp. vaseyana / Balsamorhiza sagittata Shrubland

Common species:
*Artemisia tridentata (*ssp. *vaseyana, wyomingensis)*
Purshia tridentata
Symphoricarpos oreophilus
Balsamorhiza sagittata
Pseudoroegneria spicata

Project Specifics:
Frequency = 70 total polygons
33 polygons in DINO, 37 polygons in the environs
Total area = 3698.2 acres / 1496.6 ha (%)
1917.4 acres / 776.0 ha DINO
1780.8 acres / 720.7 ha environs
Average polygon size = 52.8 acres / 21.4 ha
User's accuracy = N/A
Producer's accuracy = N/A



Interpretation:
This map unit was mapped on an as-observed basis, because it is very difficult to recognize consistently on the aerial photos. Known occurrences are medium to large, regularly shaped polygons on gentle to moderate slopes on the Yampa Plateau and Douglas Mountain. The signature is similar in color to Sagebrush – Rabbitbrush / Mixed Grass (31), but the speckling is slightly more pronounced because of the darker speckles representing bitterbrush shrubs, producing a slight "salt-and-pepper" effect. The texture is also similar to some polygons of Mixed Mountain Shrubland (54) where sagebrush mixes with true mountain mahogany.

Distribution/Ecology/Composition:
This map unit occurs primarily on skeletal, silty soils on the slopes of Stuntz Ridge near the southern park boundary, and on deep loamy soils of Douglas Mountain highlands. Stands have a shrub canopy dominated by either Wyoming sagebrush or mountain big sagebrush, with at least 5% cover of antelope bitterbrush. The understory contains a diversity of grasses and forbs.

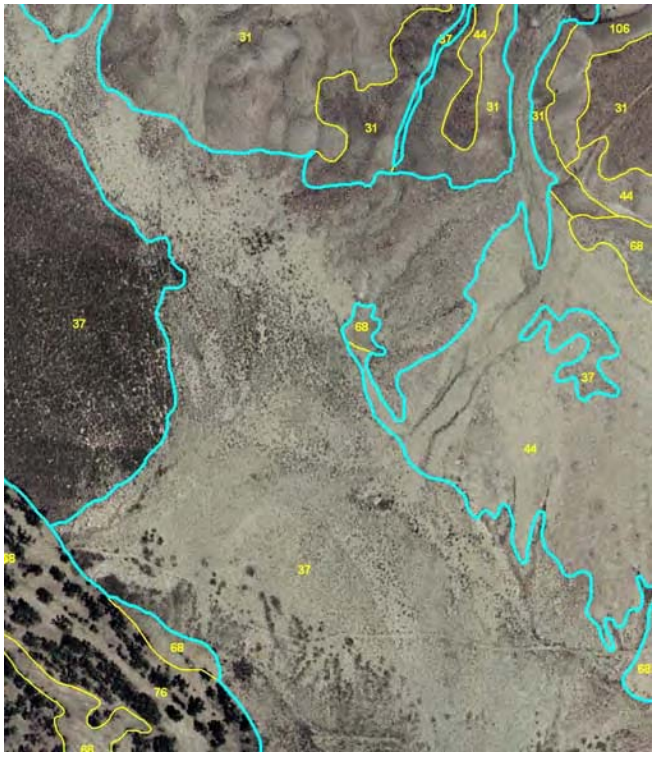


37 Bottomland Shrubland (S-BOTT)

Associations:
Artemisia tridentata - (Ericameria nauseosa) / Bromus tectorum Semi-natural Shrubland
Artemisia tridentata (ssp. tridentata, ssp. xericensis) Shrubland Alliance
Artemisia tridentata ssp. tridentata / Hesperostipa comata Shrubland
Artemisia tridentata ssp. tridentata / Leymus cinereus Shrubland
Artemisia tridentata ssp. tridentata / Sporobolus airoides Shrubland
Sarcobatus vermiculatus / Artemisia tridentata Shrubland
Sarcobatus vermiculatus / Sporobolus airoides Shrubland
Sarcobatus vermiculatus Disturbed Shrubland

Common species:
Artemisia tridentata ssp. *tridentata*
Opuntia (fragilis, polyacantha)
Elymus elymoides
Bromus tectorum
Sarcobatus vermiculatus
Sporobolus airoides
Leymus cinereus
Ericameria nauseosa
Distichlis spicata
Atriplex confertifolia
Poa fendleriana

Project Specifics:
Frequency = 1038 total polygons
562 polygons in DINO, 476 polygons in the environs
Total area = 8592.7 acres / 3477.3 ha (2.2%)
4728.6 acres / 1913.6 ha DINO
3864.0 acres / 1563.7 ha environs
Average polygon size = 8.3 acres / 3.4 ha
User's accuracy = 87% ± 4%
Producer's accuracy = 91% ± 4%



Interpretation:
This map unit occurs in small to medium, regular to elongated polygons, primarily in the floodplains of the main stem rivers and most of the low-elevation streams. All of these black greasewood and sagebrush associations may occur in a mosaic on the larger floodplains. The signature is a rough-textured medium to very dark gray or grayish brown, depending on shrub density. The matrix color is a light gray or brown depending on the cover of vegetation (brown) or bare ground (gray) present. A yellow tinge is visible in areas of high cheatgrass cover. Patches and individual shrubs often appear brighter green upon close inspection. Slopes are flat to gentle. Communities dominated by shadscale and greasewood are more open and have a signature dominated by the gray or reddish color of the underlying shale.

Distribution/Ecology/Composition:
Communities dominated by basin big sagebrush and black greasewood occur mostly in the floodplains of smaller tributary streams such as Cottonwood Creek, Conway Draw and Sage Creek, as well as on the Yampa and Green river floodplains and other broad valleys in the mapping area. Most of these valleys are filled with a fine-textured alluvium that where alkaline or saline tends to favor greasewood, while greater depth to the water table supports sagebrush. The terrace communities are out of the reach of most floods, and have been impacted by a century of domestic livestock grazing. Fire tends to convert these stands to pure cheatgrass (68). Basin big sagebrush may be mixed with Wyoming sagebrush in some stands in the uplands or outer margins of the floodplain, but the former is clearly dominant. Basin big sagebrush usually forms a dense canopy up to two meters high, but rubber rabbitbrush is commonly present to subdominant. The understory may be sparse or there may be relict clumps

of native bunchgrasses such as Great Basin wildrye, alkali sacaton or saltgrass among the tall shrubs, but weedy annual species such as cheatgrass and perennial pepperweed often form a dense groundcover.

Greasewood communities occur primarily on valley floors and alluvial benches where the water table is somewhat elevated and the soils are fine-textured and alkaline to saline. Flood events are rare but there is often a white crust on the soil surface indicating a fluctuating water table. Land use history (fire, grazing) has allowed cheatgrass to become the dominant understory species in many stands. The best developed examples occur in the floodplains of the Green and Yampa rivers where they cut through shales to form broad valleys, such as in Browns Park, Deerlodge Park, Rainbow Park and below the mouth of Split Mountain Canyon. The shrub canopy may be open to moderately closed and dominated by black greasewood, sometimes with a significant component of rubber rabbitbrush where substrates are sandy. There is usually very little herbaceous understory in these stands, although saltgrass, alkali sacaton and bottlebrush squirreltail are sometime present with low cover.

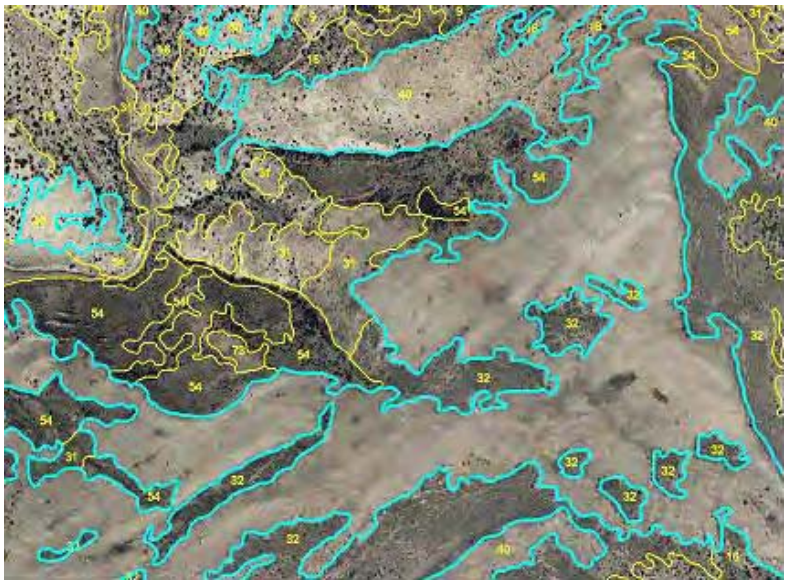
Shadscale – greasewood mixed alkaline shrubland is a rare type that was sampled once each in Deerlodge Park, Rainbow Park and below the mouth of Split Mountain Canyon. An odd, isolated upland stand occurs on the Yampa Bench on soils derived from Park City Formation. Black greasewood co-occurs with fourwing saltbush or shadscale. The understory is generally sparse, but grasses such as galleta or muttongrass often provide a few percent cover. Cheatgrass is often present, but never dominant. Adjacent polygons are often dominated by shadscale or sagebrush upslope of this map unit and purer black greasewood stands dominate areas closer to drainages.





40 Black Sagebrush Dwarf-Shrubland and Herbaceous (S-BSCU)

Associations:
Artemisia nova / Pseudoroegneria spicata Shrubland
Artemisia nova Shrubland
Pseudoroegneria spicata - Cushion Plants Herbaceous Vegetation
Pseudoroegneria spicata Herbaceous Vegetation (in part; see map class 73)



Common species:
Artemisia nova
Phlox (austromontana, hoodii)
Koeleria macrantha
Poa secunda
Pseudoroegneria spicata
Krascheninnikovia lanata
Eriogonum microthecum
Stenotus acaulis
Tetraneuris acaulis

Project Specifics:
Frequency = 1224 total polygons
453 polygons in DINO, 771 polygons in the environs
Total area = 6490.0 acres / 2626.4 ha (1.6%)
2488.1 acres / 1006.9 ha DINO
4002.0 acres / 1619.5 ha environs
Average polygon size = 5.3 acres / 2.1 ha
User's accuracy = 100%
Producer's accuracy = 88% ± 7%

Interpretation:
Occurs in small to medium, regular to irregular to elongated polygons on upper slopes, ridgelines and summits with thin soils over sandstone, limestone, and conglomerate substrates. The cushion plant herbaceous associations are found mostly at the highest elevations of the mapping area, on exposed limestones. The signature is a patchy off-white to a light gray, because of the sparse vegetation and the exposure of residual soils derived from light-colored rocks and the rock fragments themselves. Magnification reveals the evenly spaced tiny gray dots of black sagebrush shrubs in black sage-dominated stands, whereas the cushion plant herbaceous associations have a smooth, uniform texture . Adjacent polygons are commonly mapped as Sagebrush – Rabbitbrush / Mixed Grass Shrubland (31) and Mixed Mountain Shrubland (54).

Distribution/Ecology/Composition:
This map unit is restricted to windswept slopes and summits with thin or rocky soils over limestone, and to a lesser extent, sandstone or conglomerate at the highest elevations in the mapping area. Slopes range from level to moderate. Most polygons are located on ridgelines on Blue Mountain, Wild Mountain or Douglas Mountain. Wind, shallow soils and lack of snow cover create a community reminiscent of alpine tundra. Black sagebrush is often the only shrub present, but sometimes Wyoming or mountain sagebrush is a minor component. The herbaceous layer is diverse, but may be sparse. Consistent species include *Pseudoroegneria spicata, Stenotus acaulis, Phlox* spp., *Leptodactylon pungens, Lesquerella alpina, Astragalus spatulatus, Townsendia* spp. and there may be up to 5% cover of dwarf shrubs, including winterfat, buckwheat, or snakeweed. This community is usually too sparsely vegetated to carry fire, and too harsh to give way to other communities. In marginal sites, there may be some give and take between the herbaceous and black sagebrush forms of this community, with black sagebrush becoming more abundant in extended wet periods, and dying back during extended droughts.



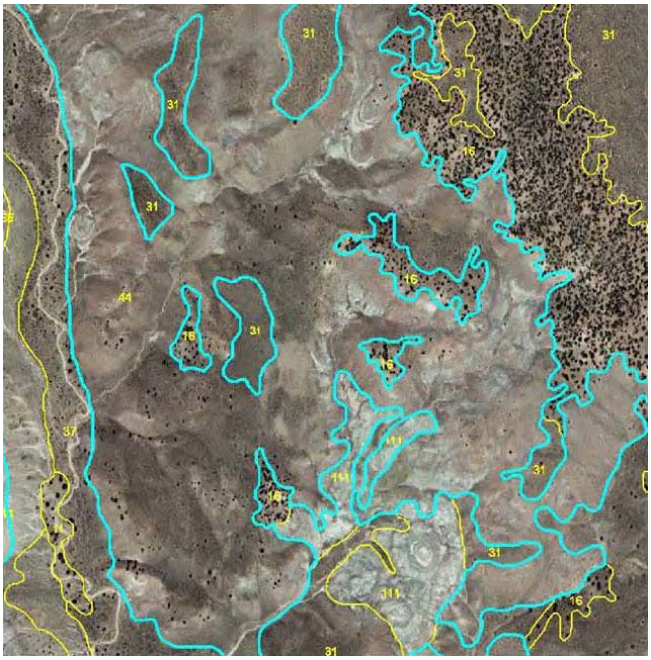



DP321
W→E


DP549
E↑W

44 Mixed Desert Shrubland (S-MXDD)

Associations:
Artemisia tridentata ssp. wyomingensis - Atriplex confertifolia Shrubland
Atriplex confertifolia - Krascheninnikovia lanata Shrubland
Atriplex confertifolia / Achnatherum hymenoides Shrubland
Atriplex confertifolia / Hesperostipa comata Shrubland
Atriplex confertifolia / Pleuraphis jamesii Shrubland
Atriplex confertifolia Great Basin Shrubland
Atriplex gardneri Dwarf-shrubland
Ephedra torreyana - (Atriplex spp.) / Nonvascular Gypsum Sparse Vegetation
Eriogonum (corymbosum, leptocladon) Dwarf-shrubland Alliance
Leymus salinus Shale Sparse Vegetation
Sarcobatus vermiculatus / Atriplex gardneri Shrubland



Common species:
Atriplex confertifolia
Artemisia tridentata ssp. wyomingensis
Atriplex gardneri
Ephedra torreyana
Eriogonum spp.
Krascheninnikovia lanata
Tetradymia spinescens
Pleuraphis jamesii

Project Specifics:
Frequency = 791 total polygons
274 polygons in DINO, 517 polygons in the environs
Total area = 8138.2 acres / 3293.4 ha (2%)
3112.2 acres / 1259.5 ha DINO
5026.0 acres / 2034.0 ha environs
Average polygon size = 10.3 acres / 4.2 ha
User's accuracy = 83% ± 10%
Producer's accuracy = 69% ± 11%

Interpretation:
Most polygons of this map unit are small to medium in size, regularly shaped, and occur primarily on eroding slopes of Moenkopi, Mancos, Morrison or other marine shales. Sparse crispleaf buckwheat communities occur in small, linear polygons on Mowry Shale. Elevations are low to moderate, and slopes are gentle to steep. There is no single distinctive signature for these occurrences; they are best identified by dominant shale color dulled only slightly by sparse vegetation. Close inspection will reveal very tiny specks of the shrubs. A minor group of polygons of this map dominated by winter-fat appear as medium to large, smooth gray openings within the dominant Sagebrush-Spiny Hopsage-Black Greasewood Shrubland (47). Adjacent map polygons often include the closely related Sagebrush- Rabbitbrush / Mixed Grass Shrubland (31), which has a slightly darker gray tint and better developed shrub texture when compared with Map Unit 44. Polygons of this map class may contain small inclusions Sagebrush- Rabbitbrush / Mixed Grass Shrubland (31).

Distribution/Ecology/Composition:
This type occurs on barren slopes of Morrison, Mancos, Chinle or Moenkopi shales and Browns Park formation where they are exposed throughout the mapping area. Most examples are on the sides of eroding drainages in Deerlodge Park, Rainbow Park, Browns Park or the Yampa Bench, and in the vicinity of the Gates of Lodore. Within this sparse community, shadscale, Torrey Mormon-tea, winterfat, spiny horsebrush, Gardner saltbush and occasionally mat saltbush may be present, all with low cover. If Wyoming sagebrush is present, it is incidental, or part of a sparse community with shadscale. Saline or alkaline soil chemistry, poor water-holding

capacity and erosion maintain these stands in a sparsely vegetated state. The closely related map unit Sagebrush - Rabbitbrush / Mixed Grass Shrubland tends to occur on gentler, more stable slopes and ridge tops. Another closely related map unit, Mat Saltbush Shrubland (59) is restricted to Mancos Shale exposures. In the Browns Park / Gates of Lodore section of the mapping area, this map unit occurs on level benchlands of Browns Park Formation, where polygons dominated by shadscale and winterfat are surrounded by flats and slopes of Sagebrush-Spiny Hopsage-Black Greasewood Shrubland (47).





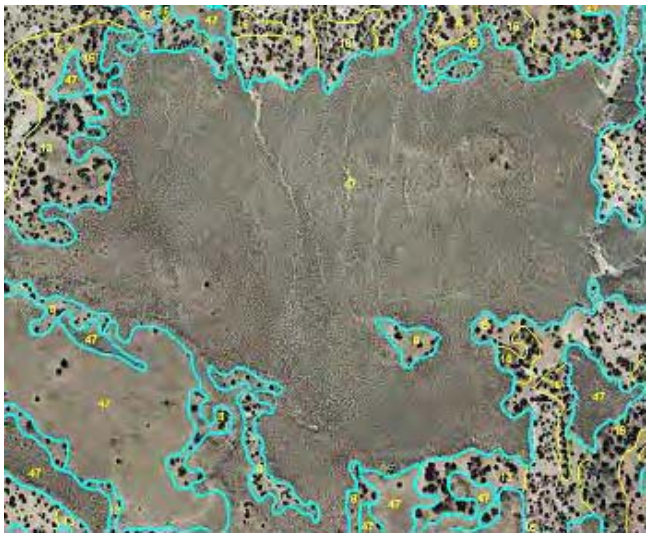


47 Sagebrush – Spiny Hopsage – Black Greasewood Shrubland (S-WSSG)

Associations:
Grayia spinosa / Achnatherum hymenoides Shrubland
Muhlenbergia pungens Herbaceous Vegetation (in part; see map class 73)

Common species:
Artemisia tridentata ssp. *wyomingensis*
Grayia spinosa
Sarcobatus vermiculatus
Achnatherum hymenoides

Project Specifics:
Frequency = 119 total polygons
13 polygons in DINO, 106 polygons in the environs
Total area = 3823.3 acres / 1547.2 ha (1.0%)
173.0 acres / 70.0 ha DINO
3650.4 acres / 1477.2 ha environs
Average polygon size = 32.1 acres / 13.0 ha
User's accuracy = 76% ± 13%
Producer's accuracy = 81% ± 12%



Interpretation:
This map class forms large, regular polygons. It is restricted to level to gently sloping benchlands underlain by Browns Park Formation. The signature is similar to that of nearby Sagebrush - Rabbitbrush / Mixed Grass Shrubland (31), but more uneven in texture and has more dark speckles. The break between map units 31 and 47 correlates very closely with the contact between the Uinta Mountain Group and the Browns Park Formation on the park geology map. adjacent polygons may also be mapped as Pinyon - Juniper / Sparse Understory Woodland (8), Pinyon - Juniper / Soil Crust Woodland (13), Rabbitbrush / Mixed Grass Shrubland (31), and Mixed Desert Shrubland (44).

Distribution/Ecology/Composition:
This type is restricted to the benchlands of Browns Park Formation east and northeast of the Gates of Lodore. Most stands contain the three named species, but in a few areas the sagebrush is missing and the community contains only spiny hopsage and greasewood. These stands have a long history of intensive grazing and support little herbaceous understory other than a few tufts of Indian ricegrass.



53 Canyon Wall Mixed Shrubland (S-CANY)



Associations:
Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrubland (in part; see map class 31)
Chrysothamnus viscidiflorus Talus Shrubland
Philadelphus microphyllus - Ephedra viridis Shrubland

Common species:
Artemisia tridentata ssp. wyomingensis
Chrysothamnus viscidiflorus
Ephedra viridis
Fraxinus anomala
Grayia spinosa
Philadelphus microphyllus
Pseudoroegneria spicata

Project Specifics:
Frequency = 154 total polygons
147 polygons in DINO, 7 polygons in the environs
Total area = 1918.4 acres / 776.3 ha (0.5%)
1863.1 acres / 754.0 ha DINO
55.3 acres / 22.4 ha environs
Average polygon size = 12.5 acres / 5.0 ha
User's accuracy = 100%
Producer's accuracy = 79% ± 13%

Interpretation:
This map unit occurs in medium to large polygons. It is restricted to the walls and steep talus slopes (all aspects) in the canyons of the two rivers and their major tributaries. The signature is that of a shrubland, often with the gray-green speckles of sagebrush or *Grayia* mixed with darker green speckles of serviceberry. The round dots of pinyon and juniper trees are absent or very scattered. The structure and often the color of the underlying bedrock is generally clearly visible. Polygons of other talus slope types, such as Mixed Mountain Shrubland (54), may occur as inclusions in this type. Some stands may have scattered juniper trees.

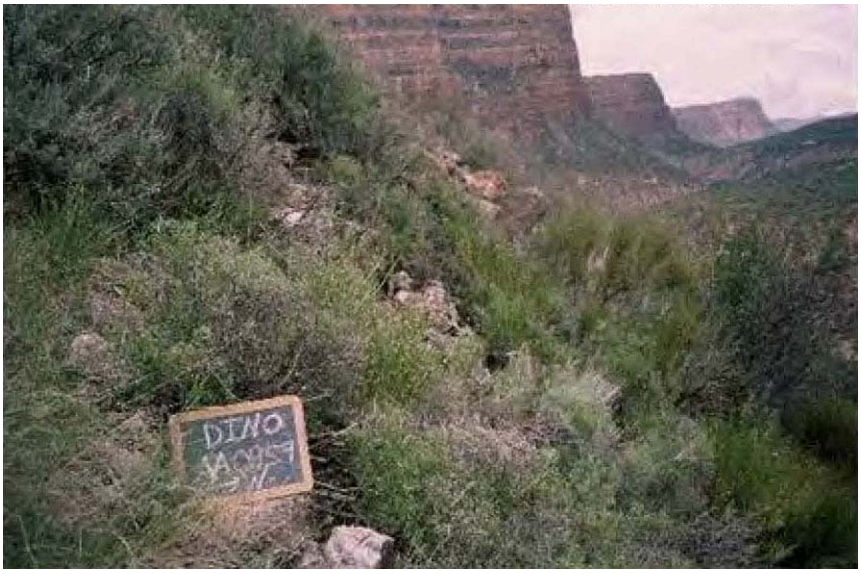
Distribution/Ecology/Composition:



This unit occurs on ledges, colluvial slopes and talus on the walls of both the Yampa and Green River canyons, as well as the major tributaries such as Jones Hole Creek. Slopes are uniformly steep, and every sandstone or limestone substrate is represented. While Utah juniper may have low cover (<10%), most of the vegetation is a rich and somewhat random mixture of xeric shrubs: *Atriplex confertifolia, Amelanchier utahensis, Artemisia tridentata ssp. wyomingensis, Grayia spinosa, Glossopetalon spinescens, Ephedra viridis, Fendlera rupicola, Fraxinus anomala, Cercocarpus montanus, Philadelphus*

microphyllus, Chrysothamnus viscidiflorus, Ericameria nauseosa, and *Gutierrezia sarothrae*. No single species is a consistent dominant, because of small variations in exposure, slope, soil depth, chemistry, and rockiness. Canyon walls that have burned have higher cover by shrubs that re-sprout, such as *Amelanchier utahensis* and *Ericameria nauseosa*, as well as an understory dominated by cheatgrass. This map class contains numerous inclusions of associations belonging to other map classes, but most stands are too small to map separately or occur in the shadows of tall cliffs where they could not be detected.

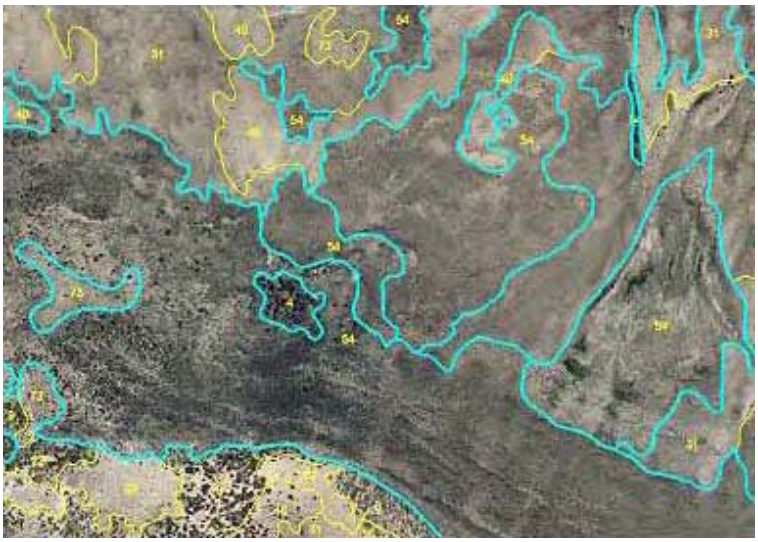




54 Mixed Mountain Shrubland (S-MXDM)

Associations:
Amelanchier (utahensis, alnifolia) - Cercocarpus montanus Shrubland
Amelanchier alnifolia / Symphoricarpos oreophilus Shrubland
Amelanchier utahensis / Pseudoroegneria spicata Shrubland
Amelanchier utahensis Shrubland
Artemisia tridentata (ssp. vaseyana, ssp. wyomingensis) - Amelanchier utahensis Shrubland
Ceanothus velutinus Shrubland
Cercocarpus montanus / Pseudoroegneria spicata Shrubland
Prunus virginiana - (Prunus americana) Shrubland

Common species:
Amelanchier (utahensis, alnifolia)
Artemisia tridentata (ssp. vaseyana, wyomingensis)
Cercocarpus montanus
Chrysothamnus viscidiflorus
Mahonia repens
Symphoricarpos oreophilus
Balsamorhiza sagittata
Pseudoroegneria spicata
Stenotus acaulis
Poa fendleriana
Purshia tridentata
Prunus virginianus
Ribes cereum



Project Specifics:
Frequency = 2636 total polygons
1006 polygons in DINO, 1630 polygons in the environs
Total area = 17047.1 acres / 6898.7 ha (4.3%)
6723.4 acres / 2720.9 ha DINO
10323.7 acres / 4177.9 ha environs
Average polygon size = 6.5 acres / 2.6 ha
User's accuracy = 88% ± 5%
Producer's accuracy = 84% ± 5%

Interpretation:
This map unit consists of small to medium, regular to elongated polygons, on moderate to steep, often rocky north-facing slopes at upper elevations of the mapping area. The signature varies depending on the composition of the community. In the final version of the map, polygons have a modifier to designate the dominant shrub, when known. Adjacent polygons are often mapped as Sagebrush – Rabbitbrush / Mixed Grass Shrubland (31) Douglas-fir Forest (1) or Aspen Forest (4).

Some stands are a mix of sagebrush and true mountain mahogany; these have the typical speckled gray-green of sagebrush modified by a speckling of darker spots representing the mountain shrubs. The overall appearance is similar to the signature for Sagebrush - Antelope Bitterbrush Shrubland (32). The way to distinguish these is that Map Unit 32 is generally at lower elevations and Map Unit 54 often has scattered dark dots that correlate to serviceberry shrubs.

Other stands, especially at the base of small cliffs, are dominated by serviceberry. These shrubs superficially resemble small pinyon or juniper trees, but close inspection reveals a brighter green color, flat shape and irregular margins. Chokecherry thickets, which occur in the same habitats, are usually smaller and are a brighter, more intense green. Aspen stands may occur nearby, but are usually obviously taller in stature and are often also a lighter green color.

Stands that are dominated by mountain mahogany have more regular shrub spacing and the

shrubs are even-sized and slightly larger than sagebrush, giving the signature a “pebbled” look.

Stands with higher relative cover of mountain shrubs have a signature that is darker than sagebrush-dominated shrublands, but lighter than solid serviceberry shrublands.

Distribution/Ecology/Composition:
This map class is known primarily from Blue Mountain and to a lesser extent on Douglas Mountain and Wild Mountain. Stands occupy areas on moderate to steep slopes with higher soil moisture than on adjacent flats (usually Sagebrush – Rabbitbrush / Mixed Grass Shrubland (31)), but with soils too mobile, rocky, or shallow to support Douglas-fir. Slopes range from gentle to steep. This map class is a mosaic of various mountain shrub associations; many stands include sagebrush,, while others are dominated by true mountain mahogany, antelope bitterbrush, serviceberry, snowberry, or chokecherry. The herbaceous understory is usually dense and diverse, with total vegetation cover often approaching 100%. Most stands are in areas of moderate snow cover. Most of the characteristic shrubs in this community sprout readily after fire, and fire may help to keep stands free of trees.



Mountain mahogany – antelope bitterbrush communities occur on moderate to steep slopes in rocky draws in upper elevations of the mapping area. The known examples are all in the central core of the mapping area, on the Yampa Plateau and Douglas Mountain. Sagebrush (mountain or Wyoming) also generally has significant cover. The herbaceous understory is well-developed, with bluebunch wheatgrass, muttongrass, balsamroot and buckwheats as the most consistent species. A few stands are being invaded by pinyon or juniper trees.

Dense thickets of serviceberry occur on rocky, sheltered slopes with deep soils at the base of small cliffs in the upper elevations of the mapping area, including the Yampa Plateau, Wild Mountain and Douglas Mountain. This community is limited to areas where snow collects. Chokecherry and sagebrush may occur beneath the serviceberry canopy. The herbaceous layer is diverse, containing a number of graminoid and forb species. Aspen stands often occur nearby, and can be difficult to distinguish from the serviceberry thickets except by their somewhat taller stature.

Dense thickets of chokecherry occur on rocky, sheltered slopes at the base of small cliffs or around the margins of talus fields in the upper elevations of the mapping area. A few polygons

occur on the very uppermost part of lee slopes where snow cornices melt out late in the spring.

Most examples are on the Yampa Plateau, Wild Mountain or Douglas Mountain. Stands generally include a diversity of other shrubs, including snowberry, gooseberry, threeleaf sumac, and serviceberry. Great Basin wildrye is the tallest and most conspicuous species in a diverse herbaceous layer.







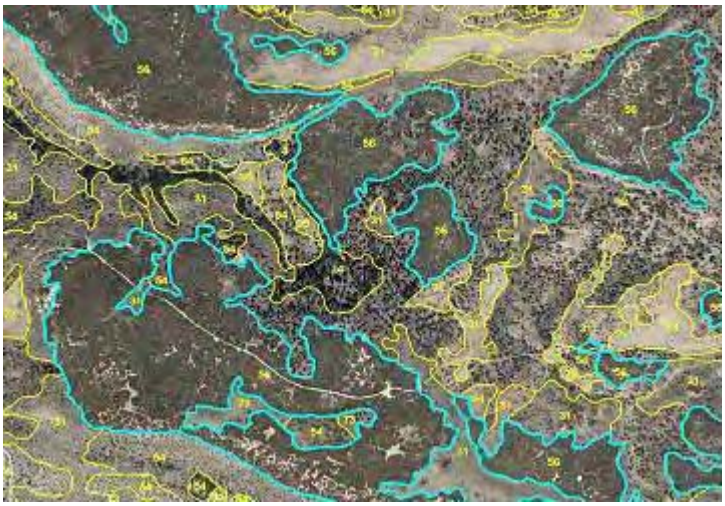


56 Greenleaf Manzanita Shrubland (S-MANZ)

Associations:
Arctostaphylos patula - Artemisia tridentata (ssp. vaseyana, ssp. wyomingensis) Shrubland

Common species:
Arctostaphylos patula
Amelanchier (alnifolia, utahensis)
Artemisia tridentata (*ssp. vaseyana, ssp. wyomingensis)*
Poa fendleriana

Project Specifics:
Frequency = 43 total polygons
2 polygons in DINO, 41 polygons in the environs
Total area = 139.6 acres / 56.5 ha (<<1%)
3.9 acres / 1.6 ha DINO
135.7 acres / 54.9 ha environs
Average polygon size = 3.2 acres / 1.3 ha
User's accuracy = 100%
Producer's accuracy = 100%



Interpretation:
This uncommon map unit is restricted to highlands of Weber Sandstone in the southern part of the mapping area. The polygons are small to medium in size and regular in shape. The signature is distinctive - the shrubs form tight, dense clones and appear as a solid medium gray-green polygons with a slightly rough texture and distinct edges – the overall impression is of mold growing in a petri dish. Adjacent polygons may be mapped as Mixed Mountain Shrubland (54) and Aspen Forest (4).

Distribution/Ecology/Composition:
This type is limited to ridges and ravine rims on the highlands on the southern edge of the mapping area, including the Yampa Plateau and Stuntz Ridge. The community consists of dense, thigh-high mats of *Arctostaphylos patula* with few other species except sagebrush. Manzanita shrubs are long-lived and clonal, and resprout freely following fire, so these communities should persist over time.

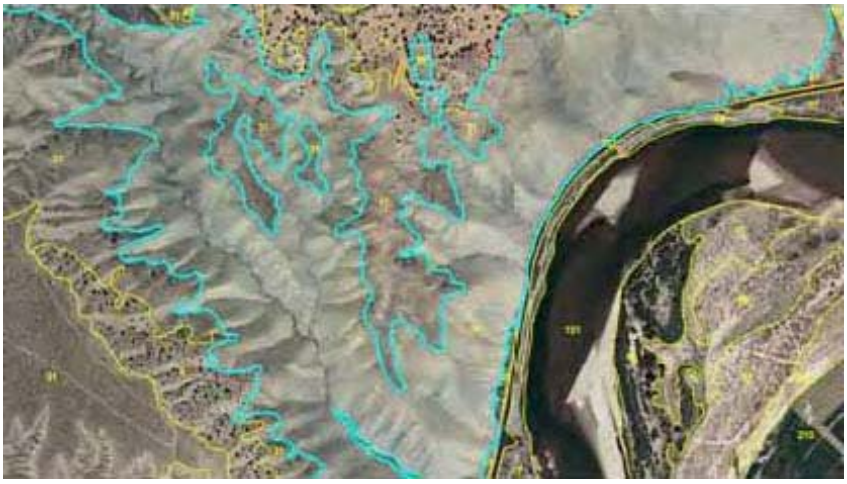


59 Mat Saltbush Shrubland (S-MATS)

Associations:
Atriplex corrugata Dwarf-shrubland
Atriplex gardneri Dwarf-shrubland

Common species:
Atriplex corrugata
Atriplex gardneri
Achnatherum hymenoides

Project Specifics:
Frequency = 205 total polygons
14 polygons in DINO, 191 polygons in the environs
Total area = 1823.9 acres / 738.1 ha (0.5%)
161.6 acres / 65.4 ha DINO
1662.3 acres / 672.7 ha environs
Average polygon size = 8.9 acres / 3.6 ha
User's accuracy = 100%
Producer's accuracy = 64% ± 24%



Interpretation:
This map unit occurs in small to medium, regular to elongated polygons. All examples are at the extreme east and west ends of the mapping area, on slopes, benches and hogbacks of Mancos Shale adjacent to Split Mountain and Deerlodge Park. Because of the high reflectance of the shale 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. However, most slopes of Mancos shale will support this community, except for the hottest and steepest south-facing slopes, which are barren. Adjacent polygons are often mapped as Sagebrush-Rabbitbrush / Mixed Grass Shrubland (31), Mixed Desert Shrubland (44), or Pinyon-Juniper / Soil Crust Woodland (13).

Distribution/Ecology/Composition:
This type occurs on slopes of badland adobe soils derived from Mancos Shale and rarely from Morrison Formation. It includes pure stands of *Atriplex corrugata* or *A. gardneri*, as well as mixed stands of *Atriplex corrugata* and *A. confertifolia* and/or *A. gardneri*. The herbaceous layer consists of sparse tufts of bunchgrass or selenium-tolerant forbs. Total vegetative cover is generally less than 15%.



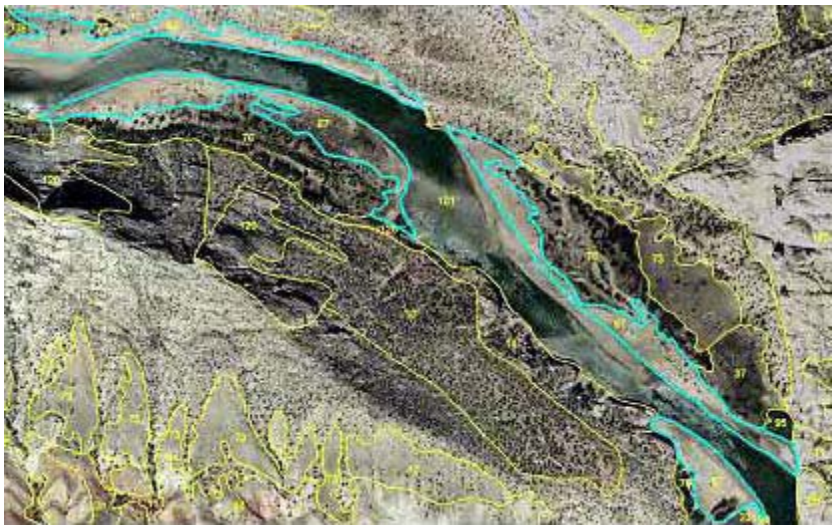
Upland Herbaceous Vegetation

67 Cobble Bar Mixed Herbaceous Vegetation (H-COBB)

Associations:
Heterotheca villosa
Herbaceous Vegetation

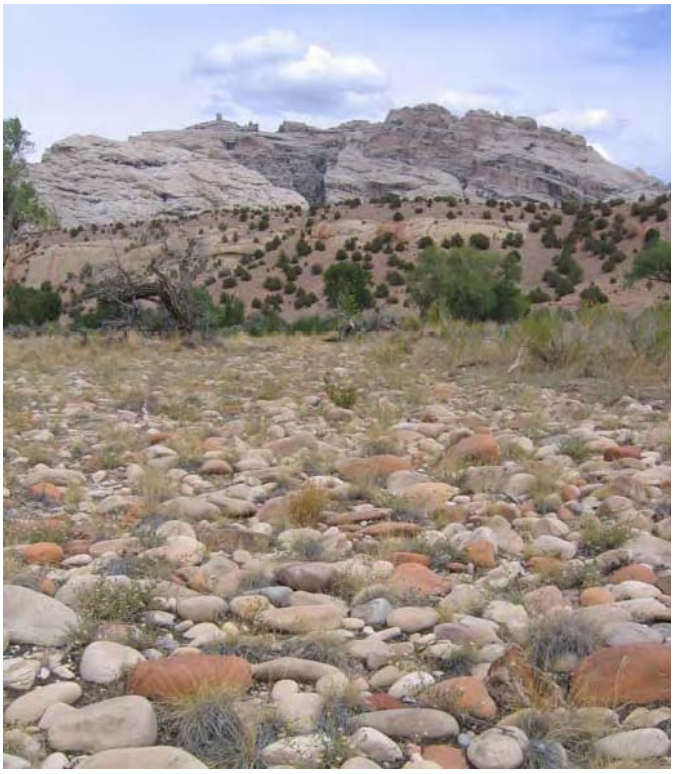
Common species:
Heterotheca villosa
Achnatherum hymenoides
Aristida purpurea
Sporobolus cryptandrus
Hesperostipa comata

Project Specifics:
Frequency = 37 total polygons
30 polygons in DINO, 7 polygons in the environs
Total area = 102.5 acres / 41.5 ha (<<1%)
81.5 acres / 33.0 ha DINO
21.0 acres / 8.5 ha environs
Average polygon size = 2.8 acres / 1.1 ha
User's accuracy = 83% ± 25%
Producer's accuracy = 83% ± 25%



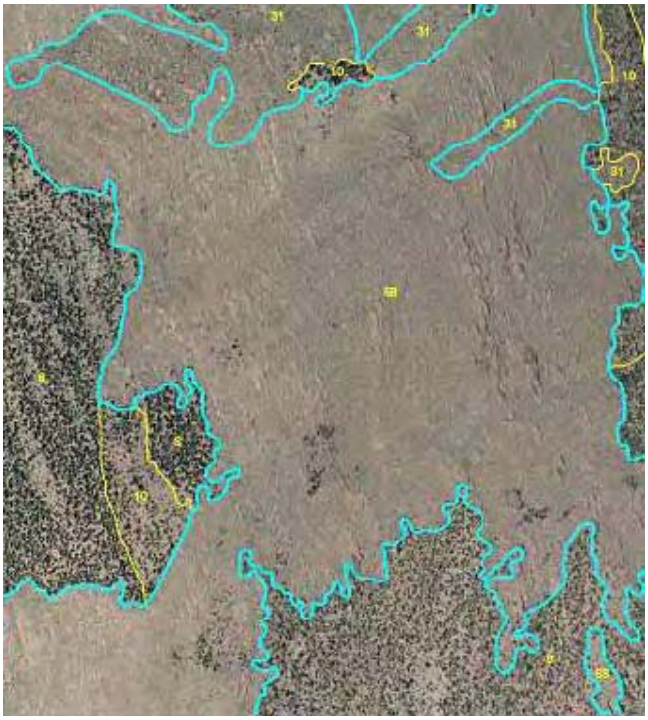
Interpretation:
This map unit occurs in small, regularly shaped to elongated polygons on islands and point bars in the Green River below its confluence with the Yampa. The signature is identical to other sparsely vegetated recent alluvium surfaces: off-white to a pale tan. The substrate is cobbles, but this is not apparent on the photos. Most examples were mapped only where encountered. There are many examples of this map unit that are smaller than the minimum mapping unit size, and thus are inclusions within the matrix community.

Distribution/Ecology/Composition:
This unique but consistent community occurs on cobble-armored bars and islands in the Green River, which are flooded only in exceptional years. The substrate of large cobbles in a sandy matrix tends to support a sparse community of sand-loving, disturbance tolerant species, of which hairy goldenaster, needle-and-thread, sand dropseed, threeawn and Indian ricegrass are diagnostic. Adjacent communities tend to be other riparian types that prefer drier sites, such as Tamarisk Shrubland (85), Bottomland Shrubland (37), Box Elder Woodland (80) or Rio Grande Cottonwood Woodland (76).



68 Weedy Herbaceous Vegetation (H-WEED)

Associations:
Bromus tectorum Semi-natural Herbaceous Vegetation
Elymus repens Semi-natural Herbaceous Vegetation
Post-fire Herbaceous Vegetation
Shale Annual Herbaceous Vegetation
Perennial Pepperweed Herbaceous Vegetation (probable)



Common species:
Halogeton glomeratus
Salsola spp.
Elymus repens
Cirsium arvense
Iva axillaris
Lepidium latifolium
Bromus tectorum

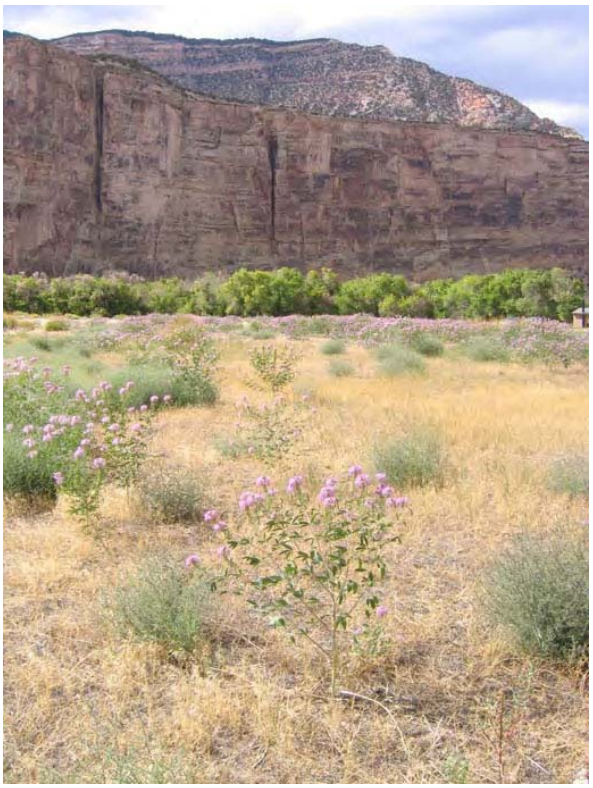
Project Specifics:
Frequency = 596 total polygons
288 polygons in DINO, 308 polygons in the environs
Total area = 6014.9 acres / 2434.1 ha (1.5%)
2842.6 acres / 1150.4 ha DINO
3172.3 acres / 1283.8 ha environs
Average polygon size = 10.1 acres / 4.1 ha
User's accuracy = 78% ± 8%
Producer's accuracy = 83% ± 7%

Interpretation:
This map class occurs in small to very large, mostly regular polygons, located throughout the mapping area on valley floors, floodplains, benches, slopes, ridgelines and mountainsides. It describes stands of perennial or persistent annual weeds such as cheatgrass, Russian thistle, Canada thistle, green wormwood, perennial pepperweed or quackgrass. Because of the large amount of dead material and/or the high percentage of bare ground, many polygons appear off-white in color with spots of darker green (weed clones) and spots and streaks of other darker colors that are probably relict basin big sagebrush shrubs or stringers of tamarisk. Some are a darker, smooth gray, and stands of cheatgrass are dark mustard yellow with a smooth texture. Where mixed with native grasses, the signature dulls toward a smooth gray-green. Areas with more than 10% cover by big sagebrush or rubber rabbitbrush are mapped separately (Map Class 31).

Distribution/Ecology/Composition:
Most examples are in areas that have experienced severe or chronic disturbance, as well as exposure to a weed source.Old fields, corrals and other sites with a history of frequent disturbance within the mapping area support weedy annual herbaceous vegetation. Perennial pepperweed is well established in the Yampa River canyon, and Canada thistle is present in both major canyons, as well as some of the tributary floodplains. Quackgrass has spread downstream from its base in Deerlodge Park. Coarser substrates support lambs quarter and tumblemustard. Fine-textured substrates support tumbleweed, Rocky Mountain beeplant, *Alyssum* or *Halogeton*. Prairie dogs may be present, and may help to maintain the community in a disturbed condition. Roadsides often support a community that keys to this map unit, but most roadside examples are too small and narrow to be mapped.

Large parts of the mapping area have burned in the past 25 years. Hot fires with a slow rate of spread tend to favor the growth of cheatgrass. In contrast, successful controlled burns have a high rate of spread that stimulates the growth of native bunch and rhizomatous grasses. Large areas burned by wildfire in the 1960s near the Gates of Lodore support extensive stands of

cheatgrass, as well as cheatgrass and rabbitbrush-dominated stands of Sagebrush – Rabbitbrush / Mixed Grass Shrubland (31). Smaller wildfire scars throughout the mapping area resulting from lightning strikes also are now dominated by cheatgrass. Other, usually smaller examples are located in floodplains or valley floors where grazing has been most intense. Bromus tectorum is the overwhelmingly dominant species in all cases, whether the cover is dense or sparse. A few relict native grasses or shrubs may persist, but they have less than 5% cover.



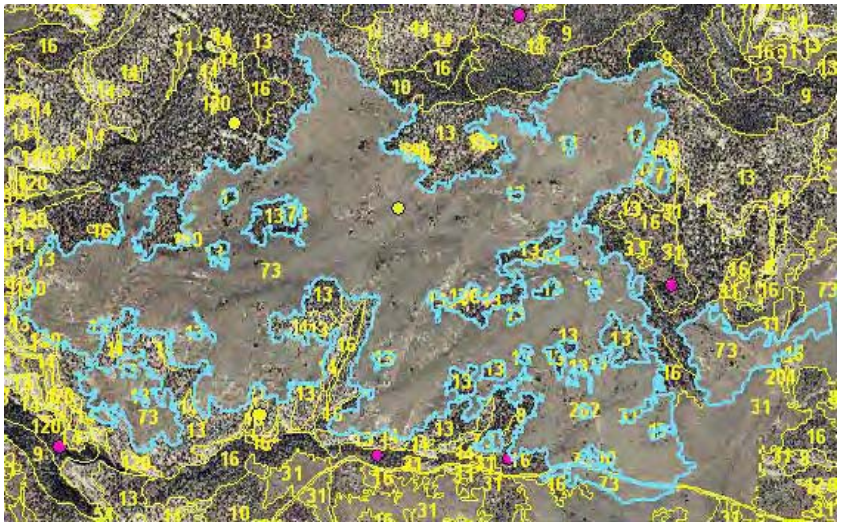




73 Native Grassland Herbaceous Vegetation (H-GRAS)

Associations:
Achnatherum hymenoides Colorado Plateau Herbaceous Vegetation
Achnatherum lettermanii Herbaceous Alliance
Chrysothamnus viscidiflorus / Hesperostipa comata Shrubland
Distichlis spicata Herbaceous Vegetation
Elymus lanceolatus Herbaceous Vegetation
Hesperostipa comata - Achnatherum hymenoides Herbaceous Vegetation
Hesperostipa comata Great Basin Herbaceous Vegetation
Leymus cinereus - Distichlis spicata Herbaceous Vegetation
Leymus cinereus - Pascopyrum smithii Herbaceous Vegetation
Leymus salinus Shale Sparse Vegetation
Muhlenbergia pungens Herbaceous Vegetation
Pascopyrum smithii Herbaceous Vegetation
Pleuraphis jamesii Herbaceous Vegetation
Pseudoroegneria spicata - Leymus salinus Herbaceous Vegetation
Pseudoroegneria spicata Herbaceous Vegetation (in part; see map class 40)
Sporobolus cryptandrus Great Basin Herbaceous Vegetation

Common species:
Achnatherum hymenoides
Hesperostipa comata
Pleuraphis jamesii
Distichlis spicata
Pseudoroegneria spicata
Elymus lanceolatus
Poa secunda
Poa fendleriana
Pascopyrum smithii
Lupinus argenteus
Leymus cinereus
Pascopyrum smithii
Muhlenbergia pungens

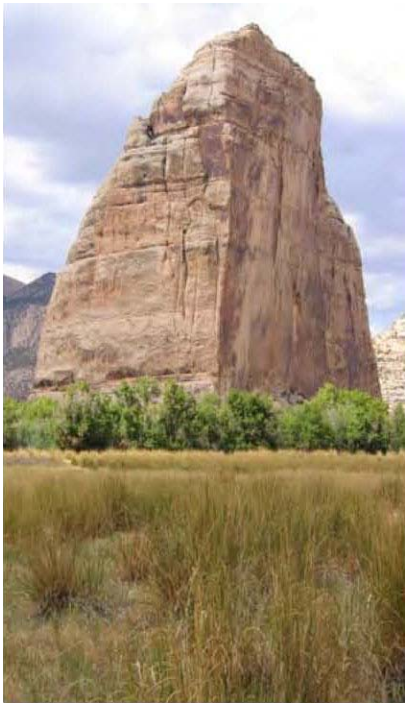


Project Specifics:
Frequency = 1983 total polygons
862 polygons in DINO, 1121 polygons in the environs
Total area = 31044.5 acres / 12563.3 ha (%)
16329.3 acres / 6608.2 ha DINO
14715.3 acres / 5955.1 ha environs
Average polygon size = 15.7 acres / 6.3 ha
User's accuracy = 74% ± 8%
Producer's accuracy = 68% ± 9%

Interpretation:
Polygons of this map class occur in all parts of the mapping area, in many different landscape positions and on many different geologic substrates. Polygons are small to large, mostly regularly shaped. Larger polygons in burned areas may contain small inclusions of Sagebrush – Rabbitbrush / Mixed Grass Shrubland (31) or various pinyon juniper map classes. This map class is easily recognized by its smooth texture and generally a uniform tan to grayish green color.

Distribution/Ecology/Composition:
This map class includes prescribed burn areas and other areas dominated by native bunchgrasses such as bluebunch wheatgrass, muttongrass, needle-and-thread, Indian ricegrass, curly bluegrass, western wheatgrass, and/or rare stands of Great Basin wildrye or James' galleta. Some examples are substrate-controlled, but most are the result of fire destroying a woody overstory and stimulating the growth of bunchgrasses. 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. Soils are generally deep, and many examples are inclusions representing burned pinyon-juniper woodlands or sagebrush shrublands. If fire is excluded, sagebrush and / or pinyon and juniper will become re-established in most sites within 30-50 years.











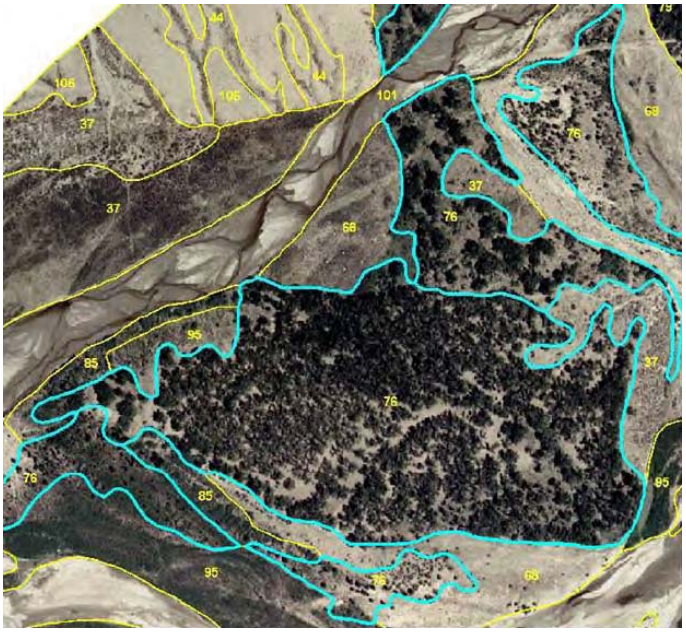




Riparian Forest and Woodland

76 Broadleaf Cottonwood Woodland (W-COTT)

Associations:
Populus deltoides (ssp. wislizeni, ssp. monilifera) / Distichlis spicata Woodland
Populus deltoides ssp. wislizeni / Acer negundo Woodland
Populus deltoides ssp. wislizeni / Disturbed Understory Woodland
Populus deltoides ssp. wislizeni / Rhus trilobata Woodland

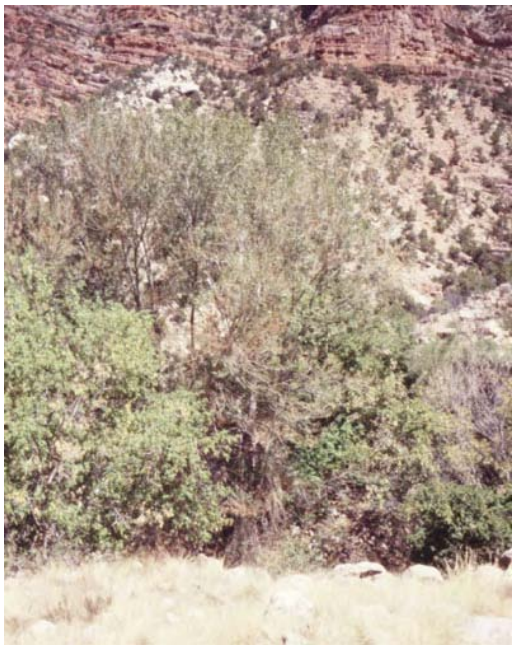


Common species:
Populus deltoides ssp. *wislizeni*
Acer negundo
Leymus cinereus
Rhus trilobata
Artemisia tridentata ssp. tridentata
Ericameria nauseosa
Distichlis spicata
Typha latifolia

Project Specifics:
Frequency = 203 total polygons
116 polygons in DINO, 87 polygons in the environs
Total area = 652.0 acres / 263.9 ha
339.4 acres / 137.3 ha DINO
312.6 acres / 126.5 ha environs
Average polygon size = 3.2 acres / 1.3 ha
User's accuracy = 94% ± 6%
Producer's accuracy = 94% ± 6%

Interpretation:
Polygons of this uncommon map unit are mostly small and elongated. Polygons occur along the main stem rivers and also as isolated stands in smaller drainages. Both the moderately tall bright green of box elder crowns and the taller darker green of cottonwood crowns are evident. The matrix color may be tan to gray, depending on the amount of vegetation in the understory.

Distribution/Ecology/Composition:
Most cottonwood stands in the mapping area are decadent and on high terraces at least 3m above the current river level. A few younger stands occupy the margins of abandoned channels. There are also occasional isolated stands in smaller drainages, presumably where springs emerge. The canopy in these communities may be open to moderately closed (less than 40% cover), and box elder often accompanies the emergent mature cottonwood trees. The understory in mature stands generally includes or is dominated by upland species, including greasewood, basin big sagebrush, Rocky Mountain juniper and needle-and-thread grass. Young stands retain vestiges of the original sandbar willow subcanopy. Canopy closure does not usually exceed 40%.




DINO 432
W E

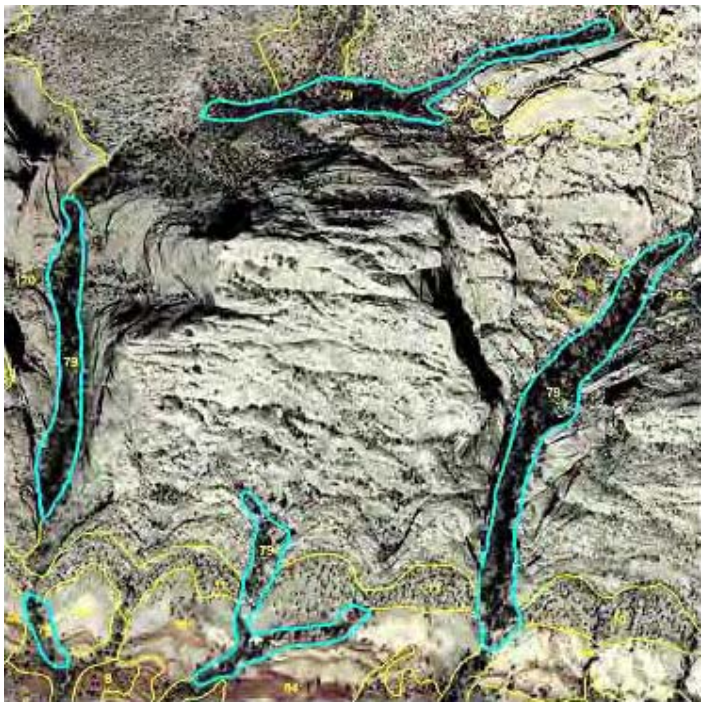


79 Narrow Canyon Mesic Woodland (W-NARR)

Associations:
Betula occidentalis / Mesic Graminoids Shrubland
Betula occidentalis Shrubland
Populus angustifolia - Juniperus scopulorum Woodland
Populus angustifolia / Betula occidentalis Woodland
Populus angustifolia / Rhus trilobata Woodland
Populus angustifolia / Salix exigua Woodland
Pseudotsuga menziesii / Acer negundo Woodland

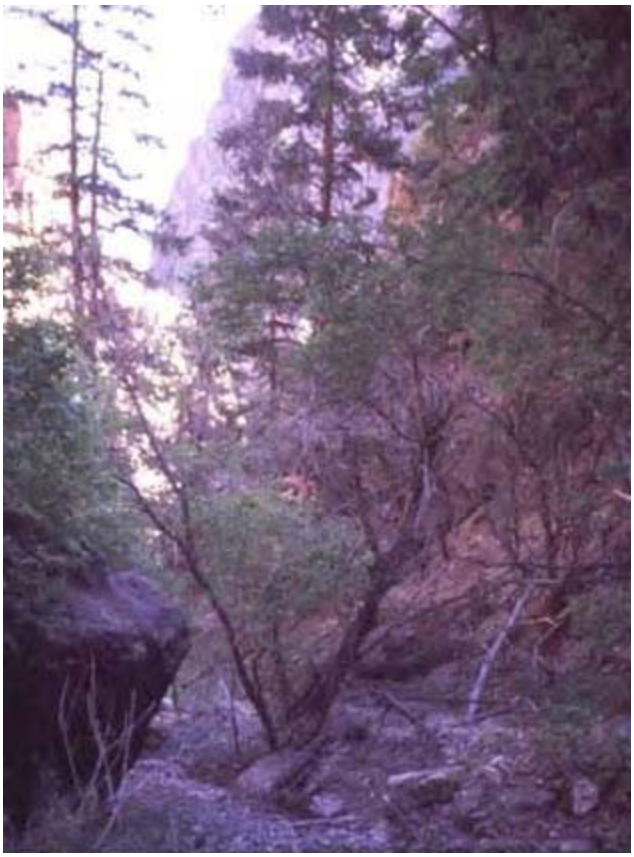
Common species:
Pseudotsuga menziesii
Acer negundo
Populus angustifolia
Rosa woodsii
Amelanchier utahensis
Betula occidentalis
Salix exigua
Rhus trilobata
Agrostis gigantea
Equisetum spp.
Juniperus scopulorum
Juncus spp.
Maianthemum stellatum

Project Specifics:
Frequency = 40 total polygons
34 polygons in DINO, 6 polygons in the environs
Total area = 123.9 acres / 50.1 ha (<<1%)
105.7 acres / 42.8 ha DINO
18.2 acres / 7.4 ha environs
Average polygon size = 3.1 acres / 1.3 ha
User's accuracy = 75% ± 21%
Producer's accuracy = 100%



Interpretation:
This rare map class occurs in cold, narrow tributary canyons of the Green and Yampa rivers, sometimes mostly dry except for cottonwood stands around small canyon-head springs. Polygons are mostly smaller than the minimum mapping unit in size. The tall, dark, narrow crowns of The pointed, dark green crowns of Douglas-fir are sometimes evident, as is the brighter green of the deciduous trees. Water birch appears dark green with no opening between shrub crowns, with a rough texture. The understory is variable and has no consistent signature. Most stands were mapped as encountered, or modeled from similar stands in nearby canyons. Adjacent polygons may include Douglas-fir Forest (1) or a variety of canyon wall shrubland or woodland map units.

Distribution/Ecology/Composition:
This diverse group of associations is found cold slot canyons cut into the south face of Split Mountain and in north-facing alcoves and drainages in the upper reaches of north-tosouth-oriented narrow tributaries of the Yampa and Green Rivers, such as Rippling Brook, Pot Creek, and Beach Draw. *Betula* stands are in areas with a fluctuating, but generally high water table and often have a diverse understory of wetland species such as *Carex, Typha* and *Clematis ligusticifolia*. In cottonwood – Douglas-fir stands, the canopy is generally closed, and the understory is dense and diverse, with a well-developed mesic shrub layer, but a sparse herbaceous layer due to the deep shade cast by canyon walls and the closed tree canopy. In pure cottonwood stands, the understory is diverse, mixed and usually not dense, but often includes Saskatoon serviceberry. A few relict stands are located where stream bottom springs have dried up.





80 Box Elder Woodland (W-BOEL)

Associations:
Acer negundo / Disturbed Understory Woodland
Acer negundo / Equisetum arvense Forest
Acer negundo / Prunus virginiana Forest
Acer negundo / Rhus trilobata Woodland

Common species:
Acer negundo
Bromus tectorum
Betula occidentalis
Artemisia tridentata ssp. *tridentata*
Prunus virginiana ssp. *melanocarpa*
Rhus trilobata
Clematis ligusticifolia
Piptatherum micranthum
Tamarix ramosissima

Project Specifics:
Frequency = 357 total polygons
307 polygons in DINO, 50 polygons in the environs
Total area = 772.2 acres / 312.5 ha (0.2%)
676.8 acres / 273.9 ha DINO
95.4 acres / 38.6 ha environs
Average polygon size = 2.2 acres / 0.9 ha
User's accuracy = 96% ± 4%
Producer's accuracy = 100%



Interpretation:
This map unit usually occurs in linear to elongated polygons on upper stream terraces, or in the narrower parts of the main canyons where riparian vegetation is poorly developed and the stream banks are rocky. Individual tree crowns are bright green, with rounded shadows due to height and canopy shape. The matrix (understory) generally appears tan to medium gray-brown because of the upland species growing there. Riverside occurrences are mapped where mature trees are spaced along the margin of the river. There are sometimes closed-canopy stands with an invisible understory, so most polygons were mapped as observed. This map unit is often recognizable where there is a stand of bright green box elder with darker green shrubs (birch, sumac, dogwood) visible around the edges. Some small polygons have brighter green, rounded deciduous tree crowns showing through the rough texture and dark green of tamarisk canopy. They are usually embedded in larger polygons of Tamarisk Thicket (85).

Distribution/Ecology/Composition:
This community is somewhat uncommon, occurring both in the narrow reaches of the river canyons, where rocky substrates and frequent, violent floods prevent a well-developed riparian community from developing, and also on well-developed, dry upper terraces that no longer flood. This community may have an understory of upland shrub, grass and forb species on the high terraces, or a sparse understory of riparian species if occurring closer to the river. Canopy closure is always less than 60%, and often less than 40%. Where box elder forms an open canopy, water birch, threeleaf sumac and chokecherry often provide a dense understory.
In a few areas on the floodplains of the Green and Yampa rivers, box elder trees have grown up through the tamarisk thicket. This type is restricted to areas where groundwater intercepts a tamarisk stand and removes enough soil salts to enable broadleaf deciduous trees to become established. Most of these stands have an open canopy and a sparse herbaceous understory of weedy species such as cheatgrass, quackgrass or knapweed.


DP200
S→N

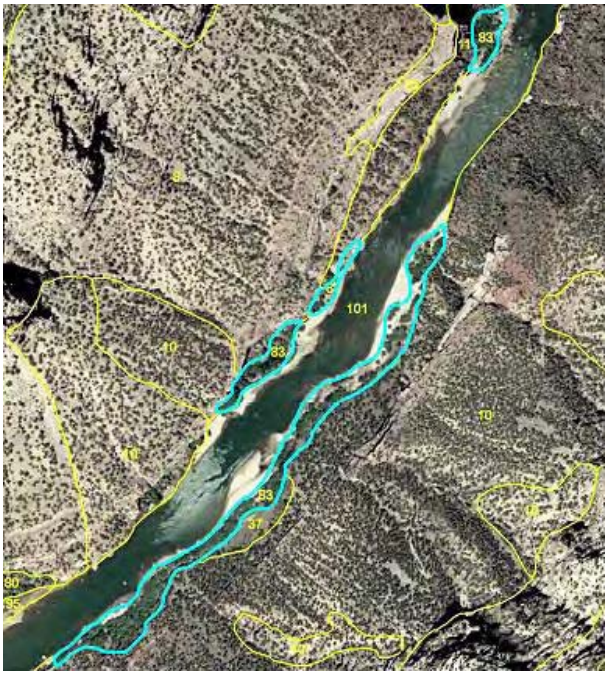








83 Box Elder / Netleaf Hackberry Woodland (W-BOHA)



Associations:
Acer negundo - Celtis laevigata var. reticulata Woodland

Common species:
Acer negundo
Celtis laevigata var. *reticulata*
Bromus tectorum

Project Specifics:
Frequency = 9 total polygons
9 polygons in DINO, 0 polygons in the environs
Area = 14.3 Total acres / 5.8 ha
14.3 acres / 5.8 ha DINO
0 acres / 0 ha environs
Average polygon size = 1.6 acres / 0.6 ha
User's accuracy = 100%
Producer's accuracy = 80% ± 29%

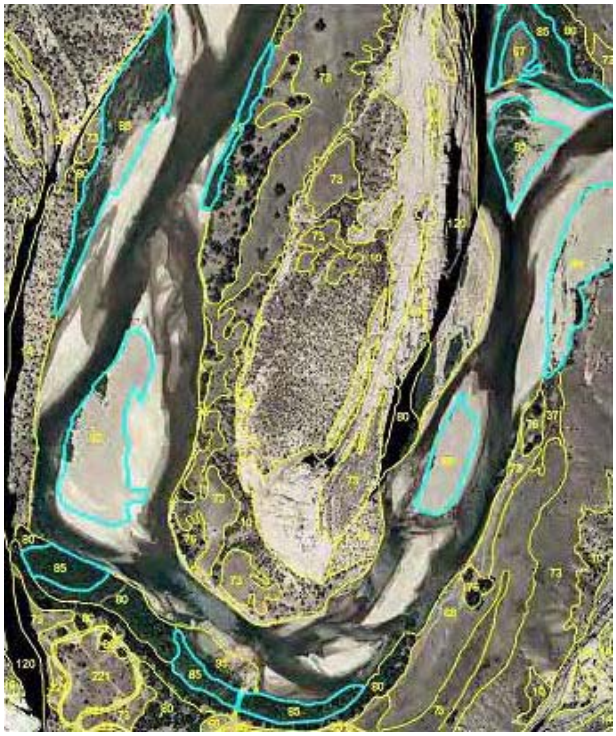
Interpretation:
This rare map unit occurs in small, regular to elongated polygons. Most polygons are smaller than the minimum mapping unit. The community is restricted to middle and upper terraces of the Green River near the confluence with the Yampa. The signature is identical to that of other closed-canopy box elder stands (80), so this type was mapped only where encountered, as the bright green signature is identical to other closed box elder woodlands in similar habitats.

Distribution/Ecology/Composition:
This community occurs in scattered small stands on middle and upper terraces of the Green River from a mile above the confluence with the Yampa River to the vicinity of Jones Hole. These stands flood rarely, if ever. The canopy and/or subcanopy includes both hackberry and box elder with at least 10% cover each, and the understory is dominated by upland species such as cheatgrass and fourwing saltbush.



Riparian / Wetland Shrubland

85 Tamarisk Thicket and Russian Olive Woodland (S-TARU)



Associations:
Tamarix spp. Temporarily Flooded Shrubland (in part; see map class 95)
Elaeagnus angustifolia Semi-natural Woodland

Common species:
Tamarix ramosissima
Elymus repens
Lepidium latifolium
Eleagnus angustifolia
Rhus trilobata
Spartina pectinata

Project Specifics:
Frequency = 287 total polygons
205 polygons in DINO, 82 polygons in the environs
Total area = 639.9 acres / 259.0 ha (0.2%)
453.1 acres / 183.3 ha DINO
186.9 acres / 75.6 ha environs
Average polygon size = 2.2 acres / 0.9 ha
User's accuracy = 84% ± 11%
Producer's accuracy = 76% ± 12%

Interpretation:
This map unit occurs on banks, islands and point bars along the Yampa and Green rivers. Mature stands appear as linear to elongated, very dark green, closed canopy stands with a rough texture. Young stands may be nearly the same color as the substrate, with only a faint yellowish tinge. In some stands, the smooth dark green of tamarisk is interrupted by bright gray crowns of Russian olive Most stands were mapped as observed.

Distribution/Ecology/Composition:
This exotic shrub community occurs in open to dense stands on the margins and lower terraces of the Yampa and Green Rivers, on both sand and cobble substrates. Russian olive occurs mixed with tamarisk in small stands only along the lower Green River downstream of Split Mountain on middle terraces that rarely flood. Mature tamarisk stands have few co-occurring species due to their density, but young stands may have an understory of quackgrass or perennial pepperweed. Stands where Russian olive is dominant may include a diverse array of native and exotic shrubs, forbs and graminoids. The monument has an aggressive, ongoing program of tamarisk removal, so that stands mapped on the 2002 photos may no longer exist.

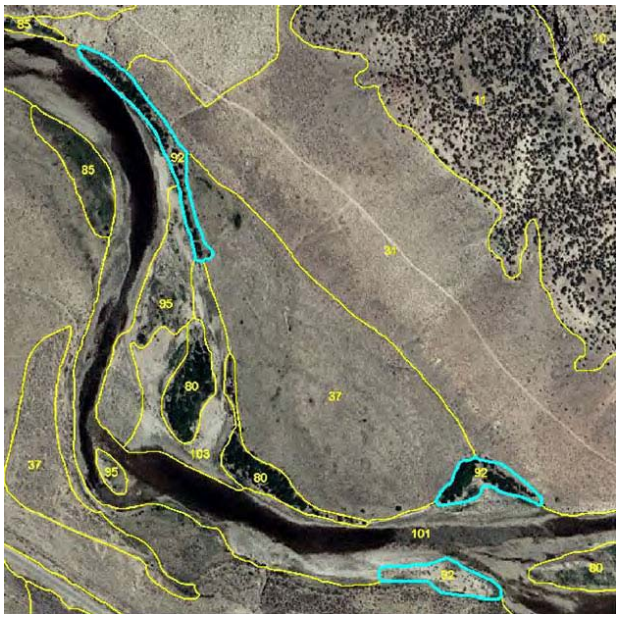



DP626
N→S


DO408
W→E

92 Threeleaf Sumac Riparian Thicket (S-SUMA)

Associations:
Rhus trilobata Intermittently Flooded Shrubland



Common species
Rhus trilobata
Artemisia tridentata ssp. *tridentata*
Chrysothamnus linifolius
Clematis ligusticifolia
Cornus sericea

Project Specifics:
Frequency = 37 total polygons
20 polygons in DINO, 17 polygons in the environs
Total area = 41.4 acres / 16.8 ha (<<1%)
19.0 acres / 7.7 ha DINO
22.4 acres / 9.1 ha environs
Average polygon size = 1.1 acres / 0.5 ha
User's accuracy = 71% ± 28%
Producer's accuracy = 100%

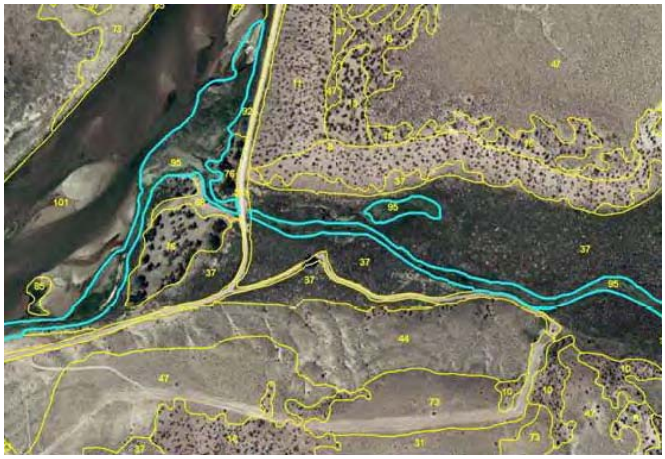
Interpretation:
This map unit occurs in small, regular to elongated polygons. The signature is a bright medium green, obviously taller than adjacent *Salix* stands and brighter green than adjacent tamarisk stands. For the most part, these were mapped where observed. Isolated stands of *Cornus sericea* at upland springs are also mapped as this type.



Distribution/Ecology/Composition:
Thick, dense stands of *Rhus trilobata* occur on the middle terraces of the Yampa River canyon, and along the Green River below Split Mountain, where flooding is uncommon but the water table is not too far below the ground surface. Sumac does not compete well with tamarisk, but in places along the Yampa where tamarisk has been removed, the sumac has readily filled the available space. A few polygons occur in alcoves on the canyon walls where springs emerge from sandstone bedrock. In some stands, threeleaf sumac forms an impenetrable thicket with few other species present. In others, the shrubs form an open canopy and other shrubs such as sagebrush are present.

Riparian / Wetland Herbaceous

95 Mixed Wetland/Riparian Vegetation (C-MXDW)



Associations:
Betula occidentalis / Mesic Graminoids Shrubland
Betula occidentalis Shrubland
Carex scopulorum Hanging Garden
Carex pellita Herbaceous Vegetation
Carex praegracilis Herbaceous Vegetation
Eleocharis palustris Herbaceous Vegetation
Equisetum hyemale Herbaceous Vegetation
Equisetum laevigatum Herbaceous Vegetation
Juncus balticus Herbaceous Vegetation
Phragmites australis Western North America Temperate Semi-natural Herbaceous Vegetation
Salix exigua / Barren Shrubland
Salix exigua / Mesic Forbs Shrubland
Salix exigua / Mesic Graminoids Shrubland
Schoenoplectus acutus Herbaceous Vegetation
Schoenoplectus pungens Herbaceous Vegetation
Spartina gracilis Herbaceous Vegetation
Spartina pectinata Western Herbaceous Vegetation
Tamarix spp. Temporarily Flooded Shrubland (in part)



Common species:
Carex spp.
Juncus spp.
Agrostis spp.
Distichlis spicata
Spartina pectinata
Phragmites australis
Schoenoplectus spp.
Apocynum cannabinum
Euthamia occidentalis
Glycyrrhiza lepidota
Calamagrostis scopulorum
Salix spp.
Solidago gigantea
Asclepias speciosa

Project Specifics:
Frequency = 396 total polygons
248 polygons in DINO, 148 polygons in the environs
Total area = 782.9 acres / 316.8 ha (0.2%)
467.8 acres / 189.3 ha DINO
315.1 acres / 127.5 ha environs
Average polygon size = 2.0 acres / 0.8 ha
User's accuracy = 88% ± 7%
Producer's accuracy = 75% ± 9%

Interpretation:
This map unit is for complexes and mosaics of herbaceous and/or shrub wetland and riparian vegetation, where the individual types are too small or whose photo signatures are too difficult to distinguish to map separately. Most polygons of this map unit are linear to elongate and are smaller than the minimum mapping unit in size. Many are located along the banks of the main stem rivers or their major tributaries, but others occur at isolated wetlands away from the rivers. The signature is usually a medium to dark, smooth green, very similar to young Tamarisk Thicket (85). Polygons in isolated wetland areas appear as a mosaic of patches of lighter and darker green, often with an irregular texture resulting from patches of shrubs too small to map separately. Most polygons were mapped as observed.

Distribution/Ecology/Composition:
Graminoid-dominated riparian communities occur where the water table is high and ground salts are low to moderate. The largest examples are on the lowest terraces of the Yampa and Green Rivers, or in abandoned channels of the river. A few polygons occur around upland springs and seeps. Tall graminoid species are the norm; polygons may be dominated by near-monocultures of *Spartina pectinata, Agrostis* spp.*, Phragmites australis*, *Juncus* spp., or *Eleocharis* spp.

Sandbar willow communities are the most abundant native riparian shrubland type in the mapping area. They occur on the banks, point bars, lowest terraces, abandoned channels and islands of the Yampa and Green rivers. The community usually has no other shrubs in the canopy layer. Stands subject to frequent flooding may 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 Tamarisk Thicket (85) or Broadleaf Cottonwood Woodland (76).

There are many small occurrences of wetlands throughout the mapping area that are complexes of graminoid-dominated, forb-dominated, and/or shrub-dominated wetland associations. Many examples are along small upland streams or in hanging garden alcoves (rarely mappable), but there are larger polygons in the wet meadow south of Josie's Cabin and Hog Canyon at the west end of the mapping area. The key factor is that the associations occur in patches too small to map separately or are not distinguishable on the aerial photography. These wetlands therefore represent both a complex and a mosaic of associations.







99 Hanging Garden (H-HANG)

Associations:
Aquilegia micrantha - Calamagrostis scopulorum Herbaceous Vegetation
Calamagrostis scopulorum Hanging Garden Herbaceous Vegetation

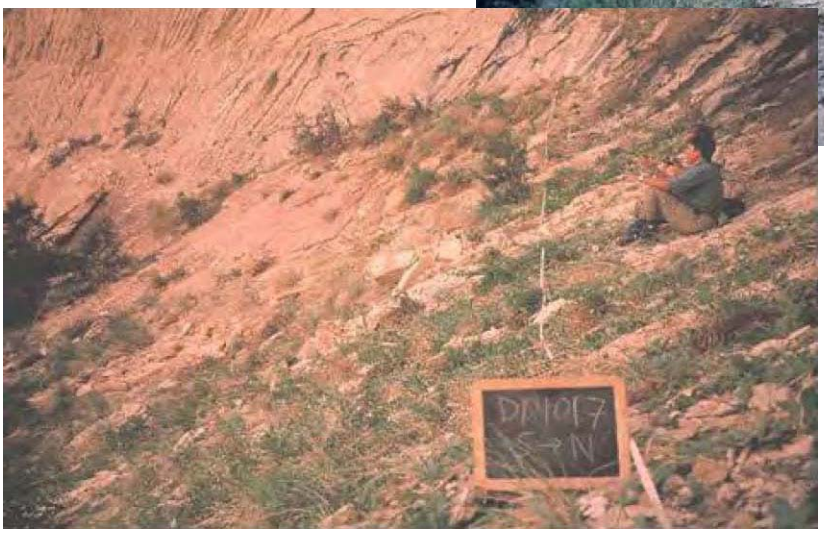
Project Specifics:
Frequency = 13 total points
13 points in DINO, 13 points in the environs

Common species:
Aquilegia micrantha
Calamagrostis scopulorum
Dodecatheon pulchellum
Carex curatorum
Zigadenus vaginatus
Epipactis gigantea
Habenaria zothecina

Interpretation:
Nearly all examples of this map class occur on vertical cliff faces or inside alcoves. They are therefore invisible on the aerial photography and were not mapped. Instead, known locations have been recorded as point data.

Distribution/Ecology/Composition:
These groundwater-fed communities are unique to the Colorado Plateau. The contain many rare and sensitive plants that are restricted to hanging gardens. Most examples occur in tributary canyons of the Green and Yampa rivers, or in alcoves set back from the stream bank. The substrate is nearly always Weber sandstone. Water quantity and chemistry controls the species that are present in a garden, but the species listed above are the most consistent across all gardens at DINO. A secondary community of mesic or riparian shrubs trees, and herbaceous species often occurs in the apron of moist sand that spreads downslope from the larger gardens. The mapped points represent a small fraction of the total number of hanging gardens present in DINO.





The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS D-240, July 2008

National Park Service
U.S. Department of the Interior

Natural Resource Program Center



Natural Resource Program Center
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

www.nature.nps.gov

EXPERIENCE YOUR AMERICA™