National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

Vegetation Inventory Project

City of Rocks National Reserve

Natural Resource Report NPS/UCBN/NRR—2011/450



ON THE COVER
Rock Spire at City of Rocks National Reserve
Photograph by: NPS

Vegetation Inventory Project

City of Rocks National Reserve

Natural Resource Report NPS/UCBN/NRR—2011/450

John A. Erixson
P.O. Box 9748
Northwest Management, Inc.
Moscow, Idaho

Dan Cogan
Cogan Technology, Inc.
21 Valley Road
Galena, IL 61036

September 2011

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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

The Natural Resource Report Series is used to disseminate high-priority, current natural resource management information with managerial application. The series targets a general, diverse audience, and may contain NPS policy considerations or address sensitive issues of management applicability.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available from NPS Upper Columbia Basin Network website (http://science.nature.nps.gov/im/units/ucbn/) and the Natural Resource Publications Management website (http://www.nature.nps.gov/publications/nrpm/).

Please cite this publication as:

Erixson, J, and D. Cogan, 2011. Vegetation inventory project report: City of Rocks National Reserve. Natural Resource Report NPS/UCBN/NRR—2011/450. National Park Service, Fort Collins, Colorado.

NPS 003/10270, September 2011

Contents

Page

Figures v

Tables vii

Appendices vii

Executive Summary ix

Acknowledgments xiii

Introduction 1

Background 1

NPS Vegetation Inventory Program 3

Upper Columbia Basin Network 4

City of Rocks National Reserve 5

Natural Setting 8

Vegetation 10

City of Rocks Vegetation Inventory Project 17

Scope of Work 17

Methods 19

Planning, Data Gathering and Coordination 19

Field Surveys 21

Vegetation Classification 23

Digital Imagery and Interpretation 26

Accuracy Assessment 30

Results 35

Vegetation Classification 35

Forest and Woodland Associations 35

Shrubland Associations 35
Herbaceous Associations 35
Riparian and Wetland Forest and Woodland Associations 40
Riparian and Wetland Shrubland Associations 40
Riparian and Wetland Herbaceous Associations 40
Digital Imagery and Interpretation 41
Vegetation Map 45
Accuracy Assessment 48
Discussion 53
Field Survey 53
Classification 54
Digital Imagery and Mapping 54
Accuracy Assessment 54
Future Recommendations 55
Research Opportunities 56
Literature Cited 57

Figures

Page

Figure 1. Map of UCBN showing the location of CIRO in the network. 4

Figure 2. Location and boundaries of CIRO and nearby Castle Rocks State Park. 6

Figure 3. CIRO landscape overview photos. 7

Figure 4. CIRO geography and location map. 8

Figure 5. The Twin Sisters rock formations within CIRO. 9

Figure 6. 3D image of CIRO and surrounding areas showing common vegetation patterns. 11

Figure 7. Representative cross-section of CIRO's topography showing life zones. 12

Figure 8. Common CIRO vegetation types by life zone. 13

Figure 9. Common CIRO cross-zone vegetation types. 15

Figure 10. Map of the CIRO vegetation project boundary and land boundary. 18

Figure 11. Vegetation classification plot locations within the CIRO project area. 24

Figure 12. Examples of the 2006 and 2009 true-color base-map imagery for CIRO. 26

Figure 13. Location of the accuracy assessment (AA) points in CIRO. 33

Figure 14. Example of the CIRO vegetation map layer. 49

Tables

Page

Table 1. Project timeline for the CIRO Vegetation Inventory Project. 20

Table 2. Plot sizes used for vegetation classification sampling at CIRO. 22

Table 3. Polygon attribute items and descriptions. 29

Table 4. Sampling protocol for AA points. 31

Table 5. Statistics used in AA analysis. 34

Table 6. List of 35 plant associations and two vegetation alliances for CIRO. 36

Table 7. List of 18 ecological systems within CIRO. 40

Table 8. Assignment of map classes to NVC plant associations/alliances. 42

Table 9. Summary statistics for the CIRO map class polygons. 46

Table 10. CIRO Map Class revisions based on the accuracy assessment. 48

Table 11. Final Contingency Table (Error Matrix) for CIRO. 51

Appendices

Page

Appendix A - Components and Flow Diagram of the Vegetation Inventory Program 61

Appendix B - Field Data Forms and Instructions 63

Appendix C - Dichotomous Key to CIRO Plant Associations 79

Appendix D: CIRO Plant Association Descriptions 85

Appendix E Plant Species List for CIRO 159

Appendix F - Photo Interpretation Mapping Conventions and Visual Key 169

Appendix G Final CIRO Vegetation Map 205

Executive Summary

City of Rocks National Reserve (CIRO) is located in south-central Cassia County, ID near the Utah border. The Reserve encompasses over 14,000 acres in the Albion Mountains near the village of Almo, ID. The unique geologic exposures, particularly the granitic spires, are renowned among rock climbers. Also present in the Reserve are many significant cultural resources, including the California Trail ruts and signatures, early homesteading and mining claims, and archaeological sites from the paleoindian to contact period. The area is considered to be within the traditional lands of the Shoshone-Bannock Tribe.

CIRO vegetation includes unique mix of native montane woodlands, basin and range shrublands, and semi-native herbaceous vegetation. The Reserve has a moderate to high elevation and steep slopes allowing (min'-max') for establishment and maintenance of subalpine fir (*Abies lasiocarpa*), limber pine (*Pinus flexilis*), and quaking aspen (*Populus tremuloides*) forests on mesic mountain ridges and slopes. Also runoff from exposed bedrock creates distinctive habitats and enhances support of extensive stands of singleleaf pinyon pine - juniper (*Pinus monophylla* and *Juniperus* spp.) woodland and curl-leaf mountain mahogany (*Cercocarpus ledifolius*) woodland and tall shrubland. As the elevation decreases and the terrain flattens, steppe shrubland vegetation characterized by sagebrush (*Artemisia* spp.), rabbitbrush (*Ericameria* spp. and *Chrysothamnus* spp.), antelope bitterbrush (*Purshia tridentata*), and several bunchgrass species become the dominant cover on deeper soils. Smaller but very important vegetation stands include wetland and riparian plant communities characterized by chokecherry (*Prunus virginiana*), Booth willow (*Salix boothii*), and gray alder (*Alnus incana*) shrublands and stands of Nebraska sedge (*Carex* spp.) herbaceous vegetation. Large fires in and around the Reserve have dramatically altered the landscape replacing burned pinyon-juniper woodland with rabbitbrush shrublands and non-native cheatgrass (*Bromus tectorum*) annual herbaceous vegetation. To better understand the plant community distribution the NPS Vegetation Inventory Program (NVIP) funded this inventory and mapping project. The Upper Columbia Basin Inventory and Monitoring Network (UCBN) coordinated this effort as part of a network-wide program.

A three-year, three-phase program was initiated to complete the tasks of sampling, classifying, and mapping the plant associations and vegetation alliances within CIRO. Phase-one, directed by UCBN staff in conjunction with Northwest Management Incorporated (NMI), Idaho State University (ISU), and S.M. Stoller Corporation (Stoller) resulted in the plant association and vegetation alliance classification using the National Vegetation Classification System (NVCS). Vegetation classification was based on the 2009 field sampling of 190 representative classification plots located within the boundary of CIRO and adjoining Castle Rocks State Park. Analysis of the classification plot data by ISU and Stoller ecologists occurred in 2010. Through this process 35 distinct plant associations were identified as were two vegetation alliances. Vegetation alliance and plant association local descriptions and a field key to determine each association in the field are included in this report.

Phase-two, directed by NMI and Cogan Technology, Inc. (CTI) resulted in creation of the digital vegetation and land use map and project geodatabase. Mapping was conducted primarily by interpreting vegetation-specific and non-vegetated site signatures from the 2009 National Aerial Imagery Program (NAIP) ortho-photo products. CTI reliably discerned 34 vegetation, 10 land

use/land cover, and one geology/sparse vegetation map units. The mapping process relied on manual digitizing of homogenous photo-signatures supported by on-site verification. All interpreted data were converted to Geographic Information System (GIS) databases using ArcGIS software. The final map layer contains vegetation, land-use, and geologic exposure polygons with corresponding map class, NVC, and modifier attributes.

Draft maps were printed, field tested, reviewed, and revised based on the field observations. Following verification, edits were applied to create the final vegetation map product for accuracy assessment (AA). In Phase-three the AA was conducted by NMI ecologists during the 2010 field season. Sampling required selecting 597 random point locations throughout the study area based on frequency and abundance for each vegetation map unit. AA locations were accessed by NMI field crews, the vegetation at each target was keyed to the proper association, and representative photographs of each location were acquired. The field data were compared to the electronic vegetation map following the final assessment and three map units with low accuracy were combined with similar map units to increase the accuracy. The AA analysis on the modified vegetation layer revealed an overall thematic accuracy of 88%.

Completion of the project in Phase-four included producing the standard project deliverables as described and presented in this report and the accompanying DVD. Deliverables include:

- The *Final Report* that includes keys to the vegetation types and imagery signatures, AA information, and a summary of the methods and results;
- A *Spatial GIS Database* containing spatial data for the vegetation units, classification plots, and AA points;
- *Digital Photos* from sample plots and miscellaneous park views;
- *Metadata* for all spatial data [Federal Geographic Data Committee (FGDC)-compliant];
- *Vegetation Descriptions and Photo-Signature Key* to the map units and plant associations/vegetation alliances.

A Summary of the projects statistics is included below:

Field Work:

- 2009 Plot Sampling = 190 Classification Plots
- 2010 Accuracy Assessment = 597 Points

Classification:

- 35 NVC Plant Associations

GIS Database:

- Project Size = 40,088 acres (16,236 hectares)
    - City of Rocks National Reserve = 14,407 acres (5,835 hectares)
    - Castle Rocks State Park = 1,440 acres (583 hectares)
    - Environs = 24,241 acres (9,818 hectares)
- Base Imagery =
    - NAIP 2009, True-color, 3-band, 1-meter, 1:12,000-scale ortho-image
- 42 Map Units = 31 Vegetated, 1 Geology/Bare Rock, and 10 Land-use/Land-cover
- Minimum Mapping Unit = ½ hectare (1.24 acres), modified to ¼ acre (0.1 hectare) for wetlands and riparian polygons
- Total Size = 4,584 Polygons
- Average Polygon Size = 8.75 acres (3.5 hectares)

Overall Thematic Accuracy = 88%

Acknowledgments

This unique vegetation inventory project required the enthusiasm and energy of several individuals over three years to complete. The dedication of everyone participating helped to produce the product described herein that we, the authors, thankfully acknowledge.

Foremost, we thank Lisa Garrett and the UCBN staff (including Tom Rodhouse and Gordon Dicus) who provided contracting, data management, and technical review through all aspects of this project. Special recognition is also credited to Dr. Karl Brown and Tammy Cook with the NPS Vegetation Inventory Program for prioritizing this project and providing funding. Without the financial support from the NPS Vegetation Inventory Program this project would not have been possible.

The CIRO vegetation inventory project benefited greatly from the planning and ecological expertise contributed by Ken Aho (Idaho State University) and Amy Forman (S.M. Stoller, Corporation). We would like to especially acknowledge all of the long days and hard work put in by our field crew members including ecologists and botanists from Northwest Management Incorporated staff.

We could not have asked for a better partner on this project than the staff at CIRO. Wallace Keck (Superintendent), Trenton Durfee (Park Ranger, Natural Resources), and Kristen Bastis (Chief of Cultural Resources) went out of their way to assist the field crews, answer questions and review all of the draft deliverables. They were always timely, professional and extremely helpful throughout the process.

Introduction

Background

In 1994, the U.S. Geological Survey (USGS) and National Park Service (NPS) formed the USGS-NPS Vegetation Mapping Program to cooperatively inventory and map the vegetation in the system of National Parks. Presently managed as the National Vegetation Inventory Program (NVIP) by the NPS Natural Resource Program Center, Biological Resource Management Division, program goals are to provide baseline ecological data for park resource managers, obtain data that can be examined in a regional and national context, and provide opportunities for future inventory, monitoring, and research activities (FGDC 1997, 2008 Grossman et al. 1998).

At program initiation, the NVIP adopted the U.S. National Vegetation Classification (USNVC; The Nature Conservancy and Environmental Systems Research Institute 1994a, Grossman et al. 1998) as a basis for the *a priori* definition of vegetation units to be inventoried. The Federal Geographic Data Committee (FGDC) adopted a modified version of the upper (physiognomic) levels as a federal standard (FGDC-STD-005; FGDC 1997, 2008). This standard was hereafter termed the National Vegetation Classification Standard (NVCS). The NVCS established a federal standard for a complete taxonomic treatment of vegetation in the U.S. at eight physiognomic levels, they are: (1) Formation Class, (2) Formation Subclass, (3) Formation, (4) Division, (5) Macrogroup, (6) Group, (7) Alliance, and (8) Association, with the finest level being the plant association. Alliances are usually aggregations of associations that are physiognomically uniform and share one or more characteristic or diagnostic species. An association is defined as a plant community or type with a consistent species composition, uniform physiognomy, and homogenous habitat conditions (Flahault and Schroter 1910). The plant association or community type is determined by environmental patterns and disturbance processes.

The NVCS established conceptual taxonomic levels for the floristic units of alliance and association, largely following the USNVC, but did not offer a taxonomic treatment for the floristic levels because of the immense scope of establishing robust floristic units for the entire U.S. The FGDC standard requires that federally funded vegetation classification efforts collect data in a manner that enables cross-walking the data to the NVCS (i.e., the physiognomic levels) and sharing between agencies, but does not require use of that standard by agencies for internal mission needs. NatureServe (2011) maintains a treatment of floristic units (alliances and associations), which, though not a federal standard, are used as classification and mapping units by the NVIP whenever feasible. For purposes of this document, the federal standard (FGDC 1997, 2008) is denoted as the NVCS; the USNVC will refer exclusively to the NatureServe treatment for vegetation floristic units (alliances and associations only).

Use of the NVCS as the standard vegetation classification system is central to fulfilling the goals of the NVIP because it:

- is vegetation based;
- uses a systematic approach to classify a continuum;
- emphasizes natural and existing vegetation;
- uses a combined physiognomic-floristic hierarchy;
- identifies vegetation units based on both qualitative and quantitative data; and
- is appropriate for mapping at multiple scales.

The use of the NVCS and the NVIP vegetation inventory protocols facilitate effective resource stewardship by ensuring compatibility and widespread use of the information throughout the NPS and by other federal and state agencies. The vegetation maps and associated information support a wide variety of resource assessment, park management, and planning needs. In addition they can be used to provide a structure for framing and answering critical scientific questions about vegetation communities and their relationship to environmental conditions and ecological processes across the landscape.

The NVCS has primarily been developed and implemented by The Nature Conservancy (TNC) and the network of State Natural Heritage Programs over the past forty years (TNC 1994a; Grossman et al. 1998). The NVCS is currently supported and endorsed by multiple federal agencies, the FGDC, NatureServe, State Heritage Programs, and the Ecological Society of America. Refinements to the classification occur in the process of application, which lead to ongoing revisions that are reviewed both locally and nationally. TNC and NatureServe have made available a two-volume publication presenting the standardized classification, providing a thorough introduction to the classification, its structure, and the list of vegetation types occurring within the U.S. as of April 1997 (Grossman et al. 1998). *Volume I: The National Vegetation Classification Standard* can be accessed electronically on the Internet at: http://www.natureserve.org/publications/library.jsp. NatureServe has since superseded *Volume II* of the publication (the classification listing), providing regular updates to ecological communities in the U.S. and Canada. This online database server, NatureServe Explorer®, can be accessed electronically on the Internet at: http://www.natureserve.org/explorer (2011).

NPS Vegetation Inventory Program

The Director of the NPS approved the Natural Resource Challenge (NRC) in 1999 to encourage the NPS to focus on the preservation of the U.S. natural heritage through science, natural resource inventories, and expanded resource monitoring (NPS 1999). The NRC provided funding for 12 baseline inventories to be completed in each of 270 parks with significant natural resources. The vegetation inventory and mapping is considered one of the 12 baseline inventories. Through the NRC, 270 NPS units were organized into 32 networks in 2000 for the purpose of accomplishing natural resource inventory and monitoring projects.

The NVIP is a cooperative effort between the NPS and the USGS to classify, describe, and map vegetation communities in more than 270 national park units across the U.S. The scope of this effort is large and implementation is complex due to the fact that vegetation species and communities can be unique from park-to-park. However, when the NVIP is completed the final products will assist park managers to: 1) identify and conserve plant biodiversity; 2) better understand resources and processes including wildlife habitat relationships and wildland fires; and 3) provide the necessary tools to better manage challenge issues including exotic species invasions, insect effects, and diseases.

The primary objective of the NVIP is to produce high-quality, standardized maps and associated data sets of vegetation and other land cover occurring within parks and selected adjacent environments (environs). This information fills data gaps and complements a wide variety of resource assessments, park management, and conservation needs. For example, in Sequoia and Kings Canyon National Parks, the 2007 vegetation map and digital database provided tools to better manage the foxtail pine (*Pinus balfouriana* ssp. *austrina*), an endemic species to the southern Sierra Nevada Mountains that can live for more than 1,000 years.

The NVIP uses well-established procedures that are compatible with other agencies and organizations including the NVCS, a system that is integrated with the major scientific efforts in the taxonomic classification of vegetation, and is a FGDC standard. In addition, stringent quality control procedures ensure the reliability of the vegetation data and encourage the use of resulting maps, reports, and databases at multiple scales.

A complete vegetation mapping project for an NPS unit includes the following products, at a minimum:

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

Maps are produced in Universal Transverse Mercator (UTM) coordinates North American Datum 1983 (NAD 83) with a 1:24,000 scale and a minimum mapping unit of 0.5 hectares (1.24 acres). The vegetation maps must meet the National Map Accuracy Standards for positional accuracy, and the minimum class accuracy goal across all vegetation and land cover classes of 80 percent.

Upper Columbia Basin Network

The specific decision to classify and map the vegetation within and adjacent to CIRO was made in response to guidelines set forth by the NPS Natural Resources Inventory and Monitoring Program and implemented by the Upper Columbia Basin Network (UCBN), which includes nine NPS units located in four states of the inland Northwest (Figure 1). The UCBN was organized to inventory and monitor status and trends for selected natural resources (network organization facilitates collaboration, information sharing, and economies of scale in natural resource monitoring). The inventory and monitoring information is used by NPS and park unit resource managers to guide management decisions, to inform scientific research, and to provide public education. One goal of the NPS service-wide monitoring program is to collect and serve data to better understand the dynamic nature and condition of park-managed ecosystems and to provide reference points for comparisons with other management types and possibly with altered environments. The development of a vegetation classification to the vegetation alliance/plant association level and associated GIS map and database for each park is viewed as a high priority in reaching this goal.

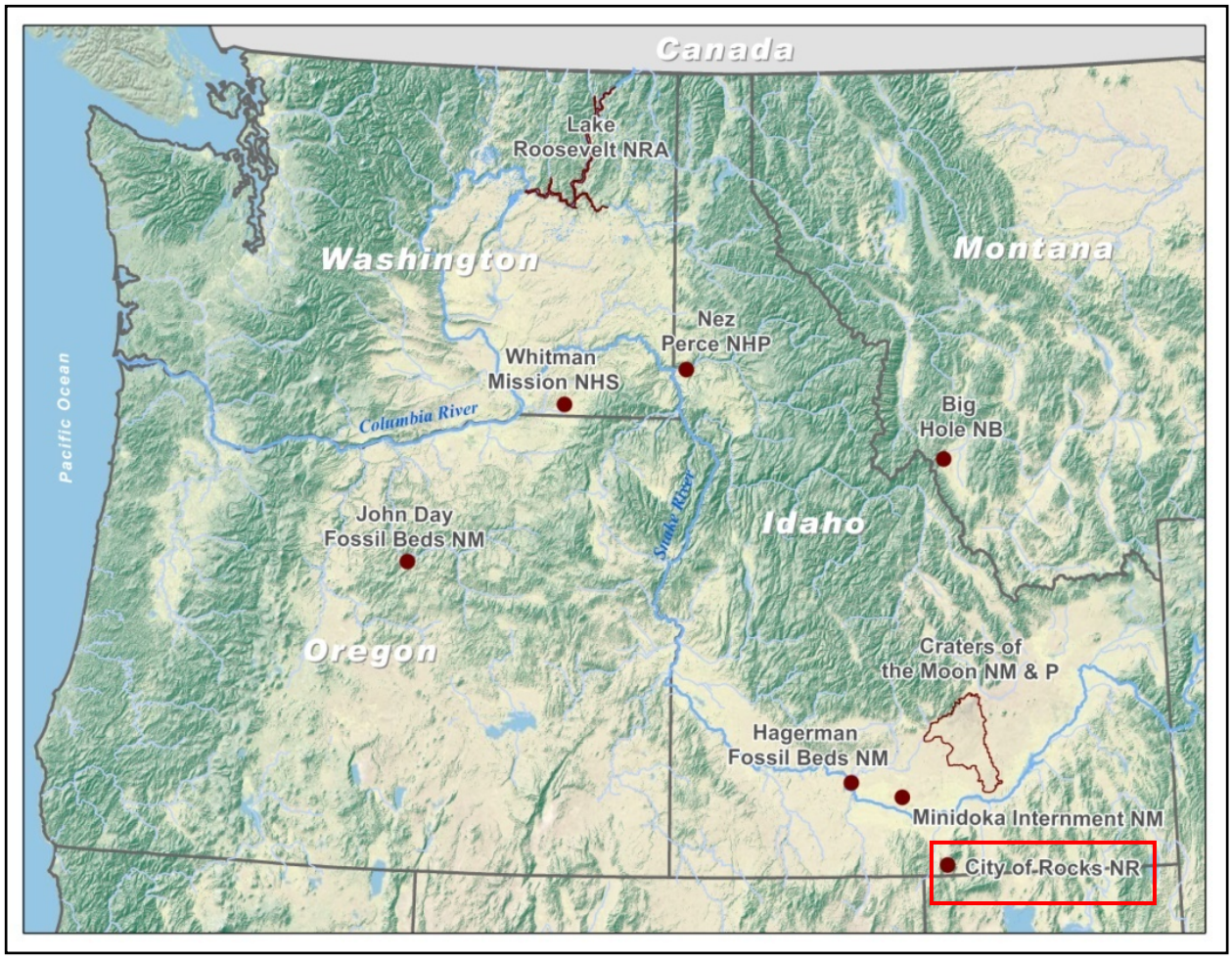


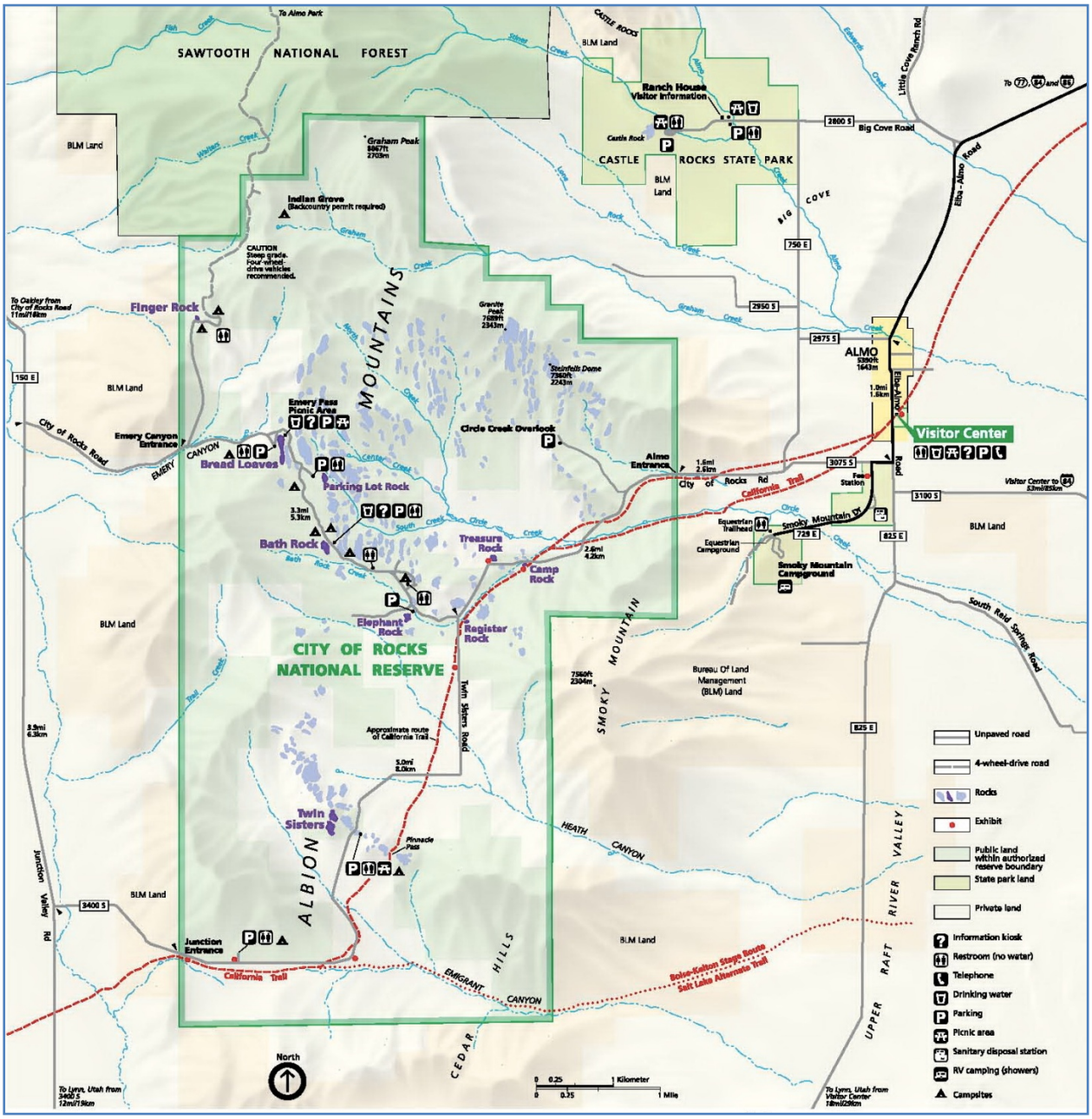
Figure 1. Map of UCBN showing the location of CIRO in the network.

City of Rocks National Reserve

City of Rocks National Reserve (CIRO) was created in 1988 to preserve and protect through cooperative efforts the scenic qualities and attributes of the California Trail landscape, historic rural setting, and granite features, while interpreting its values and managing recreation (NPS 2007). City of Rocks is designated a National Reserve since it is managed under a cooperative agreement with the Idaho Department of Parks and Recreation (IDPR). IDPR also manages Castle Rocks State Park located nearby and northeast of CIRO. As part of the largest overland emigration route in American history, CIRO preserves the most authentic and intact setting of the California Trail. The CIRO dramatic geology was used as a California Trail landmark and the area around CIRO was used as an important refuge and resting area along the trail. Today, visitors to CIRO can view remnants of the historic occupation and see examples of the California trail, read messages left by its many travelers.

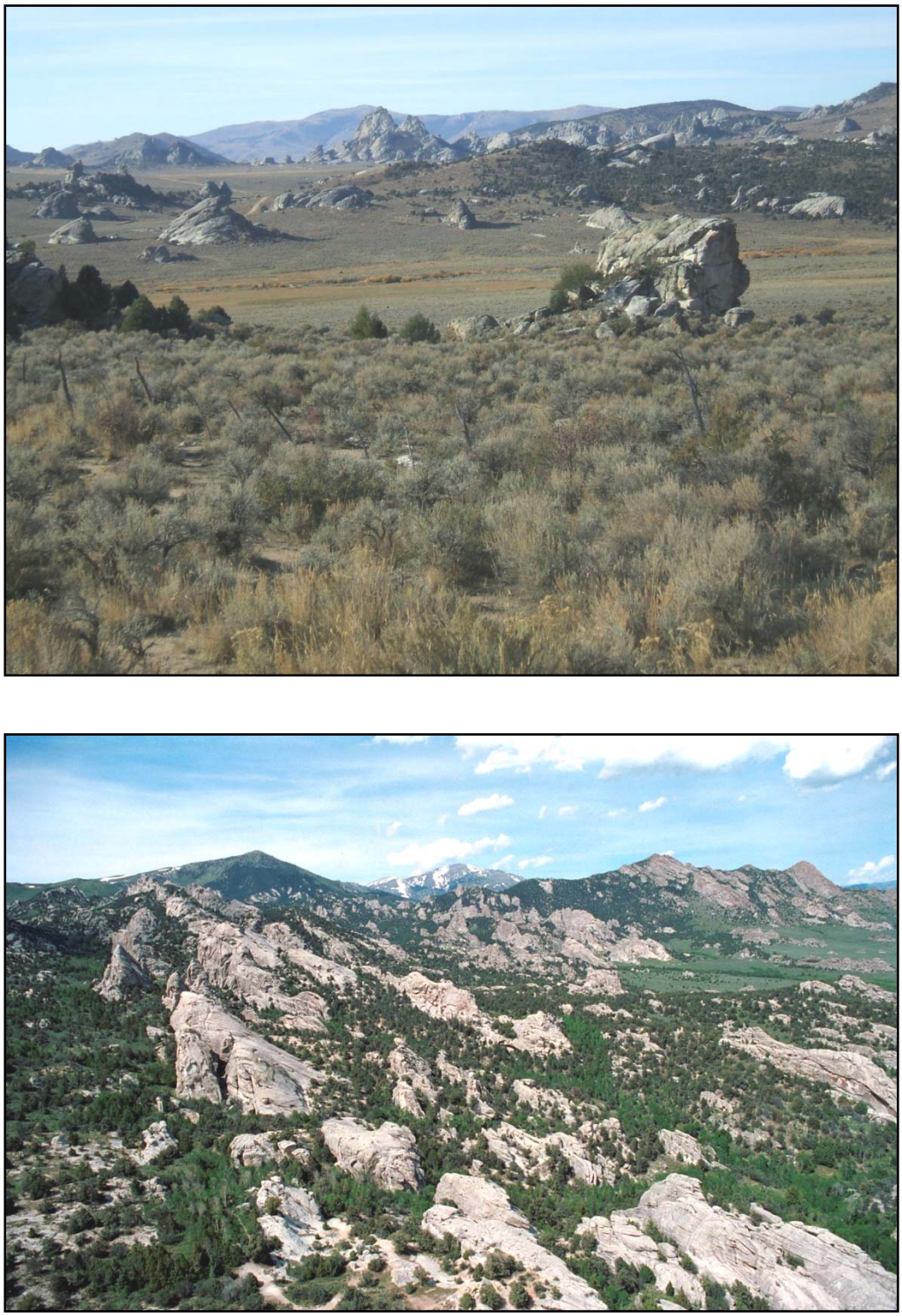
The earliest record of habitation in this area documented the Shoshone and Bannock tribes that hunted game while gathering pinyon pine nuts and other native foods (NPS CIRO Website 2011). The introduction of horses in the 16th-Century and European immigration gradually displaced the Shoshone and Bannock from this land and by 1826 Peter Skene Ogden and other European trappers were among the first to describe the striking rock formations of the City of Rocks. Because of the easily recognizable rock features. The Silent City of Rocks became a landmark for groups of emigrants travelling on the California Trail, the Salt Lake Alternate Trail, and later on freight and stage routes between Kelton, UT and Boise, ID. Perhaps the most popular of the early documented use of the term City of Rocks was that of Mr. James Wilkens who in 1849 wrote, “We encamped at the City of Rocks, a noted place from the granite rocks rising abruptly out of the ground…they are in a romantic valley clustered together which gives them the appearance of a city". In 1852, approximately 52,000 emigrants and associated livestock passed through the City of Rocks area to access the California goldfields (NPS 2011).

City of Rocks National Reserve (including Castle Rocks State Park) occupies about 15,847 acres (6,413 hectares) (Figure 2) that encompasses many of the dramatic granite spires, domes, and monolith rock features that define CIRO. CIRO also includes a portion of the Albion Mountains foothills to mid-slopes and is framed within the surrounding ranges (Figure 3). From a geologic perspective the park preserves an uplifted and eroded landscape that reveals geologic structures, igneous intrusions, and a rare exposure of some of the oldest and deepest metamorphic rocks in the western U.S. The geology results in one of the highest-quality granite-face climbing areas in the U.S. and CIRO manages about 700 known climbing routes. The popularity of rock climbing contributes greatly to the average of 100,000 visitors per year (NPS CIRO Website 2011).



Source: NPS CIRO Website 2011

Figure 2. Location and boundaries of CIRO and nearby Castle Rocks State Park.

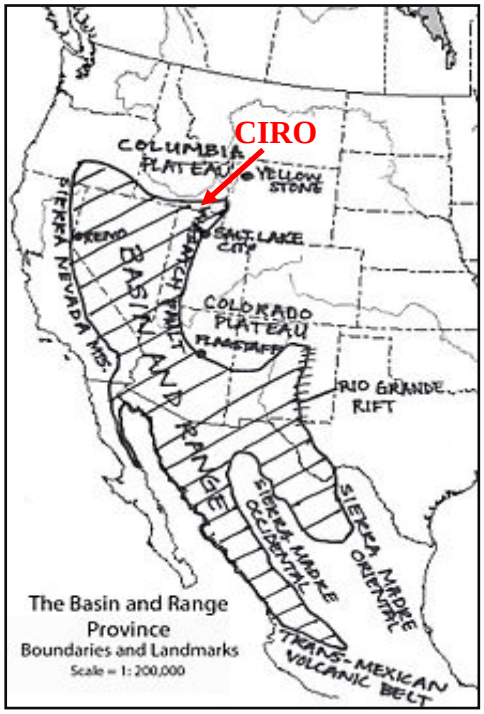


Source: Cogan 2009 (top), NPS (bottom)

Figure 3. CIRO landscape overview photos.

Natural Setting

CIRO lies at physiographic crossroads between the Snake River Plain to the north, the Basin and Range physiographic province to the south and is generally located at the southern end of the Columbia Plateau Region (NPS 2011) (Figure 4). The Basin and Range topography common to CIRO results from crustal extension that roughly created north-south-trending faults with uplifted mountains and down-dropped low valleys. This geologic process resulted in the distinctive alternating pattern of linear mountain ranges and valleys. CIRO is located in the upper end of the Raft River Valley, which borders the Albion Mountains on the south- and east-facing slopes and foothills. Elevations rise from 5,650 ft (1,720 m) where Circle Creek flows across the CIRO boundary to 8,867 feet (2,703 m) at the top of Graham Peak (Smith, et al. 2008).



Source: CIRO Website Geology Section –NPS 2011

Figure 4. CIRO geography and location map.

CIRO contains well-known weathered geological features that were created during exposure of three formations: 1) Almo Pluton, 2) Green Creek Complex, and 3) Elba Quartzite. The Almo Pluton is igneous rock formed principally from the Green Creek Complex (NPS 2011; Smith, et al. 2008) and many of the spires within CIRO are part of this complex. The Green Creek Complex includes granite that intruded into dark brown schist around 2.5 billion years ago (NPS 2011; Smith, et al. 2008). The Green Creek Complex can easily be distinguished from the younger Almo Pluton by its darker color caused by a greater concentration of iron-bearing minerals. The Elba Quartzite was formed following the Green Creek Complex deposition, it is light in color, and is extremely resistant to weathering because of high quartz content (NPS 2011; Smith, et al. 2008).

The intrusive magma that formed the Almo Pluton exposure has created complex relationships with the surrounding rock. The most dramatic example of this contact within CIRO occurs in the saddle that separates the Twin Sisters formation (Figure 5). The distinct spires, outcrops, and other rock formations within CIRO are primarily the result of weathering, mass wasting, and erosion of the Almo Pluton and Green Creek Complex exposures (NPS 2011). Weathering decays and breaks the rock into smaller pieces, mass wasting allows the soil and loose rocks to move downslope, and erosion transports the products away from their source formations into the alluvial deposits and eventually into streams and drainages. Examples of these processes occur on the slopes, foothills, and at the base of the Twin Sisters formation as well as most of the other rock outcrops within CIRO.



Source: Cogan, 2009

Figure 5. The Twin Sisters rock formations within CIRO.

As a direct result of on-going bedrock weathering many of the soils formed within CIRO are generally described as shallow to very deep rock outcrop soils. The soils are well-drained, occur on gently sloping to steep slopes, and lie on mountainsides, hillsides, ridges, and fan terraces (NRCS-SCS 1994). The majority of the soils formed within CIRO are composed of grus, coarse angular sand derived from the disintegration of the underlying and exposed granitic bedrock. The soils are highly erodible, particularly near roads, on steep slopes, and along intermittent stream channels. Erosion can be dramatic and includes deep gullies where exposed soil banks may be over 8 ft (2.4 m) high.

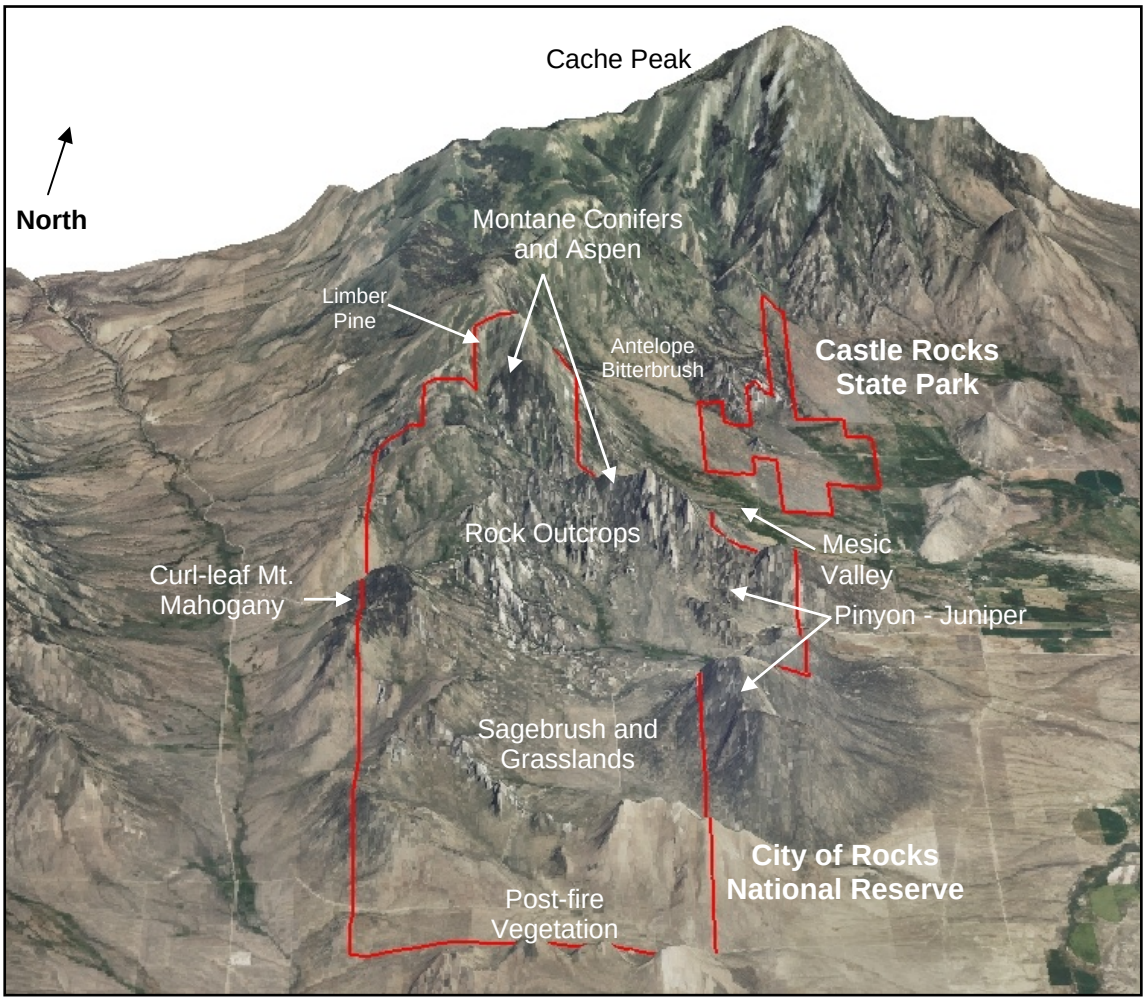
CIRO is represented by six general soil mapping units and 25 detailed mapping units (NRCS-NPS 2011). The general units are: (1) soils on mountain slopes and hillslopes representing 76% of CIRO [Povey-Pachic Haplocryolls, Howcan-Searla, Ola-Rock outcrop-Earcree, and Birchcreek-Itca-Rock outcrop]; (2) soils on fan remnants representing 24% of CIRO [Arbone-Riceton]: and (3) soils on floodplains and stream remnants representing <1% of CIRO [Cumulic Endoaquolls]. The most defining soils within CIRO are the Ola-Rock outcrop-Earcree complex; and Itca-Birchcreek-Rock outcrop complex; together comprising approximately 5,329 acres (2,157 hectares) or 37% of CIRO (NRCS-NPS 2011).

The high elevation and location of CIRO in southeastern Idaho results in a semi-arid climate consisting of hot summers that can reach 42°C (108°F) and cold winters that can drop to -33°C (-27°F). Average daily temperatures range from a minimum of 7°C (19°F) in January to a maximum of 31°C (87°F) in July (WRCC 2011; Davey, et al. 2006). Precipitation averages about 11 inches (28 centimeters) annually in the nearby town of Oakley, ID and lingering snow accumulation is common in the higher elevations.

Vegetation

Geography plays a major role in determining the general vegetation pattern for the area in and around CIRO. The plant communities trend from north to south with upper montane vegetation consisting of Douglas-fir (*Pseudotsuga menziesii*), limber pine (*Pinus flexilis*), subalpine fir (*Abies lasiocarpa*), and quaking aspen (*Populus tremuloides*) forest and woodland stands established on steep north/northwest-facing slopes of Cache Peak. Between Castle Rock State Park and CIRO is a mesic valley containing irrigated pastures of Kentucky bluegrass (*Poa pratensis*), Baltic rush (*Juncus balticus*), and Nebraska sedge (*Carex nebrascensis*). Pure stands of antelope bitterbrush (*Purshia tridentata*) are rare but occur between CIRO and Castle Rocks State Park and along the west-facing slopes of CIRO. From the northwest corner through the middle of CIRO at moderate elevations are hillslopes supporting curl-leaf mountain mahogany (*Cercocarpus ledifolius*) and singleleaf pinyon pine - Rocky Mountain juniper (*Pinus monophylla - Juniperus scopulorum*) woodlands on mesic sites and singleleaf pinyon pine - Utah juniper (*Juniperus osteosperma*) woodlands on drier sites. In the middle, south, and southeast portions of the project area, valley floors contain wide plains characterized by mixed native and non-native grasslands and sagebrush (*Artemisia* spp.) short shrublands. Near the southern border are large post-fire (former singleleaf pinyon pine - juniper woodland-covered hills) areas now supporting mixed stands of non-native grasses and green rabbitbrush (*Chrysothamnus viscidiflorus*).

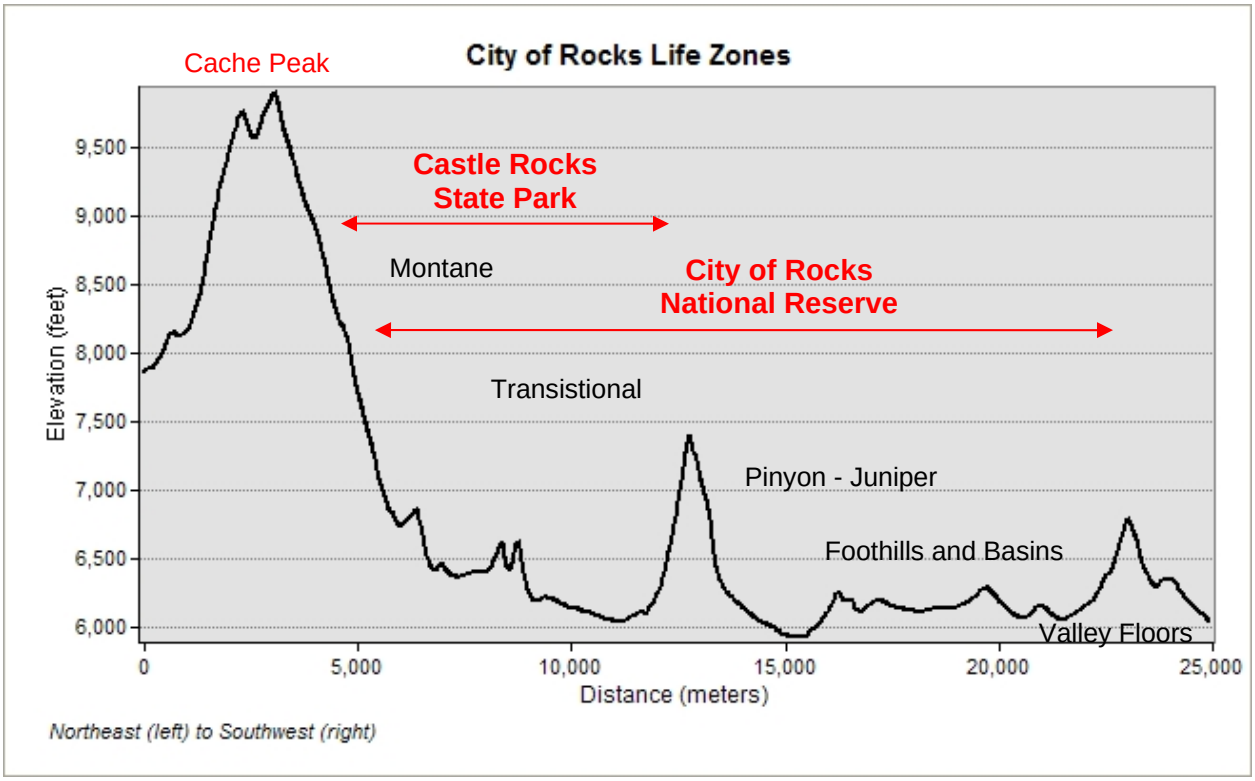
Historically vegetation of montane settings has been classified primarily by elevation and aspect (Holdridge 1967, Merriam 1898). Within CIRO and surrounding areas general altitudinal breaks can also be found in the vegetation. The resulting life or vegetation zones tend to follow a north to south pattern with more mesic vegetation extending lower on north-facing slopes. A cross-section rendering of the area highlights the life zones (Figure 7) starting with mesic conifer and quaking aspen forest stands on the highest slopes and ridges and extending to low elevation herbaceous vegetation stands. Mesic north-facing slopes and cool valleys support quaking aspen and Douglas-fir forest stands with dense shrub and herbaceous understories. Lower slopes and foothills support curl-leaf mountain mahogany woodlands/shrublands and singleleaf pinyon pine with Rocky Mountain and Utah Juniper woodlands. Mesic slopes in this region occasionally support unique stands of mixed deciduous shrubs consisting of mountain snowberry (*Symphoricarpos oreophilus*) and tobacco-brush (*Ceanothus velutinus*). Destructive fires in the southern portion of the Reserve have removed the singleleaf pinyon pine - juniper species woodland stands resulting in establishment of green rabbitbrush, non-native grasses, and remnant patches of deciduous shrubs like mountain snowberry.



Source: CTI, USGS 30-meter DEM, and 2009 NAIP Imagery

Figure 6. 3D image of CIRO and surrounding areas showing common vegetation patterns.

As the landscape transitions from mountains and hills to basins and valleys semi-arid short shrub-steppe associations dominate. Lower elevations are characterized by mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), dwarf sagebrush (*A. arbuscula*), and monotypic pockets of antelope bitterbrush. On more mesic but wind-swept slopes, bluebunch wheatgrass (*Pseudoroegneria spicata*) and Idaho fescue (*Festuca idahoensis*) provide low to moderate cover. Low elevation mesic and wetland sites including irrigated fields primarily support Kentucky bluegrass (*Poa pratensis*), Baltic rush (*Juncus balticus*), and Nebraska sedge (*Carex nebrascensis*) herbaceous vegetation stands (Figure 8).



Source: CTI and USGS 30-meter DEM

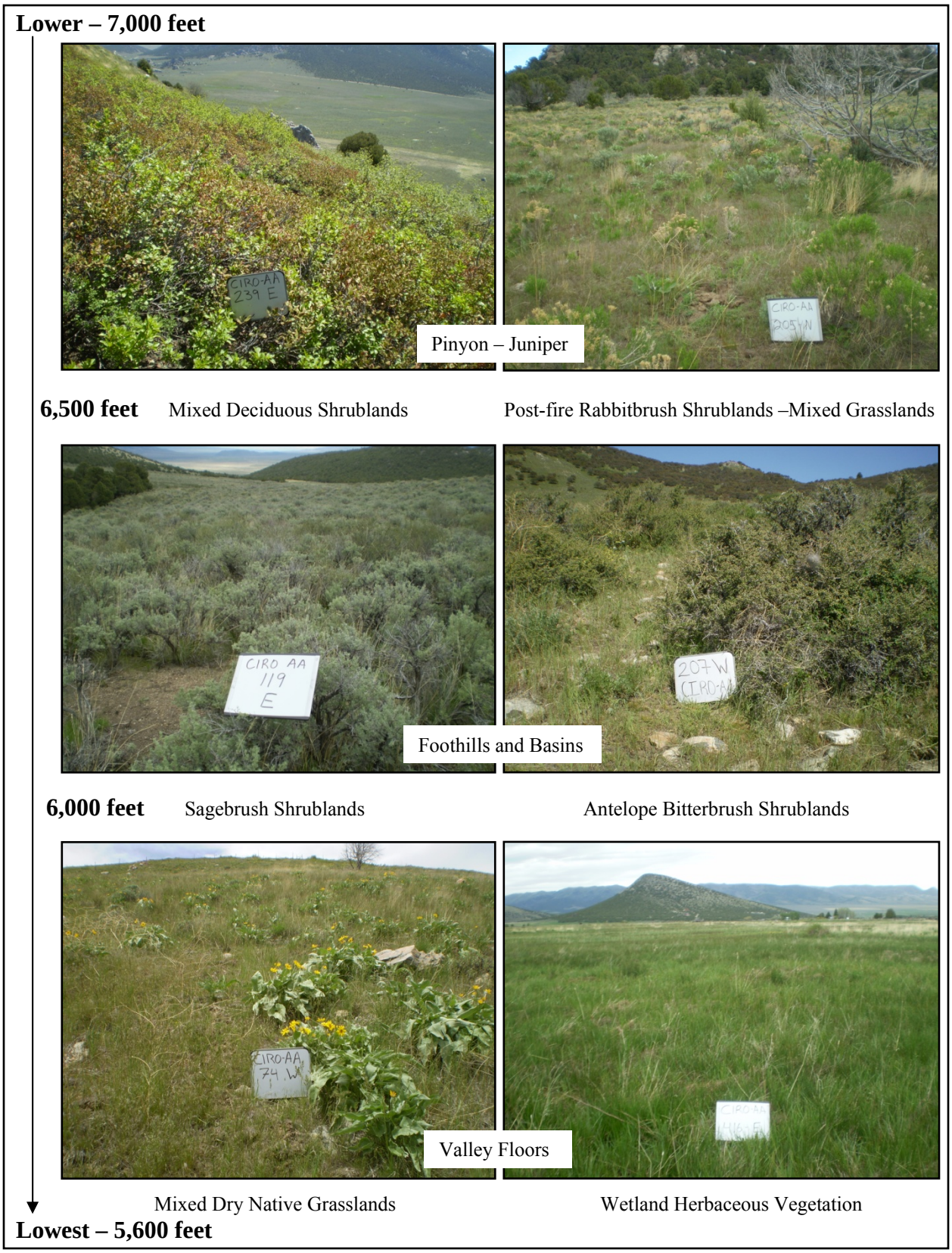
Figure 7. Representative cross-section of CIRO's topography showing life zones.

Some plant communities within CIRO extend across more than one life zone either due to high moisture levels, geology, or disturbance (Figure 9). Wet drainages and valleys support a mix of tall chokecherry (*Prunus virginiana*) and Booth's willow (*Salix boothii*) tall shrublands along with small stands of non-native white poplar (*Populus alba*) trees. Granite rock outcrops occur on most of the slopes and hills and these unique geologic features likely contain micro-habitats for sparse vascular vegetation, lichens, and mosses. Human disturbance also influences the vegetation with dramatic examples occurring around historic ranches. Corrals, irrigated/fallow fields and old homesteads often are characterized by non-native grasses like cheatgrass (*Bromus tectorum*) and desert (crested) wheatgrass (*Agropyron desertorum*).



Source: All Photos -NMI

Figure 8. Common CIRO vegetation types by life zone.



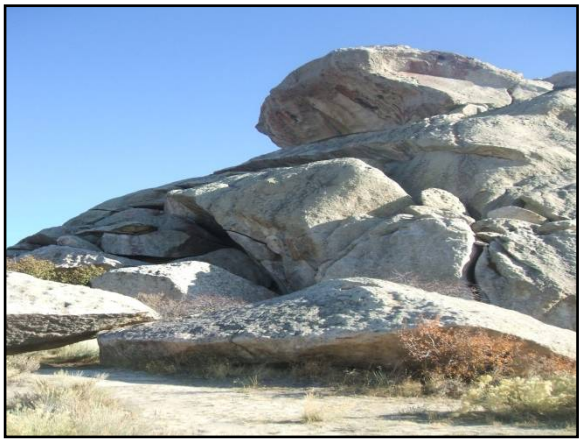
Source: All Photos -NMI

Figure 8. Common CIRO vegetation types by vegetation zone (continued)

Cross-Zone



Cheatgrass and Non-native Grasslands



Rock Outcrop and Cliff Vegetation



Riparian Tall Shrublands



Riparian Woodlands

Source: All Photos -NMI

Figure 9. Common CIRO cross-zone vegetation types.

Woodlands and Forests

Coniferous forests and woodlands are common within CIRO particularly the broad band of singleleaf pinyon pine and associated Rocky Mountain and Utah juniper that occupy most slopes from the upper to mid-elevations. Subalpine fir and limber pine occur as small stands in protected sites and on talus outcrops at the highest elevations in CIRO; Douglas-fir stands occur mostly on mesic sites of north-facing slopes, typically with an understory of Rocky Mountain maple (*Acer glabrum*) trees or tall shrubs. Quaking aspen stands can be extensive and range in composition from mostly pure stands with dense, mesic understories to mixed stands with juniper and dry grassland understories. Deciduous woodlands except for quaking aspen are uncommon within CIRO occurring only in riparian areas along streams or around bedrock seeps and springs.

Shrublands

Shrublands are common throughout the middle and lower elevations of CIRO with mountain big sagebrush the most broadly distributed. Small stands of mountain snowberry occur on mesic sites within the mountain big sagebrush distribution. In the lowest elevations of the project area moist to saturated sites next to drainages, seeps, and springs support patches of Booth's willow, speckled alder and chokecherry tall shrubs. The outer edges of floodplains and toeslopes may support basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) stands. Short shrublands established on more exposed slopes include dwarf sagebrush, black sagebrush (*Artemisia nova*), tobacco-brush or snowbrush, antelope bitterbrush, and green rabbitbrush.

Herbaceous Vegetation

Herbaceous vegetation is limited in distribution within CIRO and is represented by stands established on/in wetlands, valleys, benches, and slopes. Undisturbed wetland sites support Nebraska sedge and Baltic rush; the most common invasive grass is Kentucky bluegrass, typically established on mesic sites with Baltic rush. On drier sites throughout CIRO, native perennial grasses including Idaho fescue, bluebunch wheatgrass, and curly bluegrass (*Poa secunda*) have become established in patches and stands. A commonly associated forb in bluebunch wheatgrass stands is balsamroot (*Balsamorhiza sagittata*) characterized by large leaves and yellow flowers. Bluebunch wheatgrass Idaho fescue, curly bluegrass, spike fescue (*Leucopoa kingii*), and streambank wheatgrass (*Elymus lanceolatus*) are often understory to mountain big sagebrush and green rabbitbrush short shrubs. Non-native grasslands established as patches and stands within CIRO include cheatgrass and bulbous bluegrass (*Poa bulbosa*). Desert (crested) wheatgrass has established from pasture seeding and typically forms shrub herbaceous patches and stands with green rabbitbrush.

Sparse Vegetation

A notable feature of CIRO is the extensive bare rock and talus exposures occurring as pinnacles, domes, fins, other outcrop types, and on steep slopes, ridges, and cliff faces. These areas are often devoid of vegetation although some sites support sparse vegetation consisting of short and stunted trees and shrubs growing from cracks and soil pockets. An array of mosses and lichens may become established on rock outcrops and talus slopes.

City of Rocks Vegetation Inventory Project

CIRO is one of nine NPS units served by the UCBN Inventory & Monitoring Program. The UCBN initiated a vegetation mapping inventory for CIRO in 2006 as part of a larger effort to complete vegetation inventory maps for the network. An initial multi-year work plan was developed for the UCBN by Cogan Technology, Inc. (CTI). This work plan provided recommendations for completing the plant community classification, digital database, and map products for each of the nine UCBN parks; it received approval from the Washington Area Service Office (WASO) Inventory Coordinator in May 2006.

In September 2007 the UCBN entered into a contract with NMI to provide all of the vegetation mapping services designated by the work plan and to administer and coordinate the UCBN vegetation mapping projects for nine park units. CTI was retained by NMI as a sub-contractor to assist on the mapping and the creation of final products. NMI started the vegetation classification plot field data collection during the summer of 2009. Following the field data collection NMI contracted with the Idaho State University and S.M. Stoller Corporation to provide the preliminary and final vegetation classification.

The classification and mapping team objectives were to secure or create the following datasets:

Spatial Data

- Aerial and ortho-photography
- Map classification based on CIRO-specific requirements
- Map classification description and key
- Spatial database of vegetation communities of CIRO
- Digital and hardcopy maps of vegetation communities
- Metadata for spatial databases
- Complete accuracy assessment of spatial data

Vegetation Information

- Vegetation classification
- Dichotomous field key of vegetation classes
- Formal description for each vegetation class
- Ground photos of vegetation classes
- Field data in database format

Scope of Work

The vegetation inventory for CIRO occurred within an approximate 40,088 acres (16,236 hectares) project area, encompassing the boundary of CIRO, the boundary of Castle Rocks State Park (both provided by UCBN), and a general 2-km (1.25-mi) environs radius (Figure 10). The final project area determination was based on management needs, financial constraints, and time limitations. The 2-km (1.25-mi) environs area was used in this project for inventory and monitoring purposes and to capture various management considerations including exotic/invasive weed dispersal. Also the size of the environs corresponded to the size proposed in the work plan and matches the other vegetation mapping protocols in the UCBN.

*Please note that after the project boundary was determined, Castle Rocks State Park was expanded by about 200 acres (81 hectares) to the north. This area was included in the mapping but was not buffered.

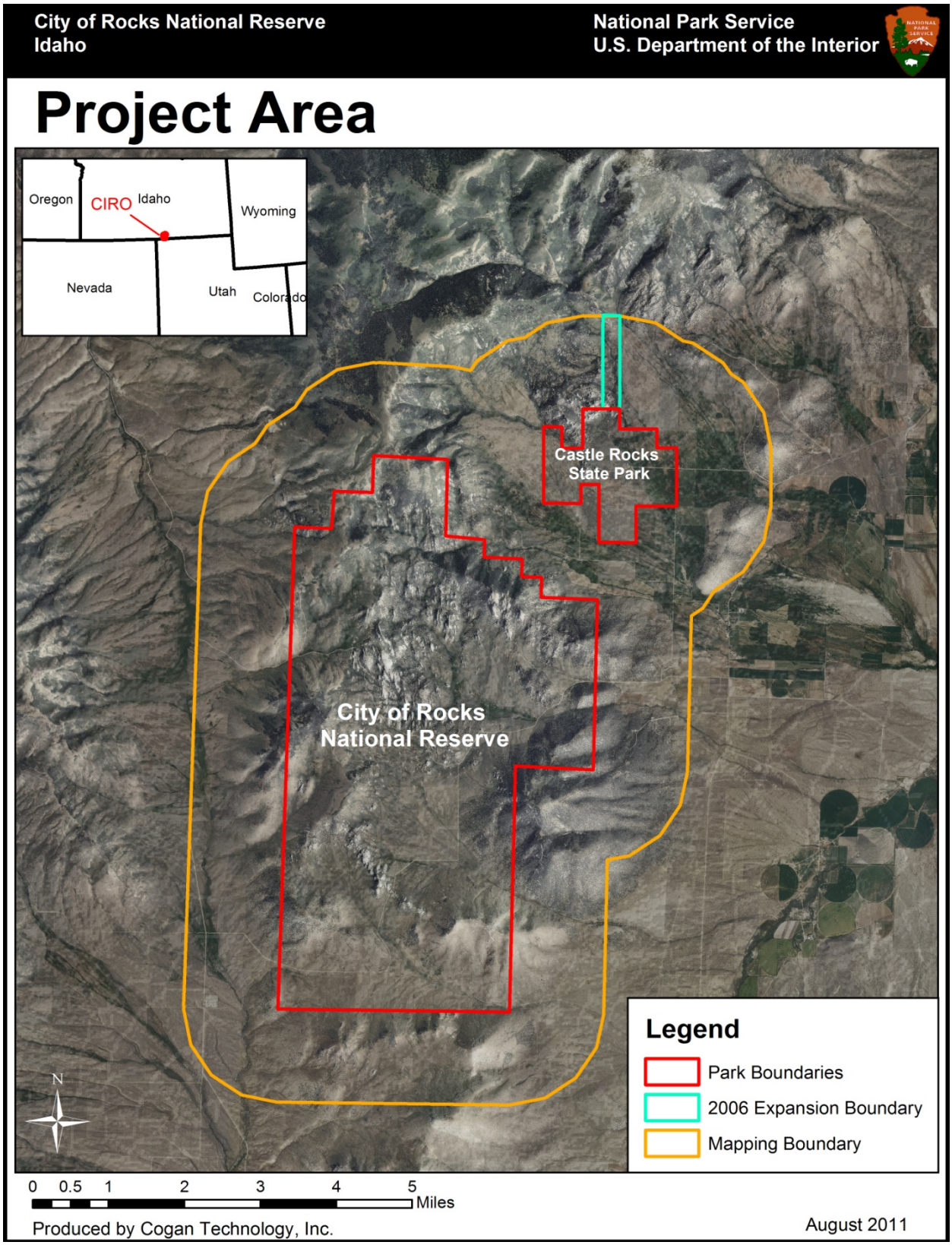


Figure 10. Map of CIRO vegetation project and land boundaries.

Methods

The vegetation mapping project at CIRO was considered to be in the ""medium park" category based on the overall size of the project area (TNC 1994b). As such, the standard methodology for sampling and mapping is to visit the entire park and select representative sites. These sites are used to characterize the vegetation types and explain their distribution across the park without having to survey each stand of vegetation. Additionally, current aerial photos were used to create field maps and unique vegetation signatures were highlighted for potential sampling. In this way all of CIRO was systematically visited throughout the summer of 2009. Based on this approach the assignment of responsibilities was divided into five major steps following the flow chart of major steps produced for the national program by the USGS (Appendix A). These responsibilities included:

1. Plan, gather data, and coordinate tasks;
2. Survey CIRO to understand and sample the vegetation;
3. Classify the vegetation using the field data to NVCS standard associations and alliances and crosswalk types to recognizable map units;
4. Acquire current digital imagery and interpret the vegetation from this using the classification scheme and NVCS crosswalk;
5. Assess the accuracy of the final map product; and
6. Create the final project deliverables

All protocols for this project as outlined in the following sections are presented in documents produced by The Nature Conservancy (1994a, 1994b, and 1994c) and subsequent updates (Lea and Curtis 2010) for the NVIP and are served at: http://biology.usgs.gov/npsveg/standards.html.

Planning, Data Gathering and Coordination

Based on the work plan and the contract commitments by UCBN, a series of preliminary project conference calls were held in 2006-2007 culminating in a scoping meeting at CIRO headquarters in Almo, ID on October 21-22, 2008. This meeting was attended by representatives from the principle team members (including NMI, CTI, UCBN, NPS and CIRO staff). The goals of the scoping meeting were to: (1) provide an overview of the National Vegetation Inventory Program; (2) learn about CIRO management issues and concerns; (3) discuss availability of existing data; (4) develop a schedule; (5) discuss procedural issues and data; (6) define potential cooperators; and (7) finalize the scope of the project.

From this meeting, participants learned that CIRO is in the process of completing a general management plan (GMP). Among the many necessary components of this plan is identifying key resources and determining the best short- and long-term strategies for protection and interpretation. Invasive species, visitor activities (such as new trail develop, campground expansion, etc.), and grazing will be discussed during the GMP process and can all impact the vegetation within CIRO. Having an accurate and detailed vegetation map and inventory baseline will greatly assist in the development of the GMP and future monitoring. Also important to management of CIRO's resources is the need for locating patches of non-native/invasive and rare/sensitive plant species and all effort should be made to delineate any small wetland or weed

patch. CIRO now includes a 312-acre (126-hectare) Research Natural Area (RNA) that was transferred from Bureau of Land Management and U.S Forest Service when the Reserve was created. The RNA contains unique geologic formations and the northern limit of the singleleaf pinyon-juniper forest/woodland type in North America. As part of the GMP process, agency information on the RNA and the current status of associated natural resources (partially based on this vegetation inventory effort) will be reviewed and a determination made on whether the RNA designation is warranted.

As a result of the scoping meeting a 2-km (1.25-mi) environs (including Castle Rocks State Park) was approved as the project boundary and review of the existing vegetation data and imagery yielded the following datasets to review for usefulness in this project: (1) UCBN sagebrush and quaking aspen monitoring plot data, (2) quaking aspen stand delineations developed during monitoring protocol development (Strand et al. 2009), and (3) all NAIP imagery for the area. A reasonable schedule was set with the project completion scheduled for 12/31/11 (Table 1).

Table 1. Project timeline for the CIRO Vegetation Inventory Project.

	2008				2009				2010				2011			
Planning and Scoping				X												
Acquire Aerial Imagery						X	X									
Field Data Collection						X	X									
Image Interpretation								X	X	X	X	X				
Vegetation Classification							X	X	X							
Local & Global Descriptions								X	X							
Spatial Database												X	X	X		
Plant Association Field Key								X	X							
Accuracy Assessment											X	X	X	X		
Final Report and Products														X	X	X

Specific work responsibilities were assigned to the following participants:

CIRO-UCBN-NPS Responsibilities
- Provide oversight and project funding;
- Provide CIRO plant list;
- Supply digital boundary files and ancillary data files;
- Assist with fieldwork and logistical considerations;
- Work with Idaho State University to develop the vegetation classification;
- Compile, review, and update drafts of the vegetation map, classification and report;
- Accept the final products and close the project.

NMI Responsibilities
- Provide project management;
- Coordinate the field work with CIRO staff;
- Collect representative plot data;

- Collect less detailed observations about the draft vegetation map;
- Write descriptions of the vegetation types occurring in CIRO;
- Collect accuracy assessment data;
- Provide a final report describing all aspects of the project;
- Create a DVD with reports, metadata, guides, vegetation classification, plot data, spatial data, vegetation database (map), graphics, and ground photos.

S.M. Stoller Corporation and Idaho State University Responsibilities
- Work with NPS to develop a vegetation classification for the study area based on the NVCS using quantitative analysis and ecological interpretation of the field data;
- Write a field key to the vegetation types occurring in CIRO;
- Provide guidance regarding the crosswalk of vegetation types to map units;
- Review the local vegetation descriptions;
- Review the final database containing the field data.

CTI Responsibilities
- Help with overall project facilitation and coordination;
- Verify vegetation and land use/land cover signatures on the imagery;
- Develop map units linked to the NVCS;
- Provide field maps and GIS support to the field crews;
- Interpret and delineate the final vegetation and land use types;
- Transfer and automate interpreted data to a digital spatial database;
- Produce spatial layers of plot and accuracy assessment site locations;
- Assist with the accuracy assessment by picking the stratified random target points, creating field maps, and providing GIS support;
- Provide final report sections describing the mapping aspects of the project;
- Provide a visual guide to the photo signatures of each map unit;
- Document FGDC-compliant metadata for all vegetation data (FGDC 1998);
- Assist in creating the project digital video disk (DVD).

Field Surveys

Field methods used in this project followed NVIP standards (e.g., TNC 1994a, 1994b, 1994c and Lea and Curtis 2010) and UCBN guidance. Important for future projects was the ability to gather consistent data that could contribute to understanding vegetation relationships across broader landscapes within all of the park units in the UCBN. In addition to the basic vegetation data collected at each plot, the UCBN and CIRO staff defined summary data fields and made suggestions for including additional information on the forms. Plot forms and individual data field descriptions appear in Appendix B.

The sampling area included all of CIRO in addition to other public lands (e.g. Castle Rocks State Park) in the environs. Private lands were not visited. NMI field crews were trained and led by ecologists with experience sampling plant communities in national parks and other landscapes. The list of plant species (John 1995) ecological systems, vegetation alliances, and component plant associations prepared by UCBN provided a starting point for identifying and naming plant associations sampled in the field. The sampling goal was to collect between three and five

classification plots in every vegetation alliance/plant association within the CIRO 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 classification plots across the landscape and to capture the full range of variation of each plant association.

Once a representative plant community was located, a Relevé macroplot was laid out to capture stand characteristics. In this manner, transitional areas particularly ecotones were avoided. Highly disturbed areas were also avoided unless they supported a distinct or homogenous plant community. Classification plots were generally located in stands exceeding the minimum mapping unit (MMU) of 0.5 hectares. A few classification plots were sampled in smaller patches of distinctive vegetation or communities of rare species. Plot size and shape requirements were consistent with NVIP guidelines (TNC and ESRI 1994a). Classification plot size was determined by the physiognomy of the community being sampled (Table 2) and measuring tapes were used to outline the sampling area. CIRO plot shape was adjusted as needed to sample linear bands of vegetation in drainage bottoms or other confined sites. Plot size and shape were recorded for all plots and representative photographs were acquired.

Table 2. Plot sizes used for vegetation classification sampling at CIRO.

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

Following classification plot establishment, environmental data were recorded including: elevation, slope, aspect, landform, topographic position, soil texture and drainage, hydrologic (flooding) regime, and evidence of disturbance or wildlife use. The unvegetated surface was recorded as percent cover of each of the following types: bedrock, litter and duff, wood, bare soil, large rocks (>10 cm), small rocks (0.2-10 cm), sand (0.1-2 mm), lichens, mosses, and fungi.

Vegetation at each plot was visually divided into strata, with the height and canopy cover of all plant species estimated for each stratum. Physiognomic class, leaf phenology, and type of dominant stratum were recorded. The species comprising each stratum were listed and percent canopy cover estimated using a twelve-point cover scale (e.g. <1%, 1-5%, >5-15%; Daubenmire 1959). Additional species within the vegetation unit that occurred outside of sampled plots were listed separately. No attempt was made to identify individual non-vascular plant species. Species that were not identifiable in the field were collected for later identification. Species were recorded by scientific nomenclature familiar to researchers. Finally, a provisional vegetation type name was assigned to the classification plot.

Field crews collected the information for each of the vegetation classification plots in two ways: (1) a species list was developed and recorded on field forms by the team botanist, UTM coordinates, field notes header information (Identifiers/Locators), environmental descriptions and a plot map were also recorded on this form and (2) all other field data were collected with mobile Archer Field PCs.

Following collection of physiognomic and environmental information, field crews used the Garmin GPS 76CSX receiver to record the southeast corner of the plot (no permanent markers were used). UTM NAD83 X-Y coordinates and elevation were recorded both manually on the plot forms and stored as waypoints in the GPS receiver. Four representative photos were acquired facing the four cardinal directions (N, E, S, and W) from the edge of the quadrant facing plot center. Field data collection was conducted in June 2009 and 190 vegetation classification plots were sampled (Figure 11).

Vegetation Classification

Field data were stored in part in Archer Field PCs with Windows Mobile 5.0 operating systems using DataPlus software. All data from the PCs were transferred and managed in a Microsoft (MS) Access database. Electronic data were transferred directly from the data recorders (NMI created data dictionaries as needed) into Database Files (DBF). DBFs were reviewed by field crews for accuracy each night, then converted and stored in the appropriate database on a laptop computer. All additional field data not recorded electronically (such as field notes) were entered manually into the database for this project. Separate databases were established as necessary. Upon completion of field surveys, all recorded data were entered into a MS Access relational database. The database is a modified PLOTS2 database initially developed specifically for the NPS NVIP so that the electronic data entry fields mirrored the standard field form. Data entry was facilitated by using drop-down menus for each plant species scientific name. Scientific names were updated according to the vascular plant list available within the NPSpecies module of the NPS Integrated Resource Management Applications web portal (https://irma.nps.gov/App/Species/Search) and in Appendix E.

Following data entry, quality assurance was performed to minimize errors associated with duplicate entries or erroneously selected plant names. Questions regarding unknown species, especially those with high cover, were resolved, as were other taxonomic issues including grouping subspecies and varieties judged to be ecologically similar. Data were regularly compiled and at the completion of the field work the final database was supplied to S.M. Stoller and ISU statisticians for quantitative analysis. A GIS data layer was also developed to document classification plot field locations

Quantitative analyses and analytical methods were employed by ISU and S.M. Stoller statisticians to determine the plant associations at CIRO. Results are presented in the accompanying classification report copied to the project DVD (Aho and Forman 2010). In summary, the classification team evaluated seven classification methods to analyze the 190 plots and 312 plant species. In general the team created 37 clusters of vegetation using Relevé tables. The clusters were then compared to the NVCS and 35 clusters (communities) were matched to plant associations and two were matched to vegetation alliances.

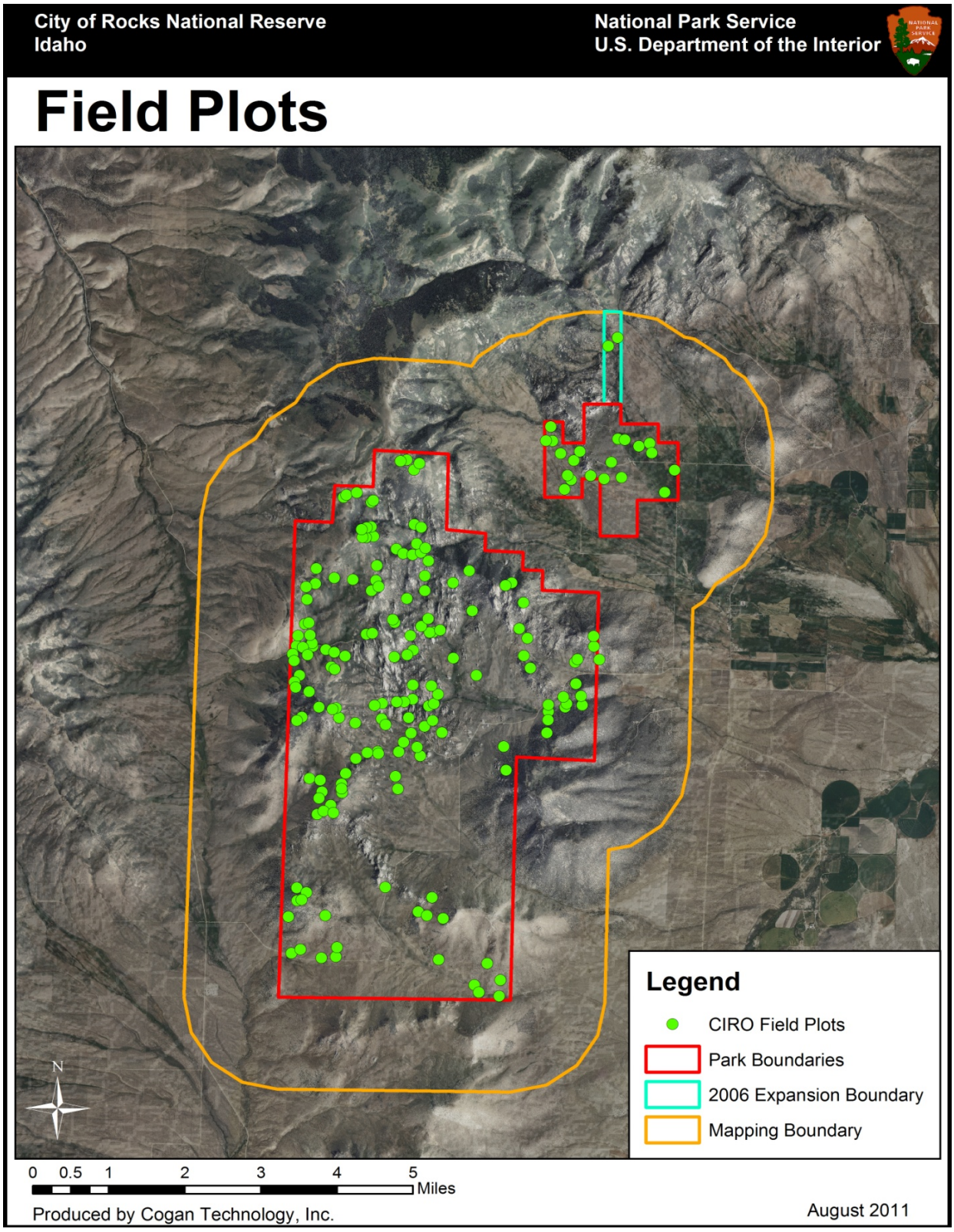


Figure 11. Vegetation classification plot locations within the CIRO project area.

Twenty-five of the 37 plant associations resulting from the classification were represented in the National Vegetation Classification (NVC) at the time the class list was compiled (NatureServe 2010). Eleven classes were not listed in the NVC at the association level, but were described within the range of variation of an appropriate NVC alliance. Several of the associations which had not been described below the alliance level by the NVC were recognized at other park units within the UCBN. For example the green rabbitbrush / wheatgrass spp. shrubland type had been described for Craters of the Moon National Monument and Preserve (Rust and Wolken 2008). Some of the associations not previously described were dominated by Kentucky bluegrass and/or bulbous bluegrass; both non-native grasses that have yet to be described in the current NVC for semi-natural herbaceous vegetation. Regardless of NVC status, plant community variations found in this project have already been described in a previous CIRO classification effort (Sanders et al. 1996) lending a degree of credibility to the overall findings.

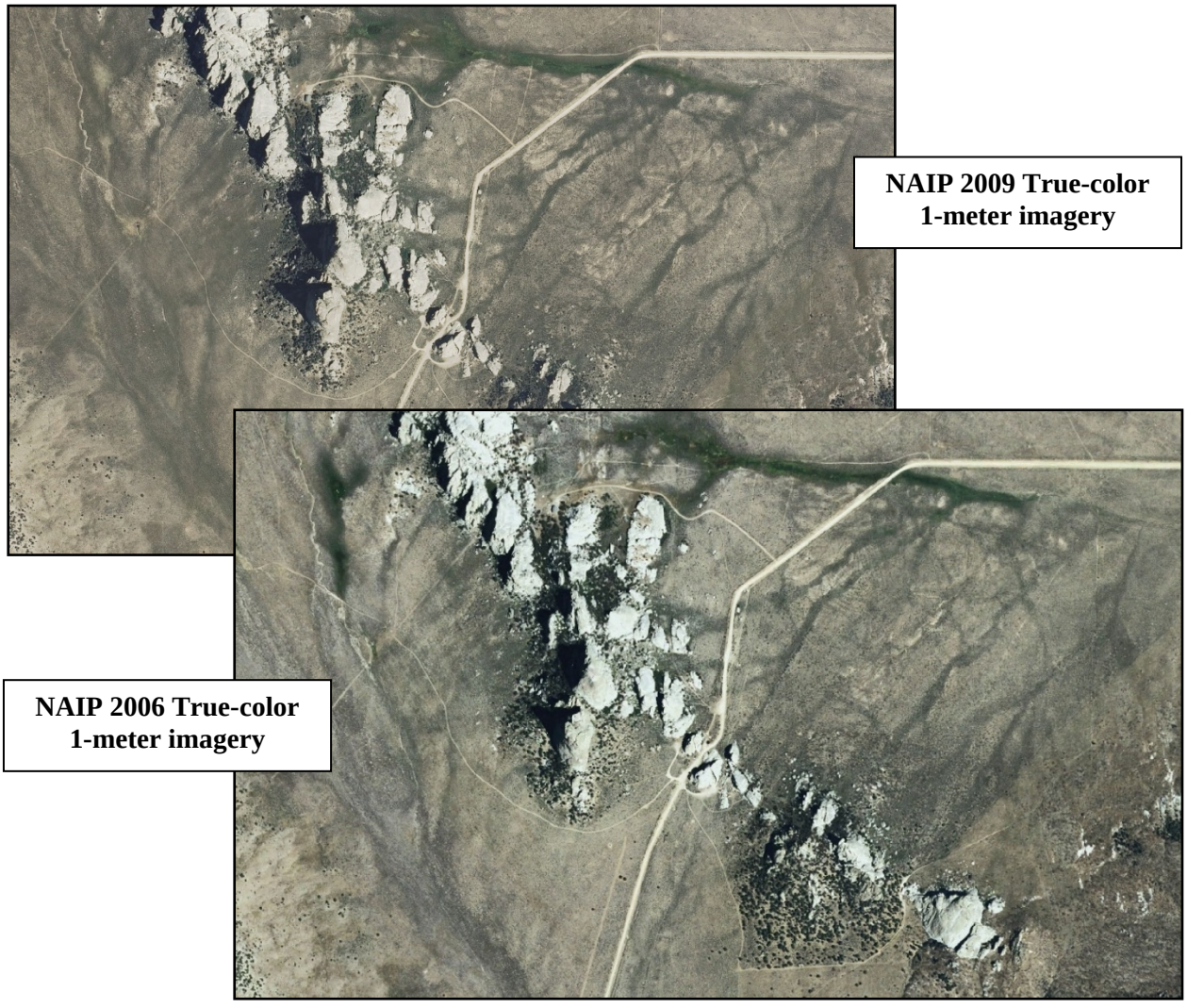
Approximately 25 of the plant associations resulting from the CIRO classification closely matched the current NVC description. Those that deviated were mostly plant associations that occurred outside currently described geographic ranges, had less canopy cover than previously described, or contained different shrub to herbaceous stratum cover ratios. For instance, associations containing tobacco-brush and bluebunch wheatgrass have not been previously described in Idaho. Also two quaking aspen and one Douglas-fir associations had an average canopy cover of less than 60% corresponding to woodlands rather than forest associations. Some of the sagebrush associations had either higher or lower herbaceous cover than was previously described and the subspecies of sagebrush (*Artemisia tridentata*) was not identified in the NatureServe database (2010) for one association. However, the NVC description for this association within CIRO, confirmed by classification plot data, indicates that the appropriate taxon is basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*).

All plant nomenclature used in this study is that of the Integrated Taxonomic Information System (ITIS) as reflected by the PLANTS Database (USDA -NRCS 2007). ITIS nomenclature is represented in the NVCS and the CIRO plant associations described herein. Naming the plant associations used indicator (dominant or diagnostic) species for each of the vegetative strata present. The indicator species of the upper strata was listed first, followed by successively lower strata (e.g., canopy, subcanopy, tall shrub, short shrub, herbaceous vegetation, etc.). Plant species that may only be occasionally present in the same stratum are separated by parentheses ( ). Species that always occurred in the same stratum (or were the same lifeform) are separated by a hyphen (-). Indicator species that occurred in different strata (or are a different lifeform) were separated by a slash (/). Alliance names were concluded with the word “Alliance” to differentiate them from association names. Plant association names incorporated the physiognomic class in which the association was classified (e.g., Forest, Woodland, or Herbaceous (FGDC 1997, 2008 and Aho and Forman 2010).

The final products of the classification task included a field key and local plant association descriptions. The dichotomous field key to the CIRO plant associations was developed to assist users in identifying vegetation associations in the field, particularly during the accuracy assessment task (Appendix C). The local descriptions were based on the field data and provide CIRO characteristics for each plant association within the NatureServe template (Appendix D).

Digital Imagery and Interpretation

Existing sources of imagery were evaluated for vegetation mapping and geodatabase development for CIRO. Among the current sources of imagery were NAIP products from which the 2006 1-meter resolution product was determined adequate for mapping. The 2006 NAIP imagery was originally used to delineate obvious land-use and physiognomic boundaries. However in 2009, NAIP acquired new 1-meter resolution (true-color format) for the entire state of Idaho. Following examination, the 2009 NAIP imagery for Cassia County, Idaho was deemed superior in color and was more recent so the vegetation mapping was switched from the 2006 imagery to the 2009 product (Figure 12). All previous land-use and physiognomic linework was updated and the final map product is based solely on the 2009 NAIP ortho-imagery.



Source: NAIP

Figure 12. Examples of the 2006 and 2009 true-color base-map imagery for CIRO.

Mapping and interpretation at CIRO involved a four-step process consisting of: (1) field reconnaissance; (2) map class development; (3) image processing and interpretation; and (4) spatial database development. Field reconnaissance was initiated by CTI and NMI staff following the scoping meeting with the goal to quickly familiarize the mapping team with CIRO vegetation patterns, plant community distribution, and land-use types. As the classification plot data collection progressed in 2009, feedback on the dominant and characteristic plant species was solicited from the field crews as they accessed more remote areas within CIRO.

All classification plot information sampled in 2009 was documented, summarized, and geo-processed into a GIS shapefile that could be overlain on the NAIP ortho-imagery. CTI created preliminary map classes (also known as map units) based largely on whether the vegetation surrounding the plot locations could be readily identified and delineated on the NAIP imagery (i.e. photo signature development). Once the photo signatures were inventoried they were matched or cross-walked back to the preliminary list of plant associations prepared in the project work plan. Supplemental land-use and land-cover classes (Anderson 1976, amended 2002) were added to classify non-vegetated areas such as developments, roads, streams, ponds, bare ground, and active agricultural areas. All obvious land-use features were manually digitized and incorporated with the project boundary into a draft GIS layer. Initial interpretation and mapping focused only on delineating obvious landforms (e.g., geologic exposures and land use) and physiognomic features (e.g., grasslands versus shrublands versus woodlands).

In 2010, CTI compared the initial map classes to both the 2009 NAIP imagery and a draft of the final CIRO vegetation classification. New map classes were added as necessary with emphasis placed on the ability to accurately delineate homogenous polygons from the base ortho-imagery. In general, the level of detail possible in a vegetation map is limited by the imagery, the skill and experience of the mapping professional, and the availability of supporting information. The relationships between the map classes and plant associations are often complex. In most cases, the CIRO map classes were derived on a 1 plant association or 1 vegetation alliance to 1 map class basis. However due to the limitations of the imagery some of the associations could not be consistently recognized. Mapping ambiguity was addressed by either scaling up the NVCS to the alliance level or combining similar associations/alliances into complexes or mosaics. Complexes were used when associations/alliances could not be discerned from each other. Conversely, mosaics were used when associations/alliances could be discerned but were so small and interspersed that individual polygon mapping would prove to be impractical.

All map classes were reviewed by UCBN and CIRO staff and based on the resulting suggestions some additional park-specific or "Park Specials" were defined as follows:

- Designating quaking aspen based on dry vs. mesic understories;
- Adding lodgepole pine, white poplar, gray alder, and streambank wheatgrass stands as map classes even though they were often small and only occurred occasionally in the project area;
- Placing emphasis on non-native vegetation by adding desert wheatgrass and sagebrush / cheatgrass as semi-natural map classes; and

- Extending the delineation of wetland and riparian stands below the minimum mapping unit (mmu) of 0.5 hectares (1.24 acres).

For some map classes (like the streambank wheatgrass unit) existing NVC alliances were later matched to the park special map units for reference based on the dominant species. In addition to the park special map classes, CIRO staff also requested that if feasible, small areas of either non-native species or rock outcrop vegetation be delineated.
CIRO vegetation mapping continued in 2010 by importing the preliminary CIRO vegetation layer into eCognition software for segmentation comparisons. Automated imagery segments (polygons) were based in part on pixel reflectance and their relationship to neighboring pixels. By incrementally increasing segmentation size within the program, small image objects (i.e. preliminary polygons) were continuously merged into larger polygons. Completion of the segmentation was based on visual judgment of the analyst when obvious, distinct features were lost the previous segmentation was adopted as the final treatment.
Following segmentation, only those lines/polygons that matched the vegetation patterns within the CIRO project area were exported as ArcInfo shapefiles and converted into ArcInfo coverages. The resulting coverages were refined through a series of smoothing routines until no obvious artificial or relict breaks in the lines were visible. Following smoothing, the line-work was manually cleaned to remove extraneous lines, very small polygons (<0.25 acre), and polygons that obviously split a homogenous stand of vegetation. The cleaned lines were overlain on the new 2009 NAIP imagery and visually inspected for completeness.

At this stage the mapping approach was switched from an automated process to a manual interpretation effort. Using the classification plot data, field notes, and ancillary data final vegetation polygons were edited, split, and merged through on-screen digitizing to create consistent, homogenous polygons that matched the mapping units. Mapping progressed by first delineating known areas within CIRO and Castle Rocks State Park and then into unsampled areas in the environs.

When the interpretation effort was considered complete, topology for the final polygon layer was built and attributed and then imported into a spatial database (geodatabase). Each polygon was attributed with a dedicated map unit name, code, and modifier. Polygon-specific modifiers included additional data on the height, density, and patterns of the dominant vegetation. Also polygons of disturbed sites were identified in a comments field along with any notable dominate understory or locally common plant species. Finally other map class data including the NVCS crosswalk and the land-use classes were added (Table 3).

Table 3. Polygon attribute items and descriptions.

ATTRIBUTE	DESCRIPTION
AREA*	Surface area of the polygon in meters squared
PERIMETER*	Perimeter of the polygon in meters
CIRO_VEG#*	Unique code for each polygon
CIRO_VEG-ID*	Unique identification code for each polygon
VEG_CODE	Final Map Unit Codes – Project specific
MAP_DESC	Map Unit Common Description Name – Project specific
DENS_MOD	Modifier - Percent cover of the upper stratum layer in the polygon Percent cover classes: Very Sparse **<10%**, Sparse **10 - 25%,** Open **25 - 60%,** Discontinuous - Closed **> 60%**
PTRN_MOD	Modifier - Vegetation pattern within the polygon Vegetation pattern classes: Evenly Dispersed **= Homogeneous** Grouped Stands of Vegetation = **Bunched / Clumped,** String of Vegetation **= Linear**
HT_MOD	Modifier - Height range of the dominant vegetation layer Height classes: **< 1, 1-5, 5-15, 15-30 & >30 meters**
CES_CODE	Ecological Systems Code – NVCS derived (NatureServe)
CES_NAME	Ecological Systems Name – NVCS derived (NatureServe)
NVC_ELCODE	Corresponding Association Code – NVCS derived (NatureServe) Association **=** Community Element Global Code – Elcode link to the NVCS
ASSN_NAME	Project Community Name - NVCS Association(s)
ASSN_CNAME	Project Common Community Name - synonym name of Association(s)
NVCS_CODE	NVCS Code - to NVCS Formation level
ALL_CODE	Alliance Name Code – NVCS derived (NatureServe) Alliance = Alliance Global Code – Alliance Link to the NVCS
ALL_NAME	Project Alliance Name = NVCS Alliance(s)
ALL_CNAME	Project Common Alliance Name = NVCS Alliance(s)
FORMATION	NVCS Formation = Formation name NVCS Code – Formation name
SUBGROUP	NVCS Formation Subgroup = NVCS Code – Subgroup name
GROUP	NVCS Formation Group = NVCS Code – Group name
SUBCLASS	NVCS Formation Subclass = NVCS Code – Subclass name
CLASS	Formation Class = NVCS Code – Class name
LUC_II_GEN	General Land Use and Land Cover Classification System Name Project specific based on Level I or II of Anderson et al. (1976)
LUC_II	Specific Land Use and Land Cover Classification System Name Project specific Level II or Level III of Anderson et al. (1976)
COMMENTS	Additional Comments about the Vegetation in Individual Polygons
ACRES	Surface area of the polygon in acres

(*****ArcInfo© default items)

Accuracy Assessment

Following vegetation map completion and finalization inside the CIRO management boundary the accuracy assessment (AA) was conducted. AA is a statistical test of how well the vegetation map represents vegetation on the ground. The AA compares field observations with the map class assignment. 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 are expressed 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 or that it was confused with other map units and not sufficiently delineated. Conversely, low producer's accuracy combined with high user's accuracy indicates that a type is over-mapped or that more of this type was mapped than actually occurs on the ground.

The thematic accuracy of the vegetation map was assessed using the methodology and standards provided by the NVIP Accuracy Assessment Procedures manual (TNC 1994c) and subsequently updated in version 2.0 (Lea and Curtis 2010). Assessment methodology included a four-step process consisting of a sample design, sample site selection, data collection, and data analysis. The design of the AA process followed the five possible scenarios provided in the first version of the field methods with stratified random targets placed in each map class based on their respective frequency and abundance. The AA included most vegetation map classes and was limited to managed lands within CIRO and Castle Rocks State Park. Sample sizes for each evaluated map class were selected using the NVMP guidelines (TNC et al. 1994b). The design of the AA process followed the five possible scenarios with stratified random targets placed in each map class based on their respective frequency and abundance (Table 4).

All AA parameters were uploaded into a custom GIS program along with the vegetation layer. Following some reformatting of the data, the program automatically picked the various random target locations, buffered each 10 meters (33 feet) away from any polygon boundary, and 50 meters (164 feet) away from other AA points. Being able to choose minimum distance to polygon boundaries helped to minimize confusion and accounted for the horizontal error typically encountered in common GPS receivers (±5 m; [16 ft]). The resulting target locations were restricted to within the CIRO and Castle Rocks State Park boundaries by masking out the environs and any private in-holdings. Eleven land-use and geologic/bare rock map classes were excluded since they are essentially unvegetated.

Table 4. Sampling protocol for AA points.

Scenario	Description	# Polygons	Area (ac)	Recommended # of Samples
A	The class is abundant. It covers more than 50 hectares (124 acres) of the total area and consists of at least 30 polygons. In this case, the recommended sample size is 30.	> 30	> 125	30
B	The class is relatively abundant. It covers more than 50 hectares (124 acres) of the total area but consists of fewer than 30 polygons. In this case, 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.	< 30	> 125	20
C	The class is relatively rare. It covers less than 50 hectares (124 acres) of the total area but consists of more than 30 polygons. In this case, 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.	> 30	< 125	20
D	The class is rare. It has more than 5 but fewer than 30 polygons and covers less than 50 hectares (124 acres) of the area. In this case, the recommended number of samples is 5. 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 5 sample sites will therefore probably result in multiple sample sites within the same (small) polygon. Collecting 5 sample sites will allow an accuracy estimate to be computed, although it will not be very precise.	5-30	< 125	5
E	The class is very rare. It has fewer than 5 polygons and occupies less than 50 hectares (124 acres) of the total area. In this case, it is recommended that the existence of the class be confirmed by a visit to each sample site. The rationale for the recommendation is that with fewer than 5 sample sites (assuming 1 site per polygon) no estimate of level of confidence can be established for the sample (the existence of the class can only be confirmed through field checking).	< 5	< 125	Visit all and confirm

Accuracy assessment point data were collected at CIRO during the 2010 field season. Following target location selection, ecologists were provided with draft field maps, overview maps, map unit definitions, the field key to the plant associations (Appendix C), and digital GPS files containing the location of the AA targets. The ecologists traveled to the AA target sites and determined the vegetation association using the field key. At each target they recorded the primary, secondary, or tertiary associations that occurred within a roughly 50-meter radius. They also recorded height and cover of vegetation strata, environmental data, and percent canopy cover of the major species (see field form Appendix B). Other nearby vegetation types outside the 50-meter radius and any recent disturbance were also recorded. To better assist the analysis 4 digital photographs were acquired at each AA point, in the sequence of cardinal directions, N-E-S-W.

Data from 597 sampled AA sites were imported from the database into a GIS layer (Figure 13) then were visually compared in two steps to the vegetation map. The first step was to compare the AA points to the original target locations to check for erroneous points and remove these from further analysis. General errors in the data were recorded at this time, including documenting points that had GPS and location errors. The most common GPS receiver error included transposing two UTM coordinate numbers. Location errors involved having the final AA point occur in the wrong target polygon either due to poor GPS satellite positioning or the point occurred too close to a polygon boundary. This initial review led to the removal of three AA sites that were either collected in the wrong target polygon or had erroneous UTM coordinates. Nomenclature standards and other data management procedures were the same as for the classification plot data.

The second review step involved deciding between the primary and secondary call for the plant association as recorded by the field crew. In larger vegetation mapping projects such as Rocky Mountain National Park (Salas et al. 2004), AA analysis involved fuzzy logic which assigns different levels of accuracy based on the primary, secondary, and tertiary calls. However due to the confusion that fuzzy logic can cause, a simple binary assessment was conducted of CIRO data. CTI assigned a final map unit for every point by choosing between the primary and secondary calls. Assignment was accomplished by first adding a new attribute to the point layer labeled “Final_Code” and then by comparing the assigned field names of the point with its corresponding location on the digital imagery. In most cases the primary vegetation map unit name assigned by the field crew was used. However some points were assigned the secondary field call based on one of the following reasons: (1) it appeared that the second call was the better choice due to the overhead perspective (e.g., a stand judged to be sparse woodland on the imagery vs. herbaceous vegetation in the field), (2) the data were actually recorded in a stand that was too small (i.e. inclusion), or (3) the second call better matched the ecological context (e.g. riparian woodland located next to a stream vs. upland woodland located next to a stream).

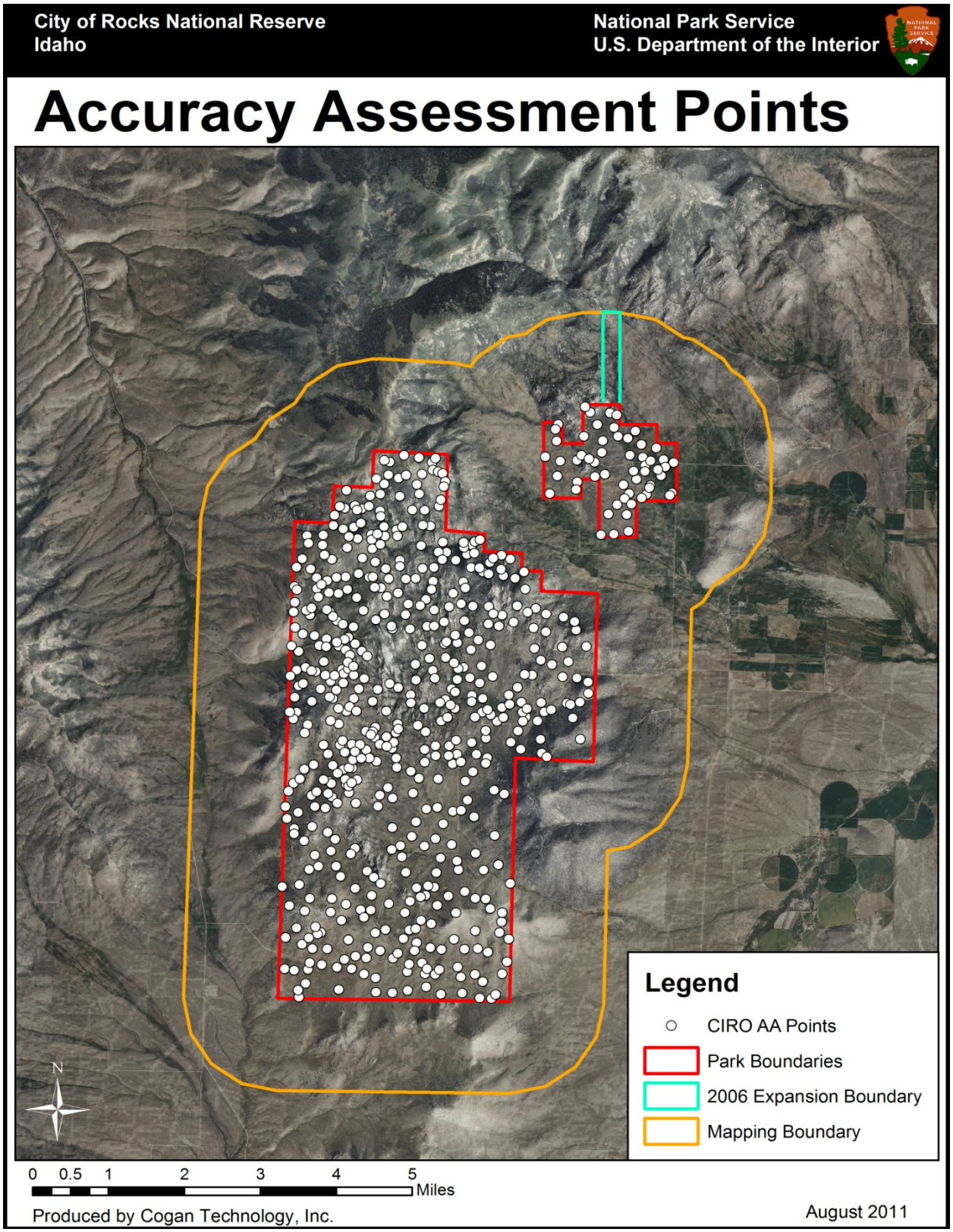


Figure 13. Location of the accuracy assessment (AA) points in CIRO.

Following AA data review the accuracy analysis was conducted. For CIRO the process was streamlined using methods developed from previous studies at Rocky Mountain National Park (Salas et al. 2004) and Wupatki National Monument (Hansen et al. 2004). Specifically many of the in-house GIS programs developed for these projects were used to compare the AA data, generate confidence intervals, Kappa statistics, and error matrices (contingency tables). Through this automated process, the final map units in the AA layer were compared to the map unit designations for their corresponding polygons. All statistics and calculations used to analyze these data are described at length in the program manuals (TNC 1994c, Lea and Curtis 2010) and are summarized in Table 5. Final assessments for each point were recorded using an error matrix.

Table 5. Statistics used in AA analysis.

Statistic	Formula	Description
User's - accuracy:	$\frac{n_{ii}}{n_{i+}}$	Where *i* is the land cover type, n_{ii} is the number of matches between map and reference data and n_{i+} is the total number of samples of *i* in the map. This formula is the number of "correct" observations divided by the sum of the row.
Producer's accuracy	$\frac{n_{ii}}{n_{+i}}$	Where n_{+i} = total number of sample of *i* in the reference data. This formula is the number of "correct" observations divided by the sum of the column.
Confidence Interval	$\hat{p} \pm \left\{ z_{\alpha} \sqrt{\frac{\hat{p}(1-\hat{p})}{n} + \frac{1}{(2n)}} \right\}$	Where z_{α} = 1.645 (this comes from a table of the z-distribution at the significance level for a two-sided limit with a 90% confidence interval). The term 1/ (2n) is the correction for continuity. The correction should be applied to account for the fact the binomial distribution describes discrete populations $\hat{p}$ = the sample accuracy (0 -1.0), *n* = the number of sites sampled.
Kappa Index	$k = \frac{N\sum_{i=1}^{r} x_{ii} - \sum_{i=1}^{r}(x_{i+} \text{ x } x_{+i})}{N^2 - \sum(x_{i+} \text{x } x_{+i})}$	Where *N* is the total number of sites in the matrix, *r* is the number of rows in the matrix, x_{ii} is the number in row *i* and column *i*, x_{+i} is the total for row *i*, and x_{i+} is the total for column *I*.

Results

Vegetation Classification

Over 450 plant species and varieties were documented during taxonomic inventories and classification plot and accuracy assessment field data collection (NPS 2011) (Appendix E). Based on the dominant/characteristic plant species and other factors the CIRO vegetation was further classified into 37 community types (35 plant associations and two vegetation alliances) (Aho and Forman 2010) (Table 6). Sixty-six percent of associations identified within CIRO are currently listed in the NVC (NatureServe 2011). Associations described but not recognized by the NVC include three semi-natural vegetation associations and nine plant associations that have not been described previously at the association level. Distinctive plant associations that should be considered for inclusion in the NVC include:

1. *Juniperus scopulorum* - *Populus tremuloides* Woodland;
2. *Artemisia tridentata* ssp. *vaseyana* - *Purshia tridentata* / *Elymus lanceolatus* Shrubland;
3. *Artemisia tridentata* ssp. *vaseyana* - *Purshia tridentata* / *Poa secunda* Shrubland;
4. *Artemisia tridentata* ssp. *vaseyana* - *Symphoricarpos oreophilus* Shrubland;
5. *Chrysothamnus viscidiflorus* / *Elymus lanceolatus – Poa secunda* Shrub Herbaceous Vegetation.

Table 6 lists the 35 plant associations and two vegetation alliances by scientific name, common name, code, and number of plots/association-alliance; they are ordered by physiognomy: forests and woodlands, shrublands, herbaceous, and sparse vegetation.

Forest and Woodland Associations

Conifer woodlands and forests were common within CIRO. Singleleaf pinyon pine and Utah juniper occupied the broadest distribution on mid-elevation slopes. Smaller stands and patches of coniferous and deciduous trees including subalpine fir, limber pine, lodgepole pine, curl-leaf mountain mahogany, Douglas-fir, Rocky Mountain juniper, and quaking aspen occurred at higher elevations typically on cooler and moister sites.

Shrubland Associations

Shrublands, predominantly of sagebrush species, were common at mid- to low elevations on slopes and in valleys. Mountain big sagebrush, basin big sagebrush, black sagebrush, and dwarf or low sagebrush associations were classified. Stands of green rabbitbrush occurred as shrublands but more often as shrub herbaceous types on disturbed sites, often in areas that experienced recent fires. Additional deciduous shrubs forming small stands included mountain snowberry, tobacco-brush, and antelope bitter brush.

Herbaceous Associations

Grass and forb associations were common in woodland openings, on exposed slopes, and on benches. Common native species included bluebunch wheatgrass, Idaho fescue, curly bluegrass, streambank wheatgrass, spike fescue, and arrowleaf balsamroot. Non-native grasses often occurred in areas that were previously cultivated, burned, or seeded and included stands of cheatgrass, crested wheatgrass, bulbous bluegrass, and Kentucky bluegrass.

Table 6. List of 35 plant associations and two vegetation alliances for CIRO.

Scientific Name	Common Name	Key Code	Elcode	N
Forest and Woodland				
Abies lasiocarpa / Sparse Woodland	Subalpine Fir / Sparse Woodland	ABLA/Sparse	N/A	3
Cercocarpus ledifolius / *Symphoricarpos oreophilus* Woodland	Curl-leaf Mountain-mahogany / Mountain Snowberry Woodland	CELE/SYOR	CEGL000970	6
Juniperus scopulorum - *Populus tremuloides* Woodland	Rocky Mountain Juniper – Quaking Aspen Woodland	JUSC2-POTR	NA	2
Pinus flexilis Woodland Alliance	Limber Pine Woodland Alliance	PIFL	A.540	2
Pinus monophylla - *Juniperus osteosperma* / Sparse Understory Woodland	Singleleaf Pinyon - Utah Juniper / Sparse Understory Woodland	PIMO–JUOS/Sparse	CEGL000829	6
Pinus monophylla / *Cercocarpus ledifolius* Woodland	Singleleaf Pinyon / Curl-leaf Mountain-mahogany Woodland	PIMO/CELE	CEGL000828	5
Pinus monophylla Woodland	Singleleaf Pinyon Woodland	PIMO	CEGL000825	13
Populus tremuloides / *Poa pratensis* Forest	Quaking Aspen / Kentucky Bluegrass Forest	POTR5/POPR	NA	3
Populus tremuloides / *Symphoricarpos oreophilus* / *Thalictrum fendleri* Forest	Quaking Aspen / Mountain Snowberry / Fendler's Meadowrue Forest	POTR5/SYOR/THFE	CEGL000616	5
Populus tremuloides / *Thalictrum fendleri* Forest	Quaking Aspen / Fendler's Meadowrue Forest	POTR5/THFE	CEGL000619	7
Pseudotsuga menziesii / Acer glabrum Forest	Douglas-fir / Rocky Mountain Maple Forest	PSME/ACGL	CEGL000418	3

Scientific Name	Common Name	Key Code	Elcode	N
Shrubland				
Artemisia arbuscula / *Poa bulbosa* Shrub Herbaceous Vegetation	Dwarf Sagebrush / Bulbous Bluegrass Shrub Herbaceous Vegetation	ARAR/POBU	NA	3
Artemisia arbuscula / *Poa secunda* Shrub Herbaceous Vegetation	Dwarf Sagebrush / Curly Bluegrass Shrub Herbaceous Vegetation	ARAR/POSE	CEGL001411	8
Artemisia nova / *Pseudoroegneria spicata* Shrubland	Black Sagebrush / Bluebunch Wheatgrass Shrubland	ARNO/PSSP	CEGL001424	6
Artemisia tridentata - Chrysothamnus viscidiflorus / *Poa secunda* Shrubland	Basin Big Sagebrush - Green Rabbitbrush / Curly Bluegrass Shrubland	ARTR-CHVI/POSE	CEGL000999	3
Artemisia tridentata ssp. *tridentata* / *Poa pratensis* Shrub Herbaceous Vegetation	Basin Big Sagebrush / Kentucky Bluegrass Shrub Herbaceous Vegetation	ARTRT/ POPR	NA	4
Artemisia tridentata ssp. *tridentata* / *Poa secunda* Shrubland	Basin Big Sagebrush / Curly Bluegrass Shrubland	ARTRT/POSE	CEGL001008	10
Artemisia tridentata ssp. *vaseyana* - *Purshia tridentata* / *Elymus lanceolatus* Shrubland	Mountain Big Sagebrush - Antelope Bitterbrush / Streambank Wheatgrass Shrubland	ARTRV-PUTR/ELLA	NA	2
Artemisia tridentata ssp. *vaseyana* - *Purshia tridentata* / *Poa secunda* Shrubland	Mountain Big Sagebrush - Antelope Bitterbrush / Curly Bluegrass Shrubland	ARTRV-PUTR/POSE	NA	11
Artemisia tridentata ssp. *vaseyana* - *Symphoricarpos oreophilus* Shrubland	Mountain Big Sagebrush - Mountain Snowberry Shrubland	ARTRV-SYOR	NA	10
Artemisia tridentata ssp. *vaseyana* / *Festuca idahoensis* Shrub Herbaceous Vegetation	Mountain Big Sagebrush / Idaho Fescue Shrub Herbaceous Vegetation	ARTRV/FEID	CEGL001533	6
Artemisia tridentata ssp. *vaseyana* / *Leucopoa kingii* Shrubland	Mountain Big Sagebrush / Spike Fescue Shrubland	ARTRV/LEKI	CEGL001025	5

Scientific Name	Common Name	Key Code	Elcode	N
Artemisia tridentata ssp. *vaseyana* / *Poa pratensis* Shrubland	Mountain Big Sagebrush / Kentucky Bluegrass Shrubland Vegetation	ARTRV/POPR	CEGL002528	4
Artemisia tridentata ssp. *vaseyana* / *Pseudoroegneria spicata* Shrubland	Mountain Big Sagebrush / Bluebunch Wheatgrass Shrubland	ARTRV/PSSP	CEGL001030	4
Ceanothus velutinus Shrubland	Tobacco-brush Shrubland	CEVE	CEGL002167	3
Chrysothamnus viscidiflorus / *Agropyron desertorum* Shrub Herbaceous Vegetation	Green Rabbitbrush / Crested Wheatgrass Shrub Herbaceous Vegetation	CHVI/AGDE	NA	3
Chrysothamnus viscidiflorus / *Elymus lanceolatus* – *Poa secunda* Shrub Herbaceous Vegetation	Green Rabbitbrush / Streambank Wheatgrass – Curly Bluegrass Shrub Herbaceous Vegetation	CHVI/ELLA-POSE	NA	5
Prunus virginiana - (*Prunus americana*) Shrubland	Chokecherry - (American Plum) Shrubland	PRVI	CEGL001108	3
Purshia tridentata / Pseudoroegneria spicata Shrub Herbaceous Vegetation	Antelope Bitterbrush / Bluebunch Wheatgrass Shrub Herbaceous Vegetation	PUTR PSSP	CEGL001495	4
Salix boothii / Mesic Forbs Shrubland	Booth's Willow / Mesic Forbs Shrubland	SABO/Mesic Forbs	CEGL001180	3
Symphoricarpos oreophilus Shrubland	Mountain Snowberry Shrubland	SYOR	CEGL002951	9

Scientific Name	Common Name	Key Code	Elcode	N
Herbaceous Vegetation				
Bromus tectorum Semi-natural Herbaceous Alliance	Cheatgrass Semi-natural Herbaceous Alliance	BRTE	A.1814	6
Carex nebrascensis Herbaceous Vegetation	Nebraska Sedge Herbaceous Vegetation	CANE	CEGL001813	4
Poa bulbosa Semi-natural Herbaceous Vegetation	Bulbous Bluegrass Herbaceous Vegetation	POBU	NA	6
Poa pratensis – Juncus balticus Semi-natural Herbaceous Vegetation	Kentucky Bluegrass – Baltic Rush Semi-natural Herbaceous Vegetation	POPR-JUBA	NA	7
Pseudoroegneria spicata - Poa secunda / Balsamorhiza sagittata Herbaceous Vegetation	Bluebunch Wheatgrass - Sandberg Bluegrass / Arrowleaf Balsamroot Herbaceous Vegetation	PSSP6-POSE/BASA3	CEGL001662	2
Pseudoroegneria spicata – Festuca idahoensis Canyon Herbaceous Vegetation	Bluebunch Wheatgrass – Idaho Fescue Canyon Herbaceous Vegetation	PSSP6-FEID	CEGL001669	4

Riparian and Wetland Forest and Woodland Associations

Mesic riparian woodlands were not classified within the CIRO project area although small stands of non-native white poplar and black cottonwood (*Populus balsamifera* ssp. *trichocarpa*) were documented in valley bottoms.

Riparian and Wetland Shrubland Associations

Riparian and wetland shrub communities were rare in valley bottoms and around seeps and springs. Booth's willow and chokecherry associations were the most common tall shrublands.

Riparian and Wetland Herbaceous Associations

Mesic riparian and wetland herbaceous associations were uncommon in valley bottoms and around seeps and springs. Common herbaceous plant species included Baltic rush, Nebraska sedge, and Kentucky bluegrass.

Classified plant associations were placed into an ecological system to provide managers a broader landscape perspective. The ecological system classification addresses natural landscapes and developed areas were not included. Eighteen ecological systems occur within the CIRO vegetation mapping project area (Aho and Forman 2010) (Table 7).

Table 7. List of 18 ecological systems within CIRO.

Ecological System	NVC Code
Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	CES306.828
Inter-Mountain Basins Curl-leaf Mountain-mahogany Woodland and Shrubland	CES304.772
Rocky Mountain Foothill Limber Pine-Juniper Woodland	CES306.955
Inter-Mountain Basins Cliff and Canyon	CES304.779
Great Basin Pinyon-Juniper Woodland	CES304.773
Rocky Mountain Aspen Forest and Woodland	CES306.813
Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	CES 306.825
Inter-Mountain Basins Montane Sagebrush Steppe	CES304.785
Inter-Mountain Basins Big Sagebrush Shrubland	CES304.777
Inter-Mountain Basins Big Sagebrush Steppe	CES304.778
Inter-Mountain Basins Semi-Desert Shrub-Steppe	CES304.788
Rocky Mountain Lower Montane-Foothill Shrubland	CES306.822
Rocky Mountain Subalpine-Montane Riparian Shrubland	CES306.832
Inter-Mountain Basins Semi-Desert Grassland	CES304.787
Rocky Mountain Alpine-Montane Wet Meadow	CES306.812
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland	CES306.821
Columbia Basin Palouse Prairie	CES304.792
Columbia Basin Foothill and Canyon Dry Grassland	CES.304.993

Digital Imagery and Interpretation

For CIRO, 42 map units (31 vegetated, 1 geology/bare rock, and 10 land-use/land-cover) were developed. The final list of map classes/units was directly cross-walked or matched to corresponding plant associations and land-use classes (Table 8). CIRO map classes represent a compromise between the detail of the NVCS, the needs for park management, and the limitations of the imagery. As a result, the mapping legend does not exactly match the NVCS. When the NVCS link was not feasible, descriptive local map units or park specials were created.

The following types represent the possible map scenarios that were encountered in the CIRO project:

1. **One-to-one relationship** = When a plant association or vegetation alliance had a unique photo signature and could be readily delineated on the imagery, the map unit adopted the plant association/vegetation alliance name or similar synonym.
2. **One-to-many relationship** = When related plant associations shared the same signature and could not be distinguished on the imagery, several plant associations were combined into a single complex.
3. **Park Specials** = When unique stands of vegetation did not have a corresponding NVCS plant association or vegetation alliance.
4. **Land Use – Land Cover** = Non-vegetated areas and vegetation types not recognized by the NVCS received Anderson et al. (1976, updated 2002) map unit designations.

CIRO map class comments and notes:

- *Pinus contorta* Woodland Alliance was added based on documented locations;
- *Populus alba* Woodland Stand was added based on field crew notes;
- *Alnus incana* Temporarily Flooded Shrubland Alliance was added based on documented locations;
- *Elymus lanceolatus* Herbaceous Alliance was added based on field crew notes;
- *Populus tremuloides* / Mesic Herbaceous Forest map class was added to help separate aspen with dry vs. mesic understory species;
- *Artemisia tridentata / Bromus tectorum - (Agropyron desertorum)* Semi-natural Shrubland Complex was added to help document sagebrush stands that contained high amounts of non-native understory grasses;
- *Agropyron desertorum* Semi-natural Herbaceous Vegetation was also added to help differentiate it from sites with high cheatgrass cover;
- *Pinus monophylla* Woodland differs from the other pinyon-juniper woodlands due to the lack of juniper cover and the presence of high sagebrush cover in the understory. This map class was originally named *Pinyon pine (Juniperus spp.) /Artemisia* ssp. Woodland.

Please reference Appendix F for detailed descriptions and representative photographs for all vegetation map units.

Table 8. Assignment of map classes to NVC plant associations/alliances.

Map Class Code	Map Class Name	NVC Association/Alliance(s) Assigned to Map Class (or Map Unit Description)	Relationship
ABLA	*Abies lasiocarpa* / Sparse Woodland	-*Abies lasiocarpa* / Sparse Woodland	1 : 1
CELE	*Cercocarpus ledifolius* / *Symphoricarpos oreophilus* Woodland	-*Cercocarpus ledifolius* / *Symphoricarpos oreophilus* Woodland	1 : 1
PICO	*Pinus contorta* Woodland Alliance	-*Pinus contorta* Woodland Alliance	1 : 1
PIFL	*Pinus flexilis* Woodland Alliance	-*Pinus flexilis* Woodland Alliance	1 : 1
PJ/SPRS	*Pinus monophylla* - *Juniperus osteosperma* / Sparse Understory Woodland	- *Pinus monophylla* - *Juniperus osteosperma* / Sparse Understory Woodland	1 : 1
PJ/CELE	*Pinus monophylla* / *Cercocarpus ledifolius* Woodland	-*Pinus monophylla* / *Cercocarpus ledifolius* Woodland	1 : 1
PIMO	*Pinus monophylla* Woodland	-*Pinus monophylla* Woodland	1 : 1
POTR/ GRASS	*Populus tremuloides – (Juniperus scopulorum)* / Dry Herbaceous Forest Complex	-*Populus tremuloides* / *Poa pratensis* Forest -*Populus tremuloides* / *Symphoricarpos oreophilus* / *Thalictrum fendleri* Forest -*Populus tremuloides* / *Thalictrum fendleri* Forest -*Juniperus scopulorum* - *Populus tremuloides* Woodland	1 : Many
POTR/ MESC	*Populus tremuloides* / Mesic Herbaceous Forest	-*Populus tremuloides* / *Symphoricarpos oreophilus* / *Thalictrum fendleri* Forest	1 : 1
PSME	*Pseudotsuga menziesii* / *Acer glabrum* Forest	-*Pseudotsuga menziesii* / *Acer glabrum* Forest	1 : 1
POAL	*Populus alba* Woodland Stand	-No NVC -Park Special	Park Special

Map Class Code	Map Class Name	NVC Association/Alliance(s) Assigned to Map Class (or Map Unit Description)	Relationship
ALIN	*Alnus incana* Temporarily Flooded Shrubland Alliance	-*Alnus incana* Temporarily Flooded Shrubland Alliance	1 : 1
ARAR	*Artemisia arbuscula* spp. *arbuscula* Shrub Herbaceous Alliance	-*Artemisia arbuscula* / *Poa bulbosa* Shrub Herbaceous Vegetation -*Artemisia arbuscula* / *Poa secunda* Shrub Herbaceous Vegetation	1 : Many
ARNO	*Artemisia nova / Pseudoroegneria spicata* Shrubland	-*Artemisia nova / Pseudoroegneria spicata* Shrubland	1 : 1
ARTRT	*Artemisia tridentata* ssp. *tridentata* Shrubland Alliance	-*Artemisia tridentata* / *Chrysothamnus viscidiflorus* / *Poa secunda* Shrubland -*Artemisia tridentata* ssp. *tridentata* / *Poa secunda* Shrubland -*Artemisia tridentata* ssp. *tridentata* / *Poa pratensis* Shrub Herbaceous Vegetation	1 : Many
ARTR-PUTR	*Artemisia tridentata* ssp. *vaseyana - Purshia tridentata* Shrubland Alliance	-*Artemisia tridentata* ssp. *vaseyana - Purshia tridentata* / *Elymus lanceolatus* Shrubland -*Artemisia tridentata* ssp. *vaseyana - Purshia tridentata* / *Poa secunda* Shrubland	1 : Many
ARTRV	*Artemisia tridentata* ssp. *vaseyana - Symphoricarpos oreophilus* Shrubland	-*Artemisia tridentata* ssp. *vaseyana - Symphoricarpos oreophilus* Shrubland	1 : 1
ARTRV/ HERB	*Artemisia tridentata* ssp. *vaseyana /* Mixed Herbaceous Shrubland Complex	-*Artemisia tridentata* ssp. *vaseyana* / *Festuca idahoensis* Shrub Herbaceous Vegetation -*Artemisia tridentata* ssp. *vaseyana / Leucopoa kingii* Shrubland -*Artemisia tridentata* ssp. *vaseyana* / *Poa pratensis* Shrubland -*Artemisia tridentata* ssp. *vaseyana* /*Pseudoroegneria spicata* Shrubland	1 : Many
ARTR/BRTE	*Artemisia tridentata / Bromus tectorum - (Agropyron desertorum)* Semi-natural Shrubland Complex	-No NVC -Park Special	Park Special
CEVE	*Ceanothus velutinus* Shrubland	-*Ceanothus velutinus* Shrubland	1 : 1

Map Class Code	Map Class Name	NVC Association/Alliance(s) Assigned to Map Class (or Map Unit Description)	Relationship
CHVI	*Chrysothamnus viscidiflorus – (Ericameria nauseosa)* Shrubland Alliance	-*Chrysothamnus viscidiflorus* / *Agropyron desertorum* Shrub Herbaceous Vegetation -*Chrysothamnus viscidiflorus* / *Elymus lanceolatus – Poa secunda* Shrub Herbaceous Vegetation	1 : Many
PRVI	*Prunus virginiana - (Prunus americana)* Shrubland	-*Prunus virginiana* - (*Prunus americana*) Shrubland	1 : 1
PUTR	*Purshia tridentata / Pseudoroegneria spicata* Shrub Herbaceous Vegetation	-*Purshia tridentata / Pseudoroegneria spicata* Shrub Herbaceous Vegetation	1 : 1
SABO	*Salix boothii* / Mesic Forbs Shrubland	-*Salix boothii* / Mesic Forbs Shrubland	1 : 1
SYOR	*Symphoricarpos oreophilus* Shrubland	-*Symphoricarpos oreophilus* Shrubland	1 : 1
AGDE	*Agropyron desertorum* Semi-natural Herbaceous Vegetation	-No NVC -Park Special	Park Special
BRTE	*Bromus tectorum* Semi-natural Herbaceous Alliance	-*Bromus tectorum* Semi-natural Herbaceous Alliance	1 : 1
CANE	*Carex nebrascensis* Herbaceous Vegetation	-*Carex nebrascensis* Herbaceous Vegetation	1 : 1
ELLA	*Elymus lanceolatus* Herbaceous Alliance	-*Elymus lanceolatus* Herbaceous Alliance	1 : 1
POPR	*Poa pratensis - (P. bulbosa) - Juncus balticus* Semi-natural Herbaceous Vegetation Complex	-*Poa pratensis – Juncus balticus* Semi-natural Herbaceous Vegetation -*Poa bulbosa* Semi-natural Herbaceous Vegetation	1 : Many
PSSP	*Pseudoroegneria spicata* Herbaceous Alliance	-*Pseudoroegneria spicata - Poa secunda / Balsamorhiza sagittata* Herbaceous Vegetation -*Pseudoroegneria spicata – Festuca idahoensis* Canyon Herbaceous Vegetation	1 : Many

Map Class Code	Map Class Name	NVC Association/Alliance(s) Assigned to Map Class (or Map Unit Description)	Relationship
STRM	Stream / River	Natural linear drainage features	N/A
CANL	Canal / Ditch	Man-made linear water conveyance systems	N/A
POND	Lake / Pond	Natural and small human-made water impoundments	N/A
RESD	Residential	Single-family housing	N/A
AGRI	Agricultural Business	Ranch and farm facilities	N/A
ROAD	Transportation	Paved and earthen roads	N/A
TRANS	Transitional	Previously developed land, fallow fields, roadsides, slash piles, etc…	N/A
MINE	Quarries / Strip Mines / Gravel Pits	Sites disturbed by humans to extract sand, gravel, rock or other minerals	N/A
ROCK	Bare Rock / Sand / Other Bare Ground	Unvegetated rock outcrops, talus, etc…	N/A
FILD	Planted / Cultivated	Tilled and cropped agricultural fields	N/A
FACL	Park/Reserve Facilities	Visitor center, Housing, Maintenance Yard, etc.	N/A

Vegetation Map

The final CIRO vegetation map (Appendix G) consisted of 4,584 polygons totaling 40,088 acres (16,236 hectares) (Table 9). Average polygon size was 8.75 acres (3.5 hectares) that includes adjacent polygons that have the same map code but different density, height, or other attributes. The area within the supplied CIRO GIS boundary file totaled 14,543 acres* (5,890 hectares) or 36% of the total project area. The area within the supplied Castle Rocks State Park boundary (including the new expansion area) totaled 1,435 acres* (581 hectares) or 4% of the total project area. Of the total number of polygons, 79% represented vegetation map classes, 18% were rock outcrops (i.e. barren or very sparsely vegetated geology), and 3% were land use classes. The most common CIRO map class was the *Pinus monophylla* - (*Juniperus osteosperma*) / *Cercocarpus ledifolius* Woodland class (1,690 acres) (684 hectares) and Bare Rock / Sand / Other Bare Ground had the largest number of polygons (623 polygons). Within Castle Rocks State Park the most prevalent map class was *Artemisia tridentata* ssp. *vaseyana* - *Purshia tridentata* Shrubland Alliance (526 acres) (213 hectares) and the *Pinus monophylla* Woodland was the most frequent (37 polygons). Across the entire project area the *Artemisia tridentata* ssp. *vaseyana* / Mixed Herbaceous Shrubland Complex was the most abundant (5,957 acres) (2,413 hectares) and the Bare Rock / Sand / Other Bare Ground map class had the highest frequency with 855 polygons.

Table 9. Summary statistics for the CIRO map class polygons.

Map Code	Map Unit Description	Castle Rocks State Park			City of Rocks NR			Total Project Area		
		Polygon Count	Acres	Hectares	Polygon Count	Acres	Hectares	Polygon Count	Acres	Hectares
ABLA	*Abies lasiocarpa* / Sparse Woodland	0	0	0	13	68.8	27.8	64	653.8	264.8
CELE	*Cercocarpus ledifolius / Symphoricarpos oreophilus* Woodland	4	4.6	1.8	175	915.8	370.0	261	1497.0	606.3
PICO	*Pinus contorta* Woodland Alliance	0	0	0	1	2.2	0.9	1	2.2	0.9
PIFL	*Pinus flexilis* Woodland Alliance	0	0	0	11	56.9	23.0	13	63.3	25.6
PJ/SPRS	*Pinus monophylla - osteosperma* / Sparse Understory Woodland Complex	4	6.8	2.7	56	621.9	251.2	173	3710.4	1502.7
PJ/CELE	*Pinus monophylla - (Juniperus osteosperma) / Cercocarpus ledifolius* Woodland	25	84.2	34.0	205	1683.7	680.2	300	2881.3	1166.9
PIMO	*Pinus monophylla* Woodland	37	134.1	54.2	167	1336.0	539.7	289	2767.7	1120.9
POTR/GRASS	*Populus tremuloides* – (*Juniperus scopulorum*) / Dry Herbaceous Forest Complex	10	15.6	6.3	94	304.7	123.1	212	836.4	338.8
POTR/MESC	*Populus tremuloides* / Mesic Forest	1	1.0	0.4	73	259.8	104.9	97	375.7	152.2
PSME	*Pseudotsuga menziesii* / Acer glabrum Forest	0	0	0	13	135.6	54.8	15	149.0	60.3
POAL	*Populus alba* Woodland Stand	2	33.5	13.5	0	0	0	12	49.6	20.1
ALIN	*Alnus incana - Juniperus scopulorum* Shrubland	0	0	0	4	4.7	1.9	4	4.7	1.9
ARAR	*Artemisia arbuscula* ssp. *arbuscula* Shrub Herbaceous Alliance	8	12.0	4.8	79	323.1	130.5	205	1120.1	453.6
ARNO	*Artemisia nova* / *Pseudoroegneria spicata* Shrubland	2	2.9	1.2	19	160.7	64.9	31	209.2	84.7
ARTRT	*Artemisia tridentata* ssp. *tridentata* Shrubland Alliance	0	0	0	64	649.3	262.3	126	1258.7	509.8
ARTR-PUTR	*Artemisia tridentata* ssp. *vaseyana - Purshia tridentata* Shrubland Complex	19	526.0	212.5	138	1490.4	602.1	213	4275.0	1731.4
ARTRV	*Artemisia tridentata* ssp. *vaseyana - Symphoricarpos oreophilus* Shrubland	14	12.8	5.2	173	1320.4	533.5	290	2660.8	1077.6
ARTRV/HERB	*Artemisia tridentata* ssp. *vaseyana* / Mixed Herbaceous Shrubland Complex	25	103.3	41.8	165	1307.3	528.2	329	4143.7	1678.2
ARTR/BRTE	*Artemisia tridentata / Bromus tectorum* - (*Agropyron desertorum*) Semi-natural Shrubland Complex	1	58.7	23.7	33	471.3	190.4	96	1833.3	742.5
CEVE	*Ceanothus velutinus* Shrubland	0	0	0	17	27.5	11.1	36	103.1	41.8
CHVI	*Chrysothamnus viscidiflorus* – (*Ericameria nauseosa*) Shrubland Alliance	0	0	0	51	1449.8	585.7	90	3441.9	1394.0

Map Code	Map Unit Description	Castle Rocks State Park			City of Rocks NR			Total Project Area		
		Polygon Count	Acres	Hectares	Polygon Count	Acres	Hectares	Polygon Count	Acres	Hectares
PRVI	*Prunus virginiana - (Prunus americana)* Shrubland	1	1.1	0.4	20	24.6	9.9	27	33.4	13.5
PUTR	*Purshia tridentata / Pseudoroegneria spicata* Shrub Herbaceous Vegetation	4	37.4	15.1	1	13.9	5.6	11	217.7	88.2
SABO	*Salix boothii* / Mesic Forbs Shrubland	10	28.5	11.5	24	41.3	16.7	97	195.1	79.0
SYOR	*Symphoricarpos oreophilus* Shrubland	0	0	0	11	110.8	44.8	24	492.1	199.3
AGDE	*Agropyron desertorum* Herbaceous Vegetation	0	0	0	14	49.7	20.1	28	294.8	119.4
BRTE	*Bromus tectorum* Semi-natural Herbaceous Alliance	17	59.7	24.1	20	541.9	218.9	161	2237.4	906.1
CANE	*Carex nebrascensis* Herbaceous Vegetation	11	156.6	63.3	10	32.9	13.3	78	847.4	343.2
ELLA	*Elymus lanceolatus* Herbaceous Vegetation	0	0	0	2	20.2	8.2	2	20.2	8.2
POPR	*Poa pratensis - (Poa bulbosa) - Juncus balticus* Semi-natural Herbaceous Vegetation Complex	27	105.0	42.4	91	201.6	81.4	295	1782.7	722.0
PSSP	*Pseudoroegneria spicata* Herbaceous Alliance	0	0	0	8	33.9	13.7	20	173.2	70.1
STRM	Stream / River	5	2.1	0.8	17	22.0	8.9	35	63.7	25.8
CANL	Canal / Ditch	1	2.1	0.8	0	0	0	8	15.9	6.4
POND	Lake / Pond	0	0	0	5	1.3	0.5	13	3.4	1.4
RESD	Residential	0	0	0	2	0.7	0.3	2	0.7	0.3
AGRI	Agricultural Business	0	0	0	2	4.1	1.6	33	77.7	31.5
ROAD	Transportation	2	12.4	5.0	8	118.1	47.7	16	322.7	130.7
TRANS	Transitional	0	0	0	1	1.2	0.5	6	8.7	3.5
MINE	Quarries / Strip Mines / Gravel Pits	0	0	0	1	0.6	0.2	2	12.8	5.2
ROCK	Bare Rock / Sand / Other Bare Ground	35	32.2	13.0	623	731.1	295.4	856	1037.4	420.1
FILD	Planted / Cultivated	0	0	0	1	3.2	1.3	12	211.8	85.8
FACL	Park/Reserve Facilities	1	2.4	1.0	0	0	0	1	2.4	1.0
	Total Vegetation	222	1,384	559	1,752	13,661	5,519	3,600	38,331	15,524
	Total Barren Geology	35	32	13	623	731	295	856	1,037	420
	Total Land-Use/Land Cover	9	19	8	37	151	61	128	720	291
	Totals	**266**	**1,435***	**580**	**2,412**	14,543*	**5,875**	**4,584**	**40,088**	**16,236**

*Please note that the total acres for CIRO and Castle State Park as reported by the GIS analysis in the above table do not match the official acreages (14,543 vs. 14,407 and 1,435 vs. 1,440 acres, respectively). These discrepancies are likely due to the map scale of the GIS boundary layers vs. the actual surveyed boundaries.

Normally the standard minimum mapping unit for NPS vegetation mapping projects is defined as 0.5 hectare (1.24 acres). However, this is a nominal unit and due to the resolution of the imagery, it was reduced to ¼ acre (0.1 hectare) for wetland and other rare classes. This MMU size allowed for more detail in the mapping and allowed for better delineation of sites deemed important for CIRO management. The ability to recognize small patches of vegetation is reflected in the high number of polygons created and the average size of the polygons for some of the rarer types.

The CIRO vegetation map should more appropriately be considered a spatial database that also contains many additional polygon attributes not presented in the preceding table (i.e. density, height, and pattern). These data are difficult to convey in a table or on a two-dimensional map, but the different attributes can be combined in many ways and at different scales and resolutions to produce other products representing the full spectrum of vegetation diversity. For example, older, more mature stands of conifer trees can quickly be located by querying the GIS vegetation layer for the specific vegetation type and then reselecting only those polygons with high density (>60%) and the tallest height class (5-15 meters).

Figure 14 is an example of a fine scale (1:6,000-scale) CIRO vegetation map created from the GIS spatial database with the 2009 NAIP imagery as the background.

Accuracy Assessment

The 2010 AA yielded 597 points distributed throughout CIRO and Castle Rocks State Park. Using the AA GIS point file created from the AA point coordinates, three points were determined to have been either sampled in the wrong polygon or were located on a small inclusion of a different vegetation type. The three points were removed from further analysis and a preliminary error matrix was created and presented to UCBN and CIRO staff with recommendations on how to improve the map accuracy. Based on this review three map classes were reclassified to other map classes to improve individual map class accuracy (Table 10). All of the original linework was retained and the original map class name and dominant species information appears in the comments field in the CIRO vegetation layer.

Table 10. CIRO Map Class revisions based on the accuracy assessment.

Preliminary Map Class	Initial User's Accuracy	Reclassified Map Class	Final User's Accuracy
Juniperus scopulorum - Populus tremuloides Woodland	67%	*Populus tremuloides – (Juniperus scopulorum)* / Dry Herbaceous Forest Complex	92%
Ericameria nauseosa / Bromus tectorum Shrubland	69%	*Chrysothamnus viscidiflorus* – (*Ericameria nauseosa)* Shrubland Alliance	96%
Poa bulbosa Herbaceous Vegetation	0	*Poa pratensis - (Poa bulbosa) - Juncus balticus* Semi-natural Herbaceous Vegetation Complex	96%

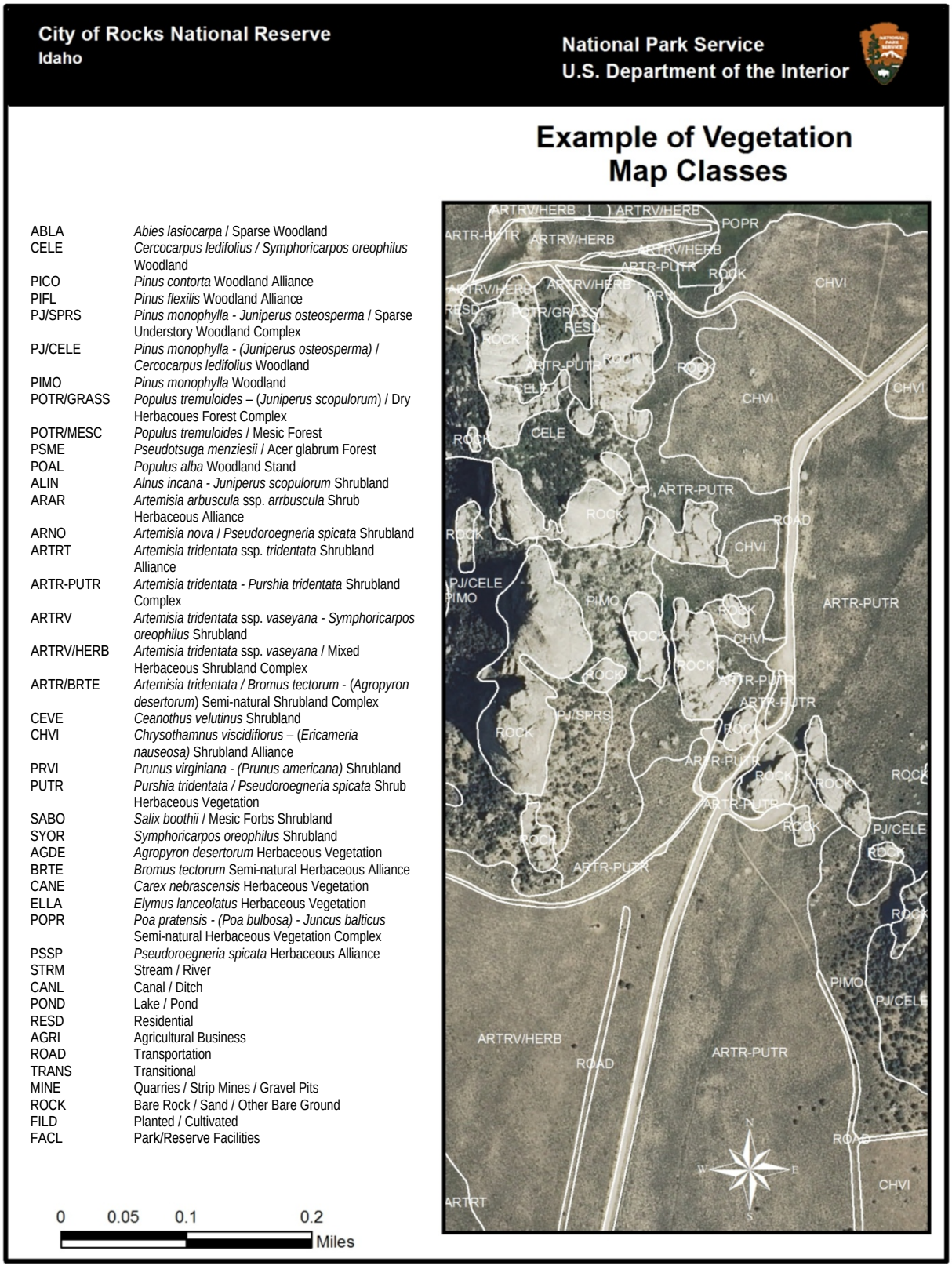


Figure 14. Example of the CIRO vegetation map layer.

The accuracy assessment analysis was repeated using the revised map classes and a final error matrix was created (Table 11). The final assessment revealed an overall accuracy of 88%.

Examination of the final error matrix showed concentrations of user's error among four map classes, likely reasons for this error are presented below:

1) Mountain big sagebrush map units (ARTRV and ARTRV/HERB) – caused by difficulty in seeing the understory species (especially mountain snowberry) on the imagery.
2) Basin big sagebrush shrublands (ARTRT) – map unit was confused with Mountain big sagebrush map units either due to similar signatures on the aerial imagery or the likelihood that these sub-species may hybridize causing identification issues;
3) Antelope bitterbrush (PUTR and ARTR-PUTR) – confused with the other sagebrush map units and with each other, a result of similar signatures, mixing of the dominant species, and/or borderline PUTR cover.
4) Desert wheatgrass (AGDE) – often occurred in disturbed sites and had a similar "weedy" signature as the yellow rabbitbrush and cheatgrass map classes; trends reflect a complicated mosaic of weedy species with inclusions or small areas of different dominant species.

General trends in the AA reveal the difficulty in obtaining sufficient numbers of AA points for very rare or small vegetation stands. Having few AA points decreases the confidence levels and makes it difficult to assume the accuracy of these classes with any certainty. Other trends in the AA are a result of using the true-color base imagery, including: (1) the difficulty in separating shrubland types with a cheatgrass understory vs. native grass understories, (2) the complexity of trying to accurately separate the different species and sub-species of sagebrush, and (3) attempting to reliably delineate different native and semi-native herbaceous vegetation types. Additionally, the differences/confusion between woodland and shrubland types can probably be explained by the difficulty in resolving the difference in scale and perspective between viewing vegetation on the imagery and assessing it on the ground. For example, field sampling could have occurred in large shrub inclusions or in canopy openings that were actually part of a larger woodland or wooded shrubland polygon.

Table 11. Final Contingency Table (Error Matrix) for CIRO.

		Observed AA Point (Reference AA Ground Data)																																					
	Map Class	ABLA	CELE	PICO	PIFL	PJ/ PSME	PJ/ CELE	PIMO	POTR/ GRASS	POTR/ MESC	PSME	POAL	ALIN	ARAR	ARNO	ARTRT	ARTR-PUTR	ARTRV	ARTRV-HERB	ARTR-BRTE	CEVE	CHVI	PRVI	PUTR	SABO	SYOR	AGDE	BRTE	CANE	ELLA	POPR	PSSP	Total	Users Accuracy	90% Conf. Interval -	90% Conf. Interval +
Predicted Map Class	ABLA	5	0	0	0	0	0	0	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	100%	90%	100%
	CELE	0	30	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	32	94%	85%	100%
	PICO	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	100%	50%	100%
	PIFL	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	100%	88%	100%
	PJ/PSME	0	0	0	0	22	1	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	26	85%	71%	98%
	PJ/CELE	0	0	0	0	4	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	90%	81%	99%
	PIMO	0	0	0	0	0	0	25	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	27	93%	82%	100%
	POTR/GRASS	0	0	0	0	0	1	0	24	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	92%	82%	100%
	POTR/MESC	0	0	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	32	94%	85%	100%
	PSME	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	100%	96%	100%
	POAL	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	100%	50%	100%
	ALIN	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	0	2	100%	75%	100%
	ARAR	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	22	87%	73%	100%
	ARNO	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	92%	74%	100%
	ARTRT	0	0	0	0	0	0	0	1	0	0	0	0	0	0	31	1	0	2	5	0	0	0	0	0	0	0	0	0	0	0	0	40	78%	65%	90%
	ARTR-PUTR	0	0	0	0	0	0	1	0	0	0	0	0	0	0	5	40	3	2	0	0	0	0	1	0	0	0	0	0	0	0	0	52	77%	66%	87%
	ARTRV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	39	15	0	0	0	0	0	0	0	0	0	0	0	0	0	56	70%	59%	81%
	ARTRV/HERB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	36	1	0	0	0	0	0	0	0	0	0	0	0	0	40	90%	81%	99%
	ARTR/BRTE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	17	82%	64%	100%
	CEVE	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%	75%	100%
	CHVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	51	0	0	0	1	1	0	0	0	0	0	53	96%	93%	100%
	PRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	100%	83%	100%
	PUTR	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	4	75%	27%	100%
	SABO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	17	100%	97%	100%
	SYOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	6	100%	92%	100%
	AGDE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	0	0	0	0	0	4	75%	27%	100%
	BRTE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	17	0	0	0	0	19	89%	75%	100%
	CANE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	1	0	11	91%	72%	100%
	ELLA	0	0	0	0	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	100%	50%	100%
	POPR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	0	23	96%	86%	100%
	PSSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	3	100%	83%	100%
	Total	5	30	1	4	26	39	28	25	31	13	1	2	21	11	42	43	44	59	20	2	54	3	4	17	9	4	17	10	1	23	5	594 Total Points		86%	90%
	Producers Accuracy	100%	100%	100%	100%	85%	92%	89%	96%	97%	100%	100%	100%	95%	100%	74%	93%	89%	61%	70%	100%	94%	94%	75%	100%	67%	75%	100%	100%	100%	96%	75%	522 Correct Points		Overall 90% Conf. Intervals	
	90% Conf. -	90%	98%	50%	88%	71%	84%	78%	92%	90%	96%	50%	75%	85%	95%	61%	85%	80%	50%	51%	75%	90%	83%	27%	97%	35%	27%	97%	95%	50%	86%	27%	85% Kappa Index			
	90% Conf. + Level	100%	100%	100%	100%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	86%	100%	98%	72%	89%	100%	100%	100%	100%	98%	100%	100%	100%	100%	100%	100%	100%	88% Overall Accuracy			

Notes: Three points were removed from analysis since they either fell into the wrong polygon or were located on small inclusions.

Instruction on Using the Accuracy Assessment Contingency Table: The contingency table or error matrix presents an array of numbers set out in rows and columns corresponding to a particular vegetation map unit relative to the actual vegetation type as verified on the ground. The column headings represent the vegetation classification as determined in the field and the row headings represent the vegetation classification taken from the vegetation map. The highlighted diagonal indicates the number of points assessed in the field that agree with the map label. Conversely, the inaccuracies of each map unit are described as both errors of inclusion (user's or commission errors) and errors of exclusion (producer's or omission errors). By reading across this table (i.e., rows) one can calculate the percent error of commission, or how many polygons for each map unit were incorrectly labeled when compared to the field data. By reading down the table (i.e., columns) one can calculate the percent error of omission, or how many polygons for that type were left off the map. Numbers "on the diagonal" tell the user how well the map unit was interpreted and how confident they can be in using it. Numbers "off the diagonal" yield important information about the deficiencies of the map including which types were: 1) over- mapped - commission errors on the right –more of this type was mapped than occurs at the site or 2) under-mapped - omission errors on the bottom – some of this type was mapped as other map units.

Discussion

City of Rocks National Reserve located in southern Idaho features the northernmost extension of Basin and Range phsiography and the northernmost distribution of singleaf pinyon pine in addition to internationally known and recreationally valuable granite outcrops. Adjacent to the park is a mix of private ranches, federally-managed forest and range land, and state-managed recreation resources. The geologic exposures, steep slopes, soil development patterns, and land use patterns resulted in moderate challenges to the classification and mapping effort. Challenges included some logistical considerations for field work due to working on exposed geologic formations, steep slopes, and negotiating passage through the Reserve. The inventory process described in this report although largely successful revealed opportunities for improvement that are discussed herein.

Approaches that worked well: Field data and local descriptions of the plant associations provided by project ecologists were extremely important ancillary data sources used by the GIS contractor to delineate map classes. The high-quality field data provided valuable on-site information for photo signature development and the high to moderate density of the plots provided a strong baseline to build the entire mapping model. Timely and high resolution base imagery is also essential to produce detailed and accurate maps. For mapping, the 2009 NAIP imagery was important to this project, providing a timely, high resolution base product that resulted in a recent final map and likely increased the overall accuracy.

Areas for Improvement: Inherent to all vegetation mapping projects is the need to produce both a consistent vegetation classification and a comprehensive set of map units. Typically, the systems are very similar, but when using a national classification such as the NVCS there is usually not a strict 1:1 correspondence. Nonconformity is due to the remote sensing nature of the interpretation and its ability to delineate map units based only on photo signatures. Subtle vegetation characteristics that can be seen on the ground are not necessarily the same as those apparent on the imagery. Canopy closure, shadows, soil reflections and the timing of the imagery acquisition can all impact the vegetation signatures. In the future if a more detailed map or classification is needed, especially for the complex sagebrush and herbaceous types, more field-based ground-truthing work could be concentrated or focused within selected units. Similarly, if more precision is needed for the delineation of the non-native versus native grass/graminoid vegetation types, new imagery (preferably color infrared) could be acquired at specific times to capture the highest degree of contrast between these types (i.e. cheatgrass purple/yellow phases).

Field Survey

The vegetation classification data driving this project should be used as the baseline from which to begin future vegetation studies. New field survey work in a judicious timeframe would improve both the classification (plant association descriptions) and mapping (refined linework) efforts. Using the accuracy assessment as a guide, map classes with lower accuracy could be further surveyed and boundaries delineated in the field to create a more accurate GIS layer. While it may appear that there are a large number of plant associations and vegetation alliances described for the study area, some were only minimally sampled likely due to access limitations. For example, some of the herbaceous vegetation types could be examined throughout the growing season to document both the cool and warm season species in order to refine their stand

composition. Also, accessing neighboring lands would allow new classification plot samples to be obtained increasing the confidence in these types, thereby strengthening the classification.

Classification

The main classification challenge within CIRO is documenting changes to plant life caused by drought, wildfire, erosion of geologic features by wind, water, and mass wasting associated with steep slopes, prescribed burns, agricultural pressures (grazing, non-native plantings), and other anthropogenic disturbance. Changes can include reduction of tree and shrub cover or outright removal and spread of invasive plant species. At all times, but especially after these events, new data should be collected to document vegetation changes over time. Overall, more specialized and targeted data collection in affected areas would help to document any changes and would greatly increase the understanding of the landscape in general.

Of special consideration for future CIRO classification refinement would be the interesting mix of native graminoids, non-native grasses, and characteristic shrubs. All three types form intricate associations/ecotones with much species overlap among the dominants. From a management perspective it is likely that broader groupings are desirable since the characteristic species in each type exhibit similar growth patterns and would respond similarly to preservation and control efforts. The complex nature of these types makes it more difficult to accurately classify the dominant species into discrete and meaningful associations. More classification work concentrating on abiotic and environmental aspects including characteristic soil types, habitats, and disturbance patterns may improve the ability to determine when single species should form separate associations and when they should be grouped with other similar species.

Digital Imagery and Mapping

The vegetation map for CIRO was based primarily on the 2009 NAIP ortho-imagery. Therefore, all of the resulting mapping products correspond to the summer of 2009 timing of the image acquisition (i.e. snapshot in time). As the data are used, it should be remembered that fires and other changes to the landscape since 2009 are not included in this product. In the future it might be beneficial to update the map with newer imagery and GPS coordinates (perimeters) for major events (e.g. wildfire perimeters, mass wasting events, etc).

Accuracy Assessment

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

Actual errors in the mapping likely stemmed from limitations within the ortho-photography as previously described, natural changes in the vegetation between sampling and the acquisition date of the imagery, errors in the field key, or the difficulty in establishing an overhead perspective to exactly match the ground view. Although the accuracy for CIRO assessed moderate to high, improvements can be made and users should fully explore and understand the sources of error as presented in the error matrix.

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

Future Recommendations

This project represents the best efforts of a multi-disciplinary team over a short time period. In order to create the best possible "long-term" vegetation classification for CIRO and the most accurate and detailed GIS layer, this project should be viewed as a place to start or baseline rather than an end product. In other words, present and future NPS staff should be encouraged to scrutinize this project, building from its strengths and bolstering its weaknesses. One example would be to periodically perform field checking by examining the map in the field (use qualified NPS or contract staff), document changes, and incorporate changes into newer versions. Realizing that this project represents a snapshot in time, future research can help to understand the vegetation in and around CIRO and changes over time. The products presented herein will help direct future vegetation and land-use monitoring and management, as follows:

1. The diversity of plant species and dynamic nature of CIRO with respect to grazing, erosion, outside influences, and fire warrants periodic **field surveys** by experienced ecologists. Working with and sampling plant communities established in the project environs would be beneficial; in this way new plant associations could be discovered, existing vegetation types could be updated, and integrated pest management strategies could be expanded. All new information could be used to update both the GIS map layer (i.e. better delineation) and the classification (i.e. new associations).

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

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

4. For monitoring purposes, **change over time** could be addressed by similar remote sensing projects. New imagery acquired at regular intervals could be used to create up-to-date vegetation layers that could be overlain on this vegetation and land-use baseline layer. Any changes between the two layers could be extracted and analyzed. Also periodically and immediately following events causing vegetation change, new data should be collected and analyzed. New vegetation map layers should be prepared as the base map becomes out-dated over time. Overall more specialized and targeted data collection in affected areas would help to document changes.

5. In the future, resource management personnel could link the habitat for **species of concern** to specific associations and map units. These map units could be used to help locate potential sites of rare, endangered, or threatened species and communities in the field or identify areas for non-native plant removal or treatment. Known populations and individual species of concern locations can be overlain using point or small polygon layers.

Research Opportunities

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

Literature Cited

Aho, K., and A.D. Forman. 2010. Classification of City of Rocks National Reserve vegetation data to support the vegetation mapping program: City of Rocks National Reserve. Natural Resource Technical Report NPS/UCBN/NRTR—2010/313. National Park Service, Fort Collins, Colorado.

Anderson, J.R., E. Hardy, J. Roach, and R. Witter. 1976. 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.

Daubenmire, R. 1959. A canopy-coverage method of vegetational analysis. Northwest Science. 23: 69-82.

Davey, C. A., K. T. Redmond, and D. B. Simeral. 2006. Weather and Climate Inventory, National Park Service, Upper Columbia Basin Network. Natural Resource Technical Report NPS/UCBN/NRTR—2006/012. National Park Service, Fort Collins, Colorado.

Federal Geographic Data Committee [FGDC]. 1997. Vegetation classification standard. Online, http://www.fs.fed.us/research/fgdc/fgdcindex2.htm. Accessed 1 May 2010.

Federal Geographic Data Committee. 1998. Content standard for digital geospatial metadata, FGDC-STD-001-1998. Online: http://www.fgdc.gov/standards/projects/FGDC-standards-projects/metadata/base-metadata. Accessed 1 May 2010.

Federal Geographic Data Committee. 2008. National Vegetation Classification Standard (Version 2). Document # FGDC-STD-005. Online, http://www.fgdc.gov/standards/projects/FGDC-standards-projects/vegetation. Accessed 1 May 2010

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

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.

Hansen, M., J. Coles, K. Thomas, D. Cogan, M. Ried, J. Von Loh, and K. Schulz. 2004. USGS-NPS National Vegetation Mapping Program: Wupatki National Monument, Arizona, Vegetation Classification and Distribution. Final Report. U.S. Geological Survey Southwest Biological Science Center. Flagstaff, AZ.

Holdridge, L.R. 1967. Life zone ecology. Tropical Science Center. San periment Station, Fort Collins, CO. Jose, Costa Rica.

Jennings, M.D., D. Farber-Langendoen, R.K. Peet, O.L. Loucks, D.C. Glew-Lewin, A. Damman, M.G. Barbour, R. Pfister, D.H. Grossman, D. Roberts and others. 2006. Description, documentation and evaluation of association and alliances within the U.S. National Vegetation Classification, Version 4.5. Ecological Society of America, Vegetaion Classification Panel, Washington D.C.

John, T. 1995. Vascular Plants of City of Rocks, An Annotated Checklist. Boise, ID. Available online at: https://irma.nps.gov/App/Reference/Profile/141052.

Lea, C. and A. C. Curtis. 2010. Thematic accuracy assessment procedures: National Park Service Vegetation Inventory, version 2.0. Natural Resource Report NPS/2010/NRR—2010/204. National Park Service, Fort Collins, Colorado.

Merriam, C. H. (1898). Life zones and crop zones of the United States. US Department of Agriculture, Division of Biological Survey Bulletin 10, Washington, D.C.

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, U.S. Department of the Interior. 2005. City of Rocks National Reserve, Fire Management Plan. 198 pp. September 30, 2005.

National Park Service. 2007. City of Rocks National Reserve Foundation Statement. Available online at: http://www.nps.gov/ciro/parkmgmt/upload/CIRO%20Foundation%20Statement%202007.pdf

National Park Service, U.S. Department of the Interior and Idaho Department of Parks and Recreation. 2008. City of Rocks National Reserve, Grazing Management Plan. 79 pp. Contribution Number 1019 of the Idaho Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow, ID.

National Park Service. 2011. City of Rocks National Reserve Website. Retrieved September 9, 2011, from http://www.nps.gov/ciro/index.htm

Natural Resources Conservation Service (Soil Conservation Service). 1994. Soil Survey of Cassia County, Idaho, Eastern Part. H.R. Noe and F.R. Kukachka. In cooperation with: USDI-Bureau of Land Management; Idaho Soil Conservation Commission; and University of Idaho, College of Agriculture.

NatureServe Explorer. 2011. An online encyclopedia of life [Web application]. Version 7.0. Arlington, VA. Online: http://www.natureserve.org/explorer, Accessed April 2011.

Rust, S. K. and P. Wolken. 2008. Classification of the Plant Communities of Craters of the Moon National Monument and Preserve, Idaho. Natural Resource Technical Report, NPS/UCBN/NRTR – 2008/096. National Park Service, Fort Collins, CO.

Salas, D., J. Stevens, and K. Schulz. 2004. USGS-NPS National Vegetation Mapping Program: Rocky Mountain National Park. Final Report. U.S. Bureau of Reclamation Remote Sensing and GIS Group Technical Memorandum 8260-05-02. Denver, CO.

Sanders, K. D., S. C. Bunting, and R. G. Wright. 1996. Development of a grazing management plan for City of Rocks National Reserve. University of Idaho Forest, Wildlife and Range Experiment Station, Moscow, ID.

Smith, D.M., R.L. Armstrong, D.R. Bedford, and M. Davis. 2008. Geologic map and digital database of the Almo quadrangle and City of Rocks National Reserve, Cassia County, Idaho. USGS Open file report 2008-1103. 36 pp. Scale 1:24,000.

Strand, E. K., S. C. Bunting, R. K. Steinhorst, L. K. Garrett, and G. H. Dicus. 2009. Upper Columbia Basin Network Aspen Monitoring Protocol Version 1.0. National Park Service. Natural Resource Report NPS/UCBN/NRR—2009/147. National Park Service, Fort Collins, Colorado.

The Nature Conservancy and Environmental Systems Research Institute [TNC and ESRI]. 1994a. NBS/NPS Vegetation Mapping Program: Final Draft, Standardized National Vegetation Classification System. Prepared for USDI – National Biological Survey and National Park Service. 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.

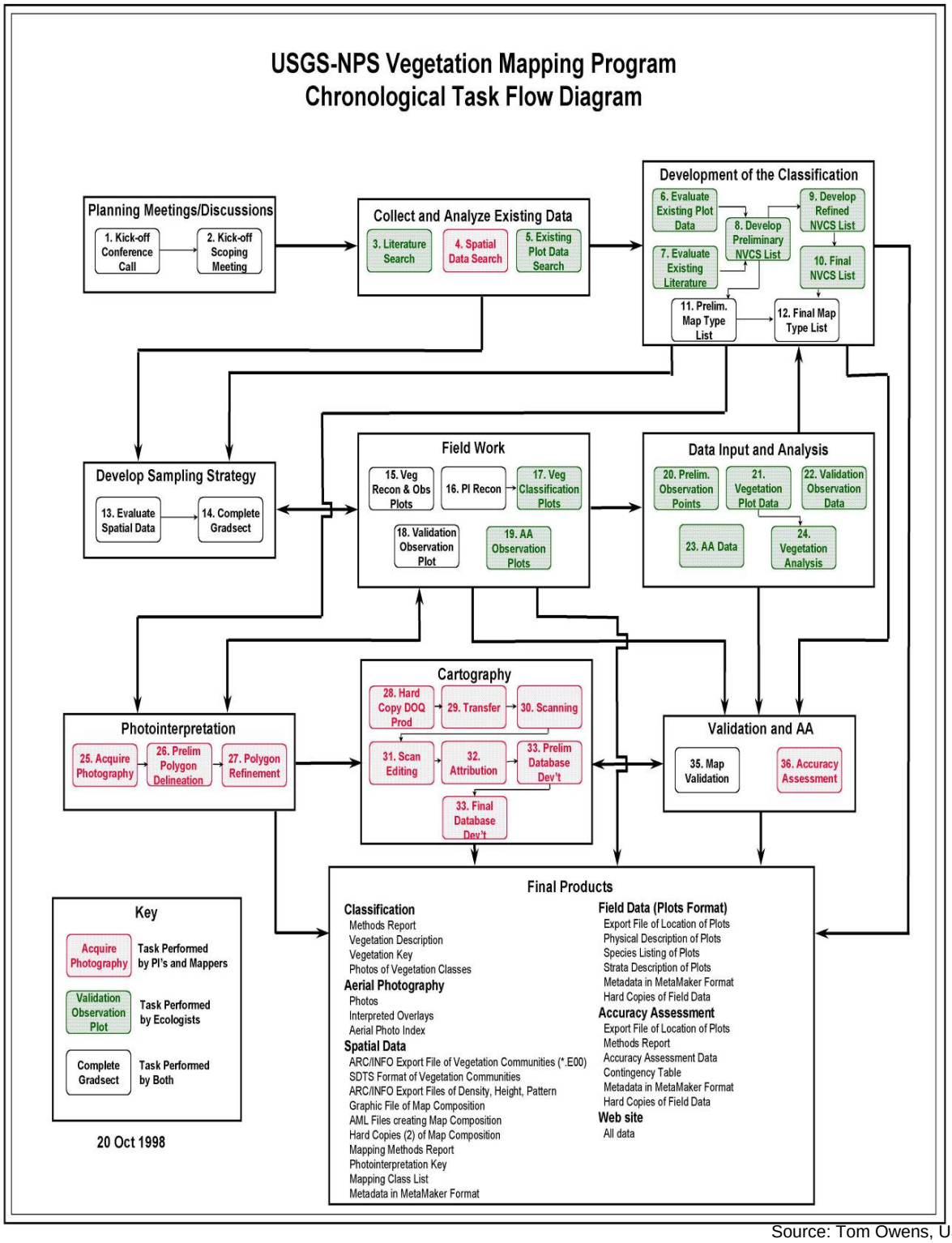
The Nature Conservancy and Environmental Research Systems Institute. 1994c. NBS/NPS Vegetation Mapping Program: Accuracy Assessment Procedures. Arlington, VA.

University of Idaho. 2011. Idaho's Champion Big Tree List. Idaho Big Tree Program. Moscow, ID.

U.S. Department of Agriculture, Natural Resources Conservation Service. 2007. The PLANTS Database. Online, http://plants.usda.gov. Accessed 1 May 2006.

Western Region Climate Center. 2011. Climate Data for Oakley, ID, 1893-2010 (Station 106542). Accessed online at: http://www.wrcc.dri.edu/.

Appendix A - Components and Flow Diagram of the Vegetation Inventory Program



Source: Tom Owens, USGS

Appendix B - Field Data Forms and Instructions

IDENTIFIERS/LOCATORS

Plot Code
Code indicating the specific plot within the vegetation polygon.

Surveyors
Names of surveyors, with principal surveyor listed first.

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

BPU Code
The biophysical unit identified.

Provisional Community Name
Using the provisional classification of the park that was provided, assign the name of the vegetation type which most closely resembles this type. Enter the finest level of the classification possible. If it's a new type, name it based on the two or three most dominant species in the plot.

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

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

GPS Rover File
Record the number of the file from the GPS unit.

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

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

Error
Error is recorded from the GPS unit.

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

Vegetation Class	Standard Plot Dimensions	PLOT AREA
Forest	20 m x 20 m	400 m^2
Woodland	20 m x 20 m	400 m^2
Shrubland	20 m x 20 m	400 m^2
Dwarf-shrubland (heath)	10 m x 10 m	100 m^2
Herbaceous	10 m x 10 m	100 m^2
Nonvascular	5 m x 5 m	25 m^2

Photo numbers
If photos of the plot have been taken at the time of sampling, indicate their numbers from the ones the camera assigns.

Plot Permanent
Note if the plot has been permanently marked.

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

ENVIRONMENTAL DESCRIPTION

Elevation
Elevation of the plot obtained from the GPS

Slope
Measure the slope in percent using a clinometer.

Aspect
Measure the aspect using a compass (be sure compass is set to correct for the magnetic declination).

Topographic Position
Choose one:

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

SHOULDER (shoulder slope, upper slope, convex creep slope). Geomorphic component that forms the uppermost inclined surface at the top of a slope. Includes the transition zone from backslope to summit. Surface is dominantly convex in profile and erosional in origin.

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

FOOTSLOPE (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 backslope and toeslope.

TOESLOPE (alluvial toeslope). Outermost gently inclined surface at base of a slope. In profile, commonly gentle and linear and characterized by alluvial deposition.

TERRACE Valley floor or shoreline representing the former position of an alluvial plain, lake, or shore.

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

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

Describe Topographic Position (Optional)
Give more details here, if needed.

Cowardin System

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

- Riverine: Below the high water mark on a moving water system (a creek bed). A community of *Eleocharis* on a sand bar would be in this category.
- Palustrine: In the riparian zone. Plants regularly have wet roots through much of the summer. A community of willows and sedges would be in this category.
- Lacustrine: Below the high water mark of a lake. The marshy debris on the edge of a lake would be in this category.

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

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

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. Includes Cowardin's Intermittently Exposed and Semipermanently Flooded modifiers.

SEASONALLY FLOODED - Surface water is present for extended periods during the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases and is very variable, extending from saturated to a water table well below the ground surface. Includes Cowardin's Seasonal, Seasonal-Saturated, and Seasonal-Well Drained modifiers.

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

TEMPORARILY FLOODED - Surface water present for brief periods during growing season, but water table usually lies well below soil surface. Often characterizes floodplain wetlands. Equivalent to Cowardin's Temporary modifier.

INTERMITTENTLY FLOODED - Substrate is usually exposed, but surface water can be present for variable periods without detectable seasonal periodicity. Inundation is not predictable to a given season and is dependent upon highly localized rain storms. This modifier was developed for use in the arid West for water regimes of Playa lakes, intermittent streams, and dry washes, but can be used in other parts of the U.S. where

appropriate. This modifier can be applied to both wetland and non-wetland situations. Equivalent to Cowardin's Intermittently Flooded modifier.

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

Unvegetated Surface
Estimate the approximate percentage of the *total* surface area covered by each category.

Soil Texture
Using the key below, assess average soil texture.

Simplified Key to Soil Texture
Soil does not remain in a ball when squeezed.....sand
Soil remains in a ball when squeezed.....2

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

2. Soil makes no ribbon.....……..……loamy sand
2. Soil makes a ribbon (may be very short).....3

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

Add excess water to small amount of soil:

4. Soil feels smooth.....silt loam
4. Soil feels at least slightly gritty……...……..…5

Squeeze a moistened ball:

5. Cast is formed which can be handled CAREFULLY without breaking…..……. sandy loam
5. Cast is formed which can be handled FREELY without breaking…… ……loam

3. Ribbon extends 1 inch or more before breaking.....6

5. Soil makes a ribbon that breaks when 1 to 2 inches long; cracks if bent into a ring.....7

Add excess water to small amount of soil:

7. Soil feels at least slightly gritty…….....clay loam
7. Soil feels smooth.....silt

6. Soil makes a ribbon 2+ inches long; does NOT crack when bent into a ring…… 8

Add excess water to a small amount of soil:

8. Soil feels at least slightly gritty.....……..clay
8. Soil feels smooth.....silty clay

In the field, soil texture is determined by the feel of a moist soil when it is rubbed between the thumb and fingers. While sand particles feel gritty, silt particles have a smooth velvety feel and clay is both sticky and plastic, an estimate of the relative proportions of the separates may be made. This procedure, of course, will not give the exact percentage of sand, silt, and clay, but, with a little practice on samples of known composition, the relative proportions of the individual separates can be closely estimated. Practice with known samples is the only way to acquire this knowledge.

The outstanding physical characteristics of the main textural grades as determined by the feel of the soil are described below.

1. Sandy Soil. A sandy soil is loose and single grained. The individual grains can be seen readily or felt. Squeezed in the hand when dry, it will fall apart when pressure is released. Squeezed when moist, it will form a cast, but will crumble when touched.

2. Sandy Loam Soil. A sandy loam soil contains much sand, but has enough silt and clay to make it somewhat coherent. Individual sand grains can be easily seen and felt. Squeezed when dry, it will form a cast which will readily fall apart; but if squeezed when moist a cast can be formed which will bear careful handling without breaking.

3. Loam Soil. A loam soil is about an equal mixture of the sand and silt with the clay content being between 7 and 27 percent. A loam is mellow with a somewhat sandy feel, yet fairly smooth and slightly plastic. Squeezed when moist, it will form a cast which can be handled freely without breaking.

4. Silt Loam Soil. A silt loam soil, when dry, may appear cloddy, but lumps are readily broken, and when pulverized, it feels soft and floury. When wet, the soil readily runs together. Either dry or moist, it will form casts which can be handled freely without breaking, but when moistened and extruded between the thumb and fingers, it will not form a ribbon, but will give a broken appearance.

5. Clay Loam Soil. A clay loam soil is fine-textured and usually breaks into clods or lumps that are hard when dry. When moist and extruded between the thumb and fingers, it will form a thin "ribbon" which will break readily, barely sustaining its own weight. The moist soil is plastic and will form a cast that will bear much handling. When kneaded in the hand, it does not crumble readily, but tends to work into a heavy, compact mass.

6. Clay Soil. A clay soil is fine-textured and usually forms very hard lumps or clods when dry and is plastic and sticky when wet. When the moist soil is ribboned out between the thumb and fingers, it will form a long flexible strip. A clay soil leaves a "slick’ surface on the thumb and fingers when rubbed together and tends to hold the thumb and fingers together due to the stickiness of the clay.

The characteristics described above are suggestive only, and will only apply to a group of similar soils. The characteristics of clay vary with the kind of clay mineral. For this reason, textural grades may exhibit different properties from region to region. For instance, clays of the montmorillonite group are very sticky and plastic; those of the oxide group are plastic and waxy with relatively little stickiness.

The preceding discussion has been directed to those soil particles whose diameters are less than 2 millimeters--the sands, silts, and clays. Soils may also contain larger sized particles that may be collectively called coarse fragments. These large particles may on occasion exceed the smaller soil particles in volume.

Soil Drainage

The soil drainage classes are defined in terms of (1) actual moisture content (in excess of field moisture capacity) and (2) the extent of the period during which excess water is present in the plant-root zone. It is recognized that permeability, level of groundwater, and seepage are factors affecting moisture status. However, because these are not easily observed or measured in the field, they cannot generally be used as criteria of moisture status. It is further recognized that soil profile morphology, for example mottling, normally, but not always, reflects soil moisture status. Although soil morphology may be a valuable field indication of moisture status, it should not be the overriding criterion. Soil drainage classes cannot be based solely on the presence or absence of mottling. Topographic position and vegetation as well as soil morphology are useful field criteria for assessing soil moisture status.

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.

MODERATELY WELL DRAINED - The soil moisture content is in excess of field capacity for a small but significant period of the year.

POORLY DRAINED - The soil moisture content is in excess of field capacity in all horizons for a large part of the year.

VEGETATION DESCRIPTION

Leaf Phenology

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

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

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

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

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

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

Leaf Type

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

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

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

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

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

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

Physiognomic Class

Choose one:

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

Woodland: Open stands of trees with crowns not usually touching (generally forming 25-60% cover). Canopy tree cover may be less than 25% in cases where it exceeds shrub, dwarf-shrub, herb, and nonvascular cover.

Shrubland: Shrubs generally greater than 2.5 feet tall with individuals or clumps overlapping to not touching (generally forming more than 25% cover, trees generally less than 25% cover). Shrub cover may be less than 25% where it exceeds tree, dwarf-shrub, herb, and nonvascular cover.

Dwarf-Shrubland: Low-growing shrubs usually under 2.5 feet tall. Individuals or clumps overlapping to not touching (generally forming more than 25% cover, trees and

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

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

Nonvascular: Nonvascular cover (bryophytes, non-crustose lichens, and algae) dominant (generally forming at least 25% cover). Nonvascular cover may be less than 25% where it exceeds tree, shrub, dwarf-shrub, and herb cover.

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

Strata, Height Class, Cover Class, Diagnostic Species

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

Trees are defined as single-stemmed woody plants, generally 15 feet in height or greater at maturity and under optimal growing conditions. Shrubs are defined as multiple-stemmed woody plants generally less than 15 feet in height at maturity and under optimal growing conditions.

List the dominant species in each stratum.

Animal Use Evidence

Comment on any evidence of wildlife (i.e., tracks, scat, gopher or prairie dog mounds, etc.). Notes on domestic animals should be made in the field below.

Natural and Anthropogenic Disturbance

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

Environmental Comments

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

Other Comments

Any miscellaneous comments.

Species/Strata/Percent Cover Table

The main use of the strata information is to categorize the plots by life form, in order to subset the data into forest, woodland, shrublands, and herbaceous plots for analysis. It is imperative that things be called the same throughout the data set.

Starting with the uppermost stratum, list all the species present and their cover class using the scale provided below. If a species is in the tree layer (single-stemmed woody plants, generally 15 feet in height or greater at maturity), list whether it is T1 (emergent tree), T2 (tree canopy), or T3 (tree sub-canopy). If a species is in the shrub layer, note if S1 (tall shrub), or S2 (short shrub), or S3 (dwarf shrub). If in the ground layer, note if H (herbaceous) or N (nonvascular). Some species will be in more than one layer. For example, Cottonwoods might have one or two especially tall specimens, which would be in the T1 (emergent tree) layer. Then the majority of the mature trees would be in T2 (tree canopy). The saplings that are coming up in the understory would be in the T3.

Seedlings are defined as trees less than “breast height” or less than 4.5 feet tall. Seedlings between knee height and breast height should be labeled as being in the short shrub layer (S2), and those below knee height should be labeled as being in the dwarf shrub layer (S3).

Cover Scale for Species Percent Cover

Use the cover scales provided on the forms.

NATIONAL PARK VEGETATION MAPPING PROGRAM: PLOT SURVEY FORM

IDENTIFIERS/LOCATORS

Plot Code_____ Polygon Code_____
Provisional Community Name_____
State ___ Park Name_____ Park Site Name_____
Quad Name_____ Quad Code_____
GPS file name_____ Field UTM X___ ___ ___ ___ ___ ___ m E Field UTM Y___ ___ ___ ___ ___ ___ ___ m N Error +/-_____ m *please do not complete the following information when in the field* Corrected UTM X___ ___ ___ ___ ___ ___ m E Corrected UTM Y___ ___ ___ ___ ___ ___ ___ m N UTM Zone_____
Survey Date_____ Surveyors_____
Directions to Plot
Plot length_____ Plot width_____ Plot Photos (y/n) ___ Roll Number _____ Frame Number _____ Plot Permanent (y/n) ____
Plot representativeness

ENVIRONMENTAL DESCRIPTION

Elevation _____ Slope _____ Aspect_____
Topographic Position
Landform
Surficial Geology

Cowardian System ___Upland ___Riverine ___Palustrine ___Lacustrine	Non-Tidal ___Permanently Flooded ___Semipermanetly Flooded ___Seasonally/Temporarily Flooded	___Saturated ___Seasonally Flooded/Saturated ___Intermittently Flooded	

Environmental Comments:	Soil Taxon/Description
	Unvegetated Surface: *(please use the cover scale on next page)* ___ Bedrock ___ Litter, duff ___ Wood (> 1 cm) ___ Large rocks (cobbles, boulders > 10 cm) ___ Small rocks (gravel, 0.2-10 cm) ___ Sand (0.1-2 mm) ___ Bare soil ___ Other:_____
Soil Texture ___ sand ___ loamy sand ___ sandy loam ___ loam ___ silt loam ___ silt ___ clay loam ___ silty clay ___ clay ___ peat ___ muck	Soil Drainage ___ Rapidly drained ___ Well drained ___ Moderately well drained ___ Somewhat poorly drained ___ Poorly drained ___ Very poorly drained

VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	Leaf Type (of dominant stratum)	Physiognomic class	Cover Scale for Strata & Unvegetated Surface		Height Scale for Strata	
<u>Trees and Shrubs</u>	___Broad-leaved	___Forest	01	5%	01	<0.5 m
___Evergreen	___Needle-leaved	___Woodland	02	10%	02	0.5-1m
___Cold-deciduous	___Microphyllous	___Shrubland	03	20%	03	1-2 m
___Drought-deciduous	___Graminoid	___Dwarf Shrubland	04	30%	04	2-5 m
___Mixed evergreen - cold-deciduous	___Forb	___Herbaceous	05	40%	05	5-10 m
___Mixed evergreen - drought-deciduous	___Pteridophyte	___Nonvascular	06	50%	06	10-15 m
		___Sparsely Vegetated	07	60%	07	15-20 m
<u>Herbs</u>			08	70%	08	20-35 m
___Annual			09	80%	09	35 - 50 m
___Perennial			10	90%	10	>50 m
			11	100%		

Strata	Height Class	Cover Class	Diagnostic species (if known)
T1 Emergent			
T2 Canopy			
T3 Sub-canopy			
S1 Tall shrub			
S2 Short Shrub			
H Herbaceous			
N Non-vascular			
V Vine/liana			
E Epiphyte			

please see above table for height and cover scales

Animal Use Evidence

Natural and Anthropogenic Disturbance Comments

Other Comments

Plot Code_____

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. Also for forests and woodlands, on a separate page **or** line below each tree species, list the DBH of all trees above 5 cm diameter. Separate measurements with a comma (note if measurements are from multi-stemmed tree). Put an asterisk next to any species that are known diagnostics for a particular community in the classification. **Also list species outside the plot at the end of the table or designate with a 0 in Cover Class column.**

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

Cover Class Scale

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

2009 ACCURACY ASSESSMENT POINT FORM – LAKE ROOSEVELT NATIONAL RECREATION AREA
UPPER COLUBIA BASIN NETWORK VEGETATION MAPPING PROJECT

IDENTIFIERS/LOCATORS

AA Plot Number: **LARO-AA.** __ __ __ __ AA Point Shape: circle other

Park Site Name _Lake Roosevelt National Recreation Area

Survey Date _____ Surveyor(s)_____

GPS Unit: Garmin Map 76 Datum NAD 83 UTM Zone: 11 Error +/-: _____ m

Camera Name and Model (circle one): Olympus Stylus FF-210 Other:_____

Camera #	Frame #	Photographer	Direction/Comments

PLANT ASSOCIATION INFORMATION

ASSOCIATIONS AT AA POINT	MAP UNIT AT AA POINT	New?	OTHER ASSOCIATIONS WITHIN 50 M OF AA POINT
Primary Name/Code	Map Code		1.
Secondary Name/Code			2.
Tertiary Name/Code			3.

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

Classification Comments: (complications, uncertainties, explanation of fair/poor representativeness)

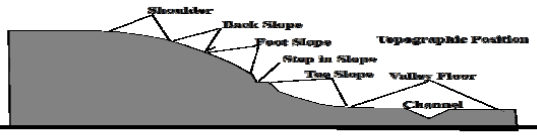
ENVIRONMENTAL DESCRIPTION

Elevation _____ m/ft From: GPS | Slope _____ Aspect_____

Topographic Position: **Circle One**

Interfluve Shoulder Backslope Footslope Toeslope Step in slope Valley floor Terrace Channel

Environmental Comments:



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

_____ Bedrock	_____ Large rocks (cobbles, boulders > 10 cm)	_____ Sand (0.1-2 mm)
_____ Litter, duff	_____ Small rocks (gravel, 0.2-10 cm)	_____ Bare soil
_____ Wood (> 1 cm)	_____ Nonvascular	_____ Other:_____

May 2009 – LARO AA Form

2009 ACCURACY ASSESSMENT POINT FORM – LAKE ROOSEVELT NATIONAL RECREATION AREA
UPPER COLUBIA BASIN NETWORK VEGETATION MAPPING PROJECT

VEGETATION DESCRIPTION

Leaf phenology (dominant stratum)	**Leaf Type (of dominant stratum)**	**Physiognomic Class**	**Height Class (m)**	**Cover Class**
Trees and Shrubs _____ Evergreen _____ Deciduous _____ Mixed evergreen - deciduous Herbs _____ Perennial _____ Annual	_____ Broad-leaved _____ Needle-leaved _____ Graminoid _____ Forb _____ Pteridophyte _____ Non Vascular _____ Mixed	Pick one ___ Forest ___ Woodland ___ Shrubland ___ Dwarf shrubland ___ Herbaceous ___ Nonvascular ___ Sparsely vegetated	T <1ft. 01 1-5ft. 05 5-15ft. 15 15-30ft. 30 >30FT	t < 0.5% T 0.5- 0.99% 01 1-1.9% 02 2-4.9% 05 5-9.9% 10 10-14% 15 15-24% 25 25-34% 35 35-49% 50 50-74% 75 75-94% 95 >95%

Strata	Height Class	Cover Class	2 - Dominant species (mark any known diagnostic species with a *)	Individual Species Cover
T1 Emergent	_____	_____	_____	_____
T2 Canopy	_____	_____	_____	_____
			_____	_____
			_____	_____
T3 Sub-canopy	_____	_____	_____	_____
			_____	_____
S1 Tall shrub	_____	_____	_____	_____
			_____	_____
			_____	_____
S2 Short Shrub	_____	_____	_____	_____
			_____	_____
			_____	_____
			_____	_____
S3 Dwarf-shrub	_____	_____	_____	_____
			_____	_____
H Herbaceous	_____	_____	_____	_____
			_____	_____
			_____	_____
			_____	_____
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)

May 2009 – LARO AA Form

Appendix C - Dichotomous Key to CIRO Plant Associations

Dichotomous Key to the Classification

The field key to plant communities for CIRO and environs follows. The key is structured into physiognomic classes (or lifeform groups). These classes do not constraint the classification *per se*; rather they are employed to assist in applying the classification. In the field, different expressions of a given plant association may occur as different physiognomic classes. Given this, associations may be found through multiple pathways within the key.

Use of the Key
To use the field key most effectively, identify a representative, homogeneous stand of vegetation. Work through the entire hierarchy of the key, beginning with *Key to Lifeform Groups*, to each sequential dichotomous lead. Estimate plant cover on an area of approximately 405 m^2. If a satisfactory determination is not made in stands with low total cover consider adjusting diagnostic species cover break-points downward. Assignment of individual species to lifeform follows USDA, NRCS (2007).

In the key the term *relative cover* is used. In this context relative cover refers to the proportional abundance of the given species (or group of species) with respect to the total abundance of the associated group. The value is calculated by dividing the percent cover of the species under consideration by the total cover of the respective group of species. For example, the relative cover of native graminoid species is calculated as follows: (sum of native graminoid species cover within the sample) / (total cover of all graminoids within the sample) = (relative native graminoid composition).

CIRO Plant Association Key

1a Trees are common to abundant, providing at least 10% absolute canopy cover

Forest and Woodland Vegetation Classes pg 92

1b Trees are absent to sparse; when present, individuals are scattered with less than 10% absolute canopy cover

2a Shrubs are common to dominant; herbaceous species may range from sparse to codominant

Shrubland and Shrub Herbaceous Vegetation Classes pg 93

2b Herbaceous species clearly dominate the plant community; shrubs may be present, but don't contribute substantial cover

Herbaceous Vegetation Classes pg 96

Forest and Woodland Vegetation Classes

1a Dominant tree species are evergreen

2a Dominant tree species are cylindrical- or conical-crowned, occur at higher elevations, and/or where environmental conditions tend to be cooler and more mesic

3a *Abies lasiocarpa* dominates the tree canopy

Vegetation Class 37: ABLA / Sparse

3b *Pseudotsuga menziesii* dominates the tree canopy

Vegetation Class 35: PSME / ACGL

2b Dominant tree species are rounded-crowned, occur at lower elevations, and/or where environmental conditions tend to be warmer and more xeric

4a Needle-leaved tree species dominate the canopy

5a *Pinus* spp. are the most abundant tree species

6a *Pinus monophylla* dominates or co-dominates the tree stratum

7a *Pinus monophylla* clearly dominates the canopy; other tree species may be present but sparse, not contributing substantial cover

Vegetation Class 5: PIMO

7b Other tree species range from common to codominant in the canopy and contribute substantial cover

8a *Juniperus osteosperma* is abundant in the tree stratum

Vegetation Class 3: PIMO – JUOS / Sparse

8b *Cercocarpus ledifolius* is abundant in the tree stratum

Vegetation Class 34: PIMO / CELE

6b *Pinus flexilis* dominates the tree stratum

Vegetation Class 36: PIFL

5b *Juniperus* spp. are the most abundant tree species

9a *Juniperus osteosperma* is the most abundant species in the tree canopy

Vegetation Class 3: PIMO – JUOS / Sparse

9b *Juniperus scopulorum* is the most abundant species in the tree canopy

Vegetation Class 8: JUSC - POTR

4b *Cercocarpus ledifolius* dominates the canopy

10a *Pinus monophylla* is common in the tree stratum

Vegetation Class 34: PIMO / CELE

10b *Pinus monophylla* is sparse or absent from the tree stratum

Vegetation Class 19: CELE / SYOR

1b *Populus tremuloides* dominates the tree canopy

11a *Juniperus scopulorum* is common to abundant in the tree stratum

Vegetation Class 8: JUSC – POTR

11b *Juniperus scopulorum* is absent to sparse in the tree stratum

12a *Symphoricarpos oreophilus* is abundant, contributes substantial cover, in the shrub stratum

Vegetation Class 17: POTR / SYOR / THFE

12b *Symphoricarpos oreophilus* is absent to sparse in the shrub stratum

13a Native species are abundant in the herbaceous stratum

Vegetation Class 7: POTR / THFE

13b Native species are sparse in the herbaceous stratum; introduced species clearly dominate

Vegetation Class 22: POTR / POPR

Shrubland and Shrub Herbaceous Vegetation Classes

1a Dominant shrub species are broad-leaved and cold deciduous

2a Dominant shrub species are found exclusively in and around riparian areas associated with streams, springs, and seeps

3a *Prunus virginiana* is the most abundant species in the shrub stratum

Vegetation Class 20: PRVI

3b *Salix* spp. are the most abundant species in the shrub stratum

Vegetation Class 16: SABO / Mesic Forbs

2b *Symphoricarpos oreophilus*, which may be found in (but is not exclusive to) riparian areas, dominates or co-dominates the shrub stratum

4a *Symphoricarpos oreophilus* clearly dominates the shrub stratum; other shrub species may be present, but do not contribute substantial cover

Vegetation Class 10: SYOR

4b Other shrub species range from common to codominant in the shrub stratum and contribute substantial cover

5a *Prunus virginiana* is abundant in the shrub stratum

Vegetation Class 20: PRVI

5b *Artemisia tridentata* ssp. *vaseyana* is abundant in the shrub stratum

Vegetation Class 27: ARTRV - SYOR

1b Dominant shrub species are microphyllous or sclerophyllous and are generally evergreen or facultatively deciduous

6a The shrub stratum of the plant community is dominated or co-dominated by an *Artemisia* species

7a Big sagebrush (*Artemisia tridentata* ssp. *tridentata*, ssp. *vaseyana*) is the most abundant sagebrush species in the shrub stratum

8a *Artemisia tridentata* ssp. *tridentata* is the most abundant big sagebrush

subspecies in the plant community

9a *Artemisia tridentata* ssp. *tridentata* clearly dominates the shrub stratum; other shrub species may be present, but do not contribute substantial cover

10a Native species are abundant in the herbaceous stratum

Vegetation Class 6: ARTRT / POSE

10b Native species are sparse in the herbaceous stratum; introduced species clearly dominate

Vegetation Class 26: ARTRT / POPR

9b *Chrysothamnus viscidiflorus* ranges from common to co-dominant in the shrub stratum and contributes substantial cover

Vegetation Class 4: ARTR / CHVI / POSE

8b *Artemisia tridentata* ssp. *vaseyana* is the most abundant big sagebrush subspecies in the plant community

11a *Artemisia tridentata* ssp. *vaseyana* clearly dominates the shrub stratum; other shrub species may be present, but do not contribute substantial cover

12a The herbaceous stratum is dominated by native grasses

13a *Leucopoa kingii* and/or *Leymus cinereus* are the most abundant grasses in the herbaceous stratum

Vegetation Class 29: ARTRV / LEKI

13b Either *Pseudoroegneria spicata* or *Festuca idahoensis* is the most abundant grass species in the herbaceous stratum

14a *Pseudoroegneria spicata* is the most abundant grass species

Vegetation 25: ARTRV / PSSP

14b *Festuca idahoensis* is the most abundant grass species

Vegetation Class 28: ARTRV / FEID

12b Native species are sparse in the herbaceous stratum; introduced species clearly dominate

Vegetation Class 23: ARTRV / POPR

11b Other shrub species range from common to codominant in the shrub stratum and contribute substantial cover

15a *Purshia tridentata* is abundant in the shrub stratum

16a *Elymus lanceolatus* is abundant in the herbaceous stratum

Vegetation Class 33: ARTRV – PUTR / ELLA

16b *Elymus lanceolatus* is sparse or absent from the herbaceous stratum

Vegetation Class 21: ARTRV – PUTR / POSE

15b *Symphoricarpos oreophilus* is abundant in the shrub stratum

Vegetation Class 27: ARTRV - SYOR

7b Dwarf sagebrush (*Artemisia arbuscula* or *Artemisia nova*) are the most abundant sagebrush species in the shrub stratum

17a *Artemisia nova* is the most abundant dwarf sagebrush species in the shrub stratum

Vegetation Class 24: ARNO / PSSP

17b *Artemisia arbuscula* is the most abundant dwarf sagebrush species in the shrub stratum

18a The herbaceous stratum is dominated by native grasses

Vegetation Class 9: ARAR / POSE

18b Native species are sparse in the herbaceous stratum; introduced species clearly dominate

Vegetation Class 12: ARAR / POBU

6b The shrub stratum of the plant community is dominated by a non-*Artemisia* species

19a The dominant shrub species is generally considered to be microphyllous

20a *Purshia tridentata* is the most abundant species in the shrub stratum

21a *Purshia tridentata* clearly dominates the shrub stratum; other shrub species may be present, but do not contribute substantial cover

Vegetation Class 31: PUTR / PSSP

21b *Artemisia tridentata* ssp. *vaseyana* is abundant in the shrub stratum and contributes substantial cover

22a *Elymus lanceolatus* is abundant in the herbaceous stratum

Vegetation Class 33: ARTRV – PUTR / ELLA

22b *Elymus lanceolatus* is sparse or absent from the herbaceous stratum

Vegetation Class 21: ARTRV – PUTR / POSE

20b *Chrysothamnus viscidiflorus* is the most abundant species in the shrub stratum

23a *Chrysothamnus viscidiflorus* clearly dominates the shrub stratum; other shrub species may be present, but do not contribute substantial cover

24a The herbaceous stratum is dominated by native grasses

Vegetation Class 2: CHVI / ELLA - POSE

24b Native species are sparse in the herbaceous stratum; introduced species clearly dominate

25a *Agropyron desertorum* is the most abundant herbaceous species

Vegetation Class 1: CHVI / AGDE

25b *Bromus tectorum* is the most abundant herbaceous species

Vegetation Class 2: CHVI / ELLA - POSE

23b *Artemisia tridentata* ssp. *tridentata* is abundant in the shrub stratum and contributes substantial cover

Vegetation Class 4: ARTR / CHVI / POSE

19b *Ceanothus velutinus* is the dominant shrub species

Vegetation Class 30: CEVE

Herbaceous Vegetation Classes

1a Dominant herbaceous species are native

2a The dominant herbaceous species is a graminoid

3a The dominant graminoid is generally considered to be a wetland indicator species

4a *Juncus balticus* is the most abundant species in the herbaceous stratum

5a Other native species, including *Carex nebrascensis*, are also common in the herbaceous stratum

Vegetation Class 15: CANE

5b Non-native species, including *Poa pratensis*, are also common in the herbaceous stratum

Vegetation Class 11: POPR - JUBA

4b *Carex nebrascensis* is the most abundant species in the herbaceous stratum

Vegetation Class 15: CANE

3b The dominant graminoid is generally considered to be an upland species

6a *Festuca idahoensis* ranges from common to codominant in the herbaceous stratum

Vegetation Class 18: PSSP - FEID

6b *Festuca idahoensis* is sparse to absent in the herbaceous stratum

Vegetation Class 13: PSSP – BASA - POSE

2b The dominant herbaceous species is *Balsamorhiza sagittata*

Vegetation Class 13: PSSP – BASA - POSE

1b Dominant herbaceous species are introduced

7a The dominant herbaceous species is a *Poa* spp.

8a *Poa pratensis* is the most abundant grass species

9a *Juncus balticus* ranges from common to abundant

Vegetation Class 11: POPR - JUBA

9b *Juncus balticus* is sparse to absent

Vegetation Class 14: POBU

8b *Poa bulbosa* is the most abundant grass species

Vegetation Class 14: POBU

7b The dominant herbaceous species is *Bromus tectorum*

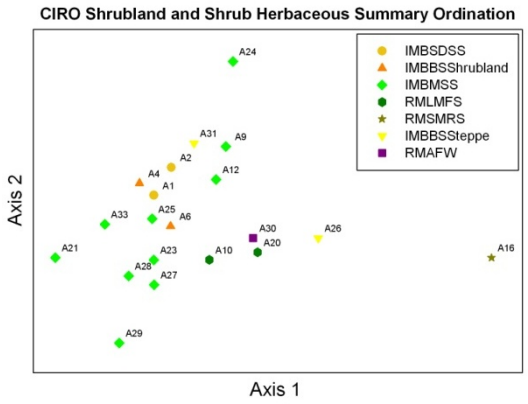
Vegetation Class 32: BRTE

Appendix D: CIRO Plant Association Descriptions

A1 Green Rabbitbrush / Crested Wheatgrass Shrub Herbaceous Vegetation

Chrysothamnus viscidiflorus / Agropyron desertorum Shrub Herbaceous Vegetation





Description

Total vegetation cover of this plant community is generally low to moderate and is characterized by an open shrub canopy of *Chrysothamnus viscidiflorus.* Other shrubs, including *Artemisia tridentata* ssp. *vaseyana* and *Ericameria nauseosa*, may provide sparse cover in the overstory. Herbaceous cover is moderate and the introduced bunchgrass, *Agropyron desertorum* is highly characteristic of this association but is not always the most abundant herbaceous species. *Bromus tectorum* and *Poa secunda* are nearly always present and may dominate or codominate the herbaceous stratum in some stands. Additional graminoids may occur in this community but are often sparse in terms of cover. Forbs are often a mix of native and introduced species, but contribute very little total cover.

This association generally occurs in areas that have experienced disturbance. *Chrysothamnus viscidiflorus*-dominated communities often result from wildland fires in sagebrush steppe ecosystems. Other types of disturbances may also ameliorate conditions and influence the spatial distribution of non-native species, such as *Agropyron desertorum*, resulting in this type of plant community. Slopes range from gentle to moderately steep. Soils are variable.

CONSERVATION RANK N/A DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 3, AA)

Tree

None

Shrub

Chrysothamnus viscidiflorus (green rabbitbrush) V.12, *Artemisia tridentata* ssp. *vaseyana* (mountain big sagebrush) V.1, *Ericameria nauseosa* (rubber rabbitbrush) IV.2

Dwarf-shrub

None

Graminoid

Agropyron desertorum (crested wheatgrass) V.15, *Poa secunda* (curly bluegrass) V.2, *Elymus lanceolatus* (streambank wheatgrass) IV.4

Forb

Alyssum desertorum (desert alyssum) V.1, *Chaenactis douglasii* (desert dusty maiden) V.<1, *Taraxacum officinale* (common dandelion) V.<1, *Erigeron lonchophyllus* (shortray fleabane) IV.1

RANGE

City of Rocks National Reserve

This association is widespread on the project area, most commonly found in the area outside CIRO boundary on neighboring parcels. Isolated areas within CIRO boundaries, mostly in the southern areas and not present at CRSP.

Global

Vegetation in the *Chrysothamnus viscidiflorus* Shrubland Alliance has been documented to occur in western Colorado, Utah and the Snake River Plain of southern Idaho. It probably also occurs throughout the interior West in disturbed areas that would otherwise support sagebrush shrublands. The *Chrysothamnus viscidiflorus / Agropyron desertorum* Shrub Herbaceous Vegetation Association may be found sporadically through the range of the greater alliance where *Agropyron desertorum* has been planted or has had the opportunity to invade the understory of otherwise native shrublands.

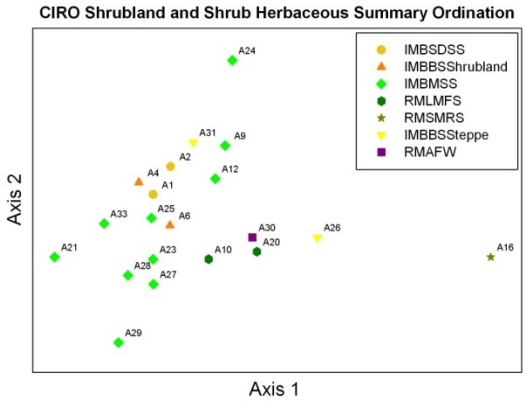
COMMENTS

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2010) at the time this document was produced. Therefore, the plant community description is based on limited data from City of Rocks National Reserve and on related plant communities that have been previously described. The descriptions provided herein may vary slightly from similar plant communities found elsewhere due to the local scale at which data were collected and the lack of a published standard in the NVC.

A2 Green Rabbitbrush / Streambank Wheatgrass – Curly Bluegrass Shrub Herbaceous Vegetation

Chrysothamnus viscidiflorus / Elymus lanceolatus – Poa secunda Shrub Herbaceous Vegetation





Description

Average cover of this plant community is moderate. It is characterized by an open canopy of *Chrysothamnus viscidiflorus*, but other shrubs, particularly *Symphoricarpos oreophilus*, may occur sporadically in the shrub stratum. Total herbaceous cover tends to range from moderate to high, especially when compared to other *Chrysothamnus viscidiflorus*-dominated communities. Herbaceous cover is from a diverse mix of grasses including; *Elymus lanceolatus*, *Achnatherum hymenoides*, *Hesperostipa comata*, *Poa secunda*, *Pseudoroegneria spicata*, and the introduced annual, *Bromus tectorum*. Forbs are generally sparse and variable across this vegetation type.

This association generally occurs in areas that have experienced disturbance. *Chrysothamnus viscidiflorus*-dominated communities often result from wildland fires in sagebrush steppe ecosystems. Slopes range from gentle to moderately steep. Soils are variable.

CONSERVATION RANK N/A DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 5, AA)

Tree

None

Shrub

Chrysothamnus viscidiflorus (green rabbitbrush) V.8, *Symphoricarpos oreophilus* (mountain snowberry) V.1, *Opuntia polyacantha* (pricklypear) V.<1

Dwarf-shrub

None

Graminoid

Elymus lanceolatus (streambank wheatgrass) V.13, *Bromus tectorum* (cheatgrass) V.12, *Poa secunda* (curly bluegrass) V.8, *Achnatherum hymenoides* (Indian rice grass) V.<1, *Hesperostipa comata* (needle and thread) IV.3, *Agropyron desertorum* (crested wheatgrass) IV.1, *Pseudoroegneria spicata* (bluebunch wheatgrass) III.2

Forb

None

RANGE

City of Rocks National Reserve

This association is widespread on the project area, most commonly found in the area outside CIRO boundary on neighboring parcels. Isolated areas within CIRO boundaries, mostly in the southern areas and not present at CRSP.

Global

Vegetation in the *Chrysothamnus viscidiflorus* Shrubland Alliance has been documented to occur in western Colorado, Utah and the Snake River Plain of southern Idaho. It probably also occurs throughout the interior West in disturbed areas that would otherwise support sagebrush shrublands. The *Chrysothamnus viscidiflorus / Elymus lanceolatus – Poa secunda* Shrub Herbaceous Vegetation Association may be found sporadically through the range of the greater alliance where *Elymus lanceolatus* and *Poa secunda* are both abundant in the understory.

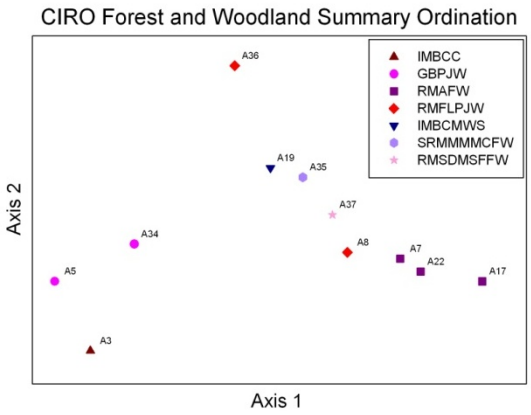
COMMENTS

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2010) at the time this document was produced. Therefore, the plant community description is based on limited data from City of Rocks National Reserve and on related plant communities that have been previously described. The descriptions provided herein may vary slightly from similar plant communities found elsewhere due to the local scale at which data were collected and the lack of a published standard in the NVC.

A3 Singleleaf Pinyon – Utah Juniper / Sparse Understory Woodland

Pinus monophylla – Juniperus osteosperma / Sparse Understory Woodland





Description

The vegetation in this association is characterized by an open to moderately dense tree canopy co-dominated by *Pinus monophylla* and *Juniperus osteosperma*. The shrub and herbaceous strata are generally sparse and species composition can be quite variable. *Artemisia tridentata* ssp. *vaseyana* is the most constant shrub species found across this plant community. *Poa secunda* occurs regularly in this association at City of Rocks National Reserve as is does across most Idaho locations. Although forbs are generally sparse, they may be diverse.

Stands occur on flat to moderately sloping sites on all aspects. The soils are variable, but are typically shallow and rocky. Litter from trees often covers much of the ground surface. Rock, pavement or bare ground surface may also be significant depending on the site.

CONSERVATION RANK G5 DATABASE CODE CEGL00829

CHARACTERISTIC SPECIES (n = 6, AA)

Tree

Juniperus osteosperma (Utah juniper) V.23, *Pinus monophylla* (singleleaf pinyon) V.16

Shrub

Artemisia tridentata ssp. *vaseyana* (mountain big sagebrush) IV.3

Dwarf-shrub

None

Graminoid

Poa secunda (curly bluegrass) IV.3

Forb

None

RANGE

City of Rocks National Reserve

This association is widespread throughout the project area.

Global

This woodland association typically occurs in the Great Basin and northern Mojave Desert. However, its presence in Idaho has been documented at the City of Rocks National Reserve and it occurs in limited distribution elsewhere across the state where conditionals are favorable.

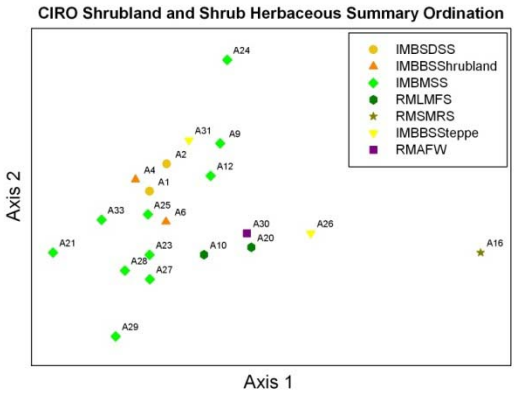
COMMENTS

Pinus monophylla and *Juniperus osteosperma* trees are highly susceptible to fire due to both highly flammable foliage and no self-pruning of their dead branches. When burned these trees are usually killed or severely damaged and do not resprout. However, because these woodlands often have an open canopy and sparse understory and lack fine fuels, fire frequency is relatively low.

A4 Basin Big Sagebrush / Green Rabbitbrush / Curly Bluegrass Shrubland

Artemisia tridentata ssp. *tridentata / Chrysothamnus viscidiflorus / Poa secunda* Shrubland





Description

This association is characterized by moderate canopy cover of *Artemisia tridentata* ssp. *tridentata* and by a sparse to moderate understory, dominated by the perennial bunchgrass, *Poa secunda*. *Chrysothamnus viscidiflorus* is generally abundant and may co-dominate the shrub stratum. Other shrub species including *Purshia tridentata* and *Symphoricarpos oreophilus* are also common. The herbaceous stratum may range from low to high diversity. In addition to *Poa secunda*, common grasses may include, but are not restricted to, *Elymus lanceolatus* and *Agropyron desertorum*. Forbs typically have very low cover but may have high species diversity and are often variable in species composition from one stand to the next. *Allium acuminatum* and *Tragopogon dubius* are among the most frequently occurring native forbs in this plant community.

Stands occur on valley floors, drainages, and lower leeward slopes of ridges. Sites are flat to moderately sloping and are found on all aspects. The unvegetated surface has high exposure of bare soil, low cover of litter, and sparse cover of small rocks and downed wood. Soils are moderately well-drained to rapidly drained and vary texturally from sandy and silty loams to silty clay loam and clay.

CONSERVATION RANK G5 DATABASE CODE CEGL000999

CHARACTERISTIC SPECIES (n = 3, AA)

Tree

None

Shrub

Chrysothamnus viscidiflorus (green rabbitbrush) V.7, *Purshia tridentata* (antelope bitterbrush) V.3, *Artemisia tridentata* ssp. *tridentata* (basin big sagebrush) IV.10, *Symphoricarpos oreophilus* (mountain snowberry) IV.1

Dwarf-shrub

None

Graminoid

Poa secunda (curly bluegrass) V.8, *Agropyron desertorum* (crested wheatgrass) V.4, *Elymus lanceolatus* (streambank wheatgrass) V.2

Forb

Cirsium undulatum (wavyleaf thistle) V.<1, *Allium acuminatum* (tapertip onion) V.<1, *Tragopogon dubius* (western salsify) V.<1, *Balsamorhiza sagittata* (arrowleaf balsamroot) IV.2

RANGE

City of Rocks National Reserve

This association is widespread throughout the project area.

Global

This big sagebrush shrubland association has only been previously reported in Nevada and California, with the potential to occur in Wyoming. However, it likely also occurs in limited distribution across the range of *Artemisia tridentata* ssp. *tridentata* where *Chrysothamnus viscidiflorus* is abundant and where abiotic factors are appropriate for *Poa secunda* to dominate the understory.

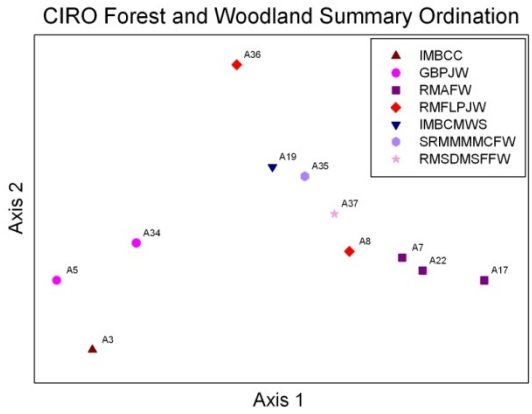
COMMENTS

None.

A5 Singleleaf Pinyon Woodland

Pinus monophylla Woodland





Description

The vegetation of this association is characterized by an open to moderately dense tree canopy dominated by *Pinus monophylla*. *Juniperus osteosperma* may be present but sparse. *Artemisia tridentata* ssp. *vaseyana*, *Chrysothamnus viscidiflorus, Symphoricarpos oreophilus,* and *Cercocarpus ledifolius* often occur in the shrub stratum, but total shrub cover is generally low. The herbaceous stratum also tends to be sparse. *Poa secunda* is the most frequently occurring grass in stands of this association. However, other graminoids often occur and may even be locally abundant. Although forbs are generally sparse, *Balsamorhiza sagittata* occurs regularly and forb composition can be quite variable from one stand to the next.

Stands of this association occur on flat to moderately sloping sites on all aspects. The soils are variable, but are typically shallow and rocky. Litter from trees often covers much of the ground surface. Rock, pavement, or bare ground surface may also be significant depending on the site.

CONSERVATION RANK G5 DATABASE CODE CEGL00825

CHARACTERISTIC SPECIES (n = 13, AA)

Tree

Pinus monophylla (singleleaf pinyon) V.28

Shrub

Artemisia tridentata ssp. *vaseyana* (mountain big sagebrush) IV.3, *Chrysothamnus viscidiflorus* (green rabbitbrush) IV.1, *Opuntia polyacantha* (pricklypear) IV.1, *Symphoricarpos oreophilus* (mountain snowberry) IV.1, *Cercocarpus ledifolius* (curl-leaf mountain mahogany) III.2

Dwarf-shrub

None

Graminoid

Poa secunda (curly bluegrass) V.2, *Bromus tectorum* (cheatgrass) IV.1

Forb

Balsamorhiza sagittata (arrowleaf balsamroot) IV.2

RANGE

City of Rocks National Reserve

This association is widespread throughout the project area *Global*

This woodland association typically occurs in the Great Basin and northern Mojave Desert. However, its presence in Idaho has been documented at the City of Rocks National Reserve and it occurs in limited distribution elsewhere across the state where conditionals are favorable.

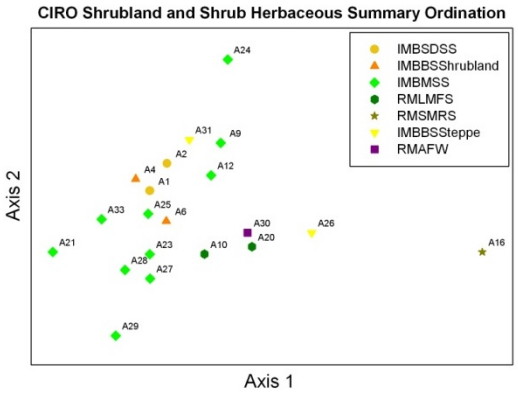
COMMENTS

Pinus monophylla and *Juniperus osteosperma* trees are highly susceptible to fire due to both highly flammable foliage and no self-pruning of their dead branches. When burned these trees are usually killed or severely damaged and do not resprout. However, because these woodlands often have an open canopy and sparse understory and lack fine fuels, fire frequency is relatively low.

A6 Basin Big Sagebrush / Curly Bluegrass Shrubland

Artemisia tridentata ssp. *tridentata* / *Poa secunda* Shrubland





Description

This association is characterized by a moderate to dense canopy which is strongly dominated by the tall shrub, *Artemisia tridentata* ssp. *tridentata*, and a sparse understory dominated by the perennial bunchgrass, *Poa secunda*. *Chrysothamnus viscidiflorus* and *Symphoricarpos oreophilus* occur regularly in the shrub stratum, but tend to have very low total cover. Diversity of the herbaceous stratum can be quite variable. In addition to *Poa secunda*, common grasses may include, but are not restricted to, *Elymus lanceolatus*, *Leymus cinereus*, and the non-native, annual grass, *Bromus tectorum*. In many stands *Bromus tectorum* may be more abundant than the native grasses. Forbs typically have very low cover but may have high species diversity and are often variable in species composition from one stand to the next. *Lupinus argenteus* and *Balsamorhiza sagittata* are among the most frequently occurring forbs in this plant community.

Stands occur on valley floors, drainages, and lower leeward slopes of ridges. Sites are flat to moderately sloping and are found on all aspects. The unvegetated surface has high exposure of bare soil, low cover of litter, and sparse cover of small rocks and downed wood. Soils are moderately well-drained to rapidly drained and vary texturally from sandy and silty loams to silty clay loam and clay.

CONSERVATION RANK G4 DATABASE CODE CEGL001008

CHARACTERISTIC SPECIES (n = 10, AA)

Tree

Pinus monophylla (singleleaf pinyon) III.2

Shrub

Artemisia tridentata ssp. *tridentata* (basin big sagebrush) V.28, *Chrysothamnus viscidiflorus* (green rabbitbrush) V.3, *Symphoricarpos oreophilus* (mountain snowberry) IV.1

Dwarf-shrub

None

Graminoid

Poa secunda (curly bluegrass) V.2, *Elymus lanceolatus* (streambank wheatgrass) IV.2, *Leymus cinereus* (basin wildrye) III.4, *Bromus tectorum* (cheatgrass) III.2

Forb

Balsamorhiza sagittata (arrowleaf balsamroot) IV.2, *Lupinus argenteus* (silvery lupine) IV.1

RANGE

City of Rocks National Reserve

This association is widespread throughout the project area *Global*

This big sagebrush shrubland association has been reported to occur in the Great Basin, southern Columbia Plateau, Colorado Plateau, and Wyoming.

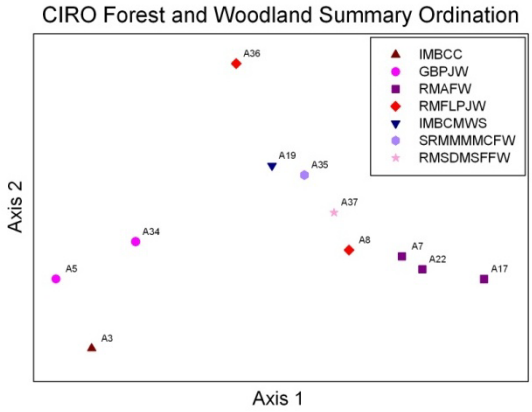
COMMENTS

None.

A7 Quaking Aspen / Fendler's Meadow-rue Forest

Populus tremuloides / Thalictrum fendleri Forest





Description

The vegetation structure of this plant community is essentially two-layered; it is comprised of a moderate tree stratum, which is strongly dominated by *Populus tremuloides*, and a low-herb stratum. Although *Populus tremuloides* clearly dominates the canopy, other trees may occur sporadically and component species include; *Juniperus scopulorum*, *Abies lasiocarpa*, *Acer glabrum*, or *Pseudotsuga menziesii*. Shrub occurrence in the understory is variable, but total shrub cover is generally low and *Symphoricarpos oreophilus* occurs with the greatest regularity. Forbs are abundant and species richness is generally high. *Thalictrum fendleri* is typically the most abundant forb species, but *Maianthemum stellatum, Osmorhiza occidentalis, Achillea millefolium, Lupinus argenteus*, and *Nemophila breviflora* are also common in the understory. Graminoids tend to be less abundant than forbs; *Poa pratensis* occurs with the greatest regularity, but *Bromus carinatus* and *Elymus glaucus* may also be present.

This quaking aspen-dominated association occurs on sheltered sites, swales, benches and lower slopes, or on sideslopes of canyons. Soils are variable and appropriate textures may include silty loam, silty clay loam, and gravelly loams. Soil depth ranges from moderately deep to deep, and moisture varies from well-drained to moist. Slopes are generally moderate to steep, straight to concave, and occur on all aspects.

CONSERVATION RANK G5 DATABASE CODE CEGL000619

CHARACTERISTIC SPECIES (n = 7, AA)

Tree

Populus tremuloides (quaking aspen) V.20, *Juniperus scopulorum* (Rocky Mountain juniper) V.4, *Acer glabrum* (Rocky Mountain maple) III.2

Shrub

Symphoricarpos oreophilus (mountain snowberry) III.2

Dwarf-shrub

Mahonia repens (creeping barberry) V.4

Graminoid

Poa pratensis (Kentucky bluegrass) V.9

Forb

Thalictrum fendleri (Fendler's meadow-rue) V.7, *Osmorhiza occidentalis* (western sweetroot) V.5, *Maianthemum stellatum* (starry false lily of the valley) V.1, *Taraxacum officinale* (common dandelion) V.1, *Nemophila breviflora* (basin nemophila) V.1

RANGE

City of Rocks National Reserve

Common in the central part of the srudy area and in the northern portion of the study area. Mainly along riparian zones.

Global

This in an infrequently occurring forest association described from occurrences in Idaho, western Wyoming, Utah, north-central New Mexico, and Colorado.

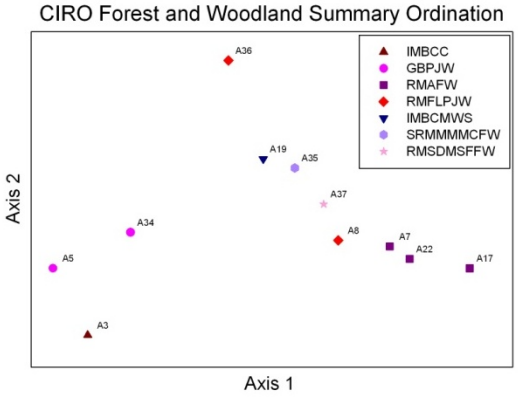
COMMENTS

None.

A8 Rocky Mountain Juniper – Quaking Aspen Woodland

Juniperus scopulorum / Populus tremuloides Woodland





Description

Woodlands in this alliance are dominated by *Juniperus scopulorum*, a small scale-leaved tree that is typically less than 10 m tall, but can reach up to 20 m in height. *Populus tremuloides* also ranges from present to abundant in the tree canopy, and may co-dominate. The understory of the plant community can vary from sparse under closed canopies to a moderately dense in open stands. The dominant shrub species are variable among stands and scattered dwarf-shrubs such as *Mahonia repens* are frequently present. The herbaceous layer is generally both sparse and variable, lacking diagnostic grasses or forb species. In some stands mosses and lichens cover the majority of the ground surface. Annual grasses and forbs may be seasonally present.

Stands included in this woodland alliance occur on moderate to very steep, dry and rocky slopes. Soils are shallow to moderately deep, stony, and typically coarse-textured loams but range from loamy sand to clay. Exposed bedrock is common and many stands have significant amounts of bare soil.

CONSERVATION RANK N/A DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 2, NA)

Tree

Juniperus scopulorum (Rocky Mountain juniper) V.43, *Populus tremuloides* (quaking aspen) V.13

Shrub

None

Dwarf-shrub

Mahonia repens (creeping barberry) V.3

Graminoid

Elymus glaucus (blue wildrye) V.<1

Forb

Cystopteris fragilis (brittle bladderfern) V.<1, *Maianthemum stellatum* (starry false lily of the valley) V.<1, *Nemophila breviflora* (basin nemophila) V.<1, *Thalictrum fendleri* (Fendler's meadow-rue) V.<1

RANGE

City of Rocks National Reserve

This association is widespread throughout the project area, most common in the southern and eastern areas.

Global

Stands in the *Juniperus scopulorum* Woodland Alliance occur on dry slopes in the foothills and lower elevations of the northern and southern Rocky Mountains and the Black Hills. The vegetation type extends east to breaks, badlands and canyon slopes in the Great Plains in western Nebraska and the Dakotas and may extend south to escarpments in the panhandle of Texas. An association typified by the co-dominance of *Juniperus scopulorum* and *Populus tremuloides* likely occurs as limited patches within the greater distribution of *Juniperus scopulorum* where local site conditions become mesic enough to support *Populus tremuloides*.

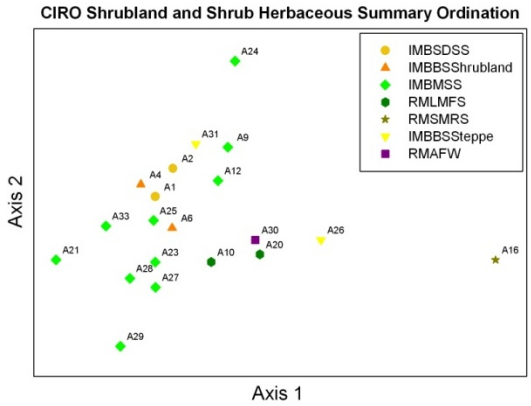
COMMENTS

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2010) at the time this document was produced. Therefore, the plant community description is based on limited data from City of Rocks National Reserve and on related plant communities that have been previously described. The descriptions provided herein may vary slightly from similar plant communities found elsewhere due to the local scale at which data were collected and the lack of a published standard in the NVC.

A9 Dwarf Sagebrush / Curly Bluegrass Shrub Herbaceous Vegetation

Artemisia arbuscula / Poa secunda Shrub Herbaceous Vegetation





Description

Artemisia arbuscula is the dominant dwarf-shrub species in this shrub herbaceous vegetation type, although it can be obscured by the tall grass cover. Cover of *Artemisia arbuscula* is low to moderate and the canopy is generally open. Other shrub or dwarf-shrub species occur sporadically, but contribute very little total cover. *Poa secunda* dominates the herbaceous stratum. However, *Pseudoroegneria spicata* and *Koeleria macrantha* also often occur at low to moderate cover. Forb cover is generally low and species composition can be highly variable. *Antennaria microphylla*, *Phlox hoodii*, and *Sedum lanceolatum* occur with the greatest regularity.

Associations in the *Artemisia arbuscula* Shrub Herbaceous Alliance occur on dry, exposed moderate slopes, on undulating to rolling topography, lower mountain toeslopes, inaccessible ridges, and on very steep canyon talus slopes. Slope can range from low to moderate. Soils are shallow or moderately deep, from well- to moderately well-developed. Textures range from silt loam to gravel loams. Often there is a claypan limiting rooting depth.

CONSERVATION RANK G5 DATABASE CODE CEGL001411

CHARACTERISTIC SPECIES (n = 8, AA)

Tree

None

Shrub

Chrysothamnus viscidiflorus (green rabbitbrush) IV.1

Dwarf-shrub

Artemisia arbuscula (dwarf sagebrush) V.13, *Stenotus acaulis* (stemless mock goldenweed) IV.1

Graminoid

Poa secunda (curly bluegrass) V.5, *Pseudoroegneria spicata* (bluebunch wheatgrass) V.2, *Koeleria macrantha* (prairie Junegrass) IV.1

Forb

Antennaria microphylla (littleleaf pussytoes) V.3, *Phlox hoodii* (Hood's phlox) V.<1, *Sedum lanceolatum* (spearleaf stonecrop) V.<1

RANGE

City of Rocks National Reserve

This association is widespread throughout the project area; most common on west and northern reaches of the study area.

Global

This association is common and widespread in the western United States and occurrences have been documented in Idaho, Oregon, Nevada, and California.

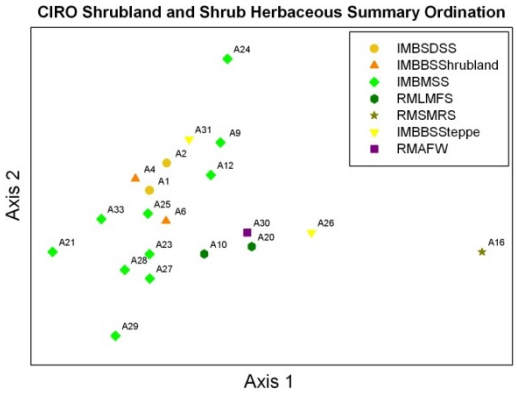
COMMENTS

None.

A10 Mountain Snowberry Shrubland

Symphoricarpos oreophilus Shrubland





Description

Symphoricarpos oreophilus strongly dominates this shrubland association. Other shrubs are often present, but in much lower abundance. Other component shrub species may include *Chrysothamnus viscidiflorus*, *Prunus virginiana, Ribes cereum, Artemisia tridentata, Rosa woodsii, Mahonia repens*, and *Artemisia nova*. The herbaceous stratum in this plant community ranges from sparse to moderate. Characteristic graminoid species include *Leymus cinereus*, *Melica bulbosa*, and *Poa secunda*. However, additional grasses like *Achnatherum hymenoides, Festuca idahoensis, Elymus elymoides, Pascopyrum smithii*, and *Pseudoroegneria spicata* may be locally abundant in some stands. Forbs tend to be quite diverse in this vegetation type and *Balsamorhiza sagittata*, *Agoseris glauca*, *Delphinium depauperatum, Lupinus argenteus,* and *Achillea millefolium* are some of the most common.

This association can occupy steep slopes or even terrain; it can occur in depressions, in gentle drainages, on undulating plateaus, along canyon ridges, and on mounded topography. Soils range from sandy loam to clay loam with little surface rock. Soil depth can range from shallow to moderately deep. Slopes range from gentle to steep, and are often south-facing, but can include all aspects.

CONSERVATION RANK GNR DATABASE CODE CEGL002051

CHARACTERISTIC SPECIES (n = 9, AA)

Tree

None

Shrub

Symphoricarpos oreophilus (mountain snowberry) V.27, *Chrysothamnus viscidiflorus* (green rabbitbrush) V.2

Dwarf-shrub

Mahonia repens (creeping barberry) IV.2

Graminoid

Leymus cinereus (basin wildrye) V.3, *Melica bulbosa* (oniongrass) IV.3, *Poa secunda* (curly bluegrass) IV.2, *Festuca idahoensis* (Idaho fescue) III.4

Forb

Lupinus argenteus (silvery lupine) V.1, *Agoseris glauca* (pale agoseris) V.<1, *Delphinium depauperatum* (slim larkspur) V.<1, *Balsamorhiza sagittata* (arrowleaf balsamroot) IV.2, *Nemophila breviflora* (basin nemophila) IV.1

RANGE

City of Rocks National Reserve

Present in the park unit but most common outside of the park unit. Not present in CRSP.

Global

This association has been described in western Wyoming, Colorado, on the Colorado Plateau and in the high plateaus of Utah, Idaho, and Oregon.

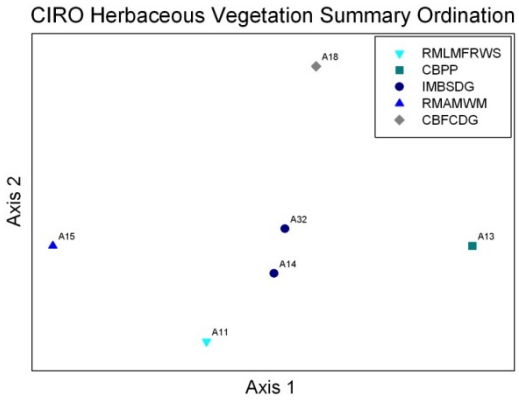
COMMENTS

This low-statured shrubland is often limited to very local spatial scales, yet remains common across the greater extent of its range. It is overlooked as a distinct community type because it often occupies the "transition zone" between forests and grasslands or between riparian vegetation and drier upslope communities.

A11 Kentucky Bluegrass – Baltic Rush Semi-natural Herbaceous Vegetation

Poa pratensis – Juncus balticus Semi-natural Herbaceous Vegetation





Description

This semi-natural plant association is characterized by a moderate to dense herbaceous stratum that is co-dominated by the introduced perennial, sod-forming grass, *Poa pratensis* and the common, native rush, *Juncus balticus*. Other graminoids, particularly *Poa bulbosa*, also occurs regularly in this vegetation type. Forbs common to this association include *Achillea millefolium, Cirsium arvense, Potentilla gracilis, and Taraxacum officinale*.

This association typically occupies seasonally flooded swales and wet, low- to mid-elevation sites. Habitats are often alkaline meadows and may have long-term grazing disturbance. Sites are typically gently sloping on all aspects. Soils are mineral with dark surface horizons containing large amounts of well-decomposed organic matter. Soil texture ranges from silt to sandy loam. Water tables are often at or near the soil surface in early summer but may drop below 50 cm by late August. Arid sites receive enough moisture to support at least some wetland species.

CONSERVATION RANK N/A DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 7, AA)

Tree

None

Shrub

None

Dwarf-shrub

None

Graminoid

Poa pratensis (Kentucky bluegrass) V.25, *Juncus balticus* (Baltic rush) V.16, *Poa bulbosa* (bulbous bluegrass) V.8

Forb

Potentilla gracilis (slender cinquefoil) V.2, *Taraxacum officinale* (common dandelion) V.1, *Achillea millefolium* (common yarrow) V.<1, *Iris missouriensis* (Rocky Mountain iris) IV.1

RANGE

City of Rocks National Reserve

Small pockets throughout the study area.

Global

This association has the potential to occur in limited distribution from the plains to montane regions, and likely has much associated variability. The *Poa pratensis* Semi-natural Herbaceous Alliance is reported to occur in Washington, Oregon, Montana, Wyoming, Idaho, Utah, and California, but is likely widespread in the western U.S. and northern Great Plains.

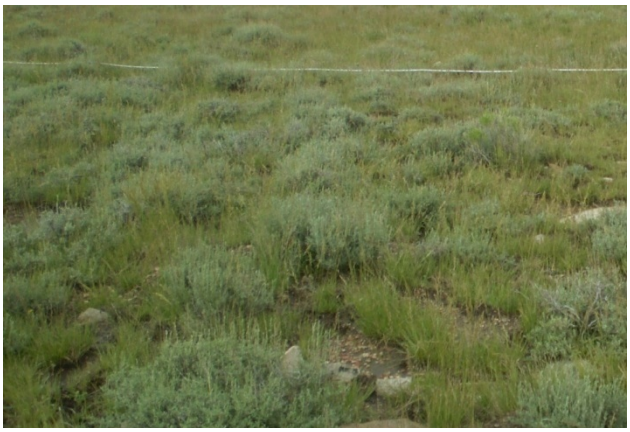
COMMENTS

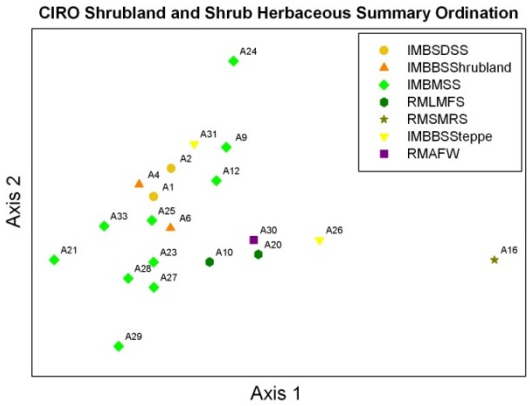
Poa pratensis is widespread in the western U.S. where, following disturbance, its extensive rhizome system allows it to spread and establish, outcompeting many native graminoids. It is tolerant of heavy grazing and burning and increases at the expense of less tolerant native species.

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2010) at the time this document was produced. Therefore, the plant community description is based on limited data from City of Rocks National Reserve and on related plant communities that have been previously described. The descriptions provided herein may vary slightly from similar plant communities found elsewhere due to the local scale at which data were collected and the lack of a published standard in the NVC.

A12 Dwarf Sagebrush / Bulbous Bluegrass Shrub Herbaceous Vegetation

Artemisia arbuscula / Poa bulbosa Shrub Herbaceous Vegetation





Description

Artemisia arbuscula is the dominant shrub species in this shrub herbaceous association. Cover of *Artemisia arbuscula* ranges from low to moderate and herbaceous species are generally abundant. The shrub *Purshia tridentata* and sub-shrub *Artemisia ludoviciana* are often present, but occur sporadically with low cover. The non-native graminoid, *Poa bulbosa* is the dominant understory grass. *Poa secunda* and *Danthonia unispicata* are also often abundant in the herbaceous layer. Other graminoids that occur regularly, but with lower average cover values include *Koeleria macrantha* and *Bromus tectorum*. Forb cover is generally low and species composition is variable.

Associations in the *Artemisia arbuscula* Shrub Herbaceous Alliance occur on dry, exposed moderate slopes, on undulating to rolling topography, lower mountain toeslopes, inaccessible ridges, and on very steep canyon talus slopes. Slope can range from low to moderate. Soils are shallow or moderately deep, and range from well- to moderately well-developed. Textures range from silt loam to gravel loams. Often there is a claypan limiting the rooting depth.

CONSERVATION RANK N/A DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 3, AA)

Tree

None

Shrub

Purshia tridentata (antelope bitterbrush) IV.1

Dwarf-shrub

Artemisia arbuscula (dwarf sagebrush) IV.13

Graminoid

Poa bulbosa (bulbous bluegrass) V.15, *Poa secunda* (curly bluegrass) V.4, *Danthonia unispicata* (onespike danthonia) IV.5, *Bromus tectorum* (cheatgrass) IV.1, *Koeleria macrantha* (prairie Junegrass) IV.1, *Juncus balticus* (Baltic rush) IV.1

Forb

Artemisia ludoviciana (white sagebrush) IV.1, *Microseris nutans* (nodding microseris) IV.1

RANGE

City of Rocks National Reserve

This association is widespread throughout the project area, most common on west and northern reaches of the study area.

Global

This association likely occurs sporadically within the range of the *Artemisia arbuscula / Poa secunda* Shrub Herbaceous Vegetation Association where native grasses have been replaced by *Poa bulbosa.* Analogous associations are distributed across the western United States and occurrences have been specifically documented in Idaho, Oregon, Nevada, and California.

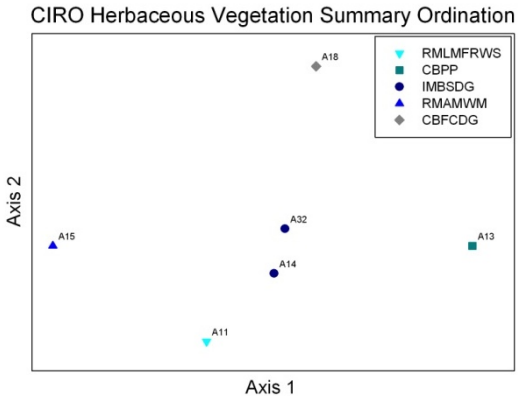
COMMENTS

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2010) at the time this document was produced. Therefore, the plant community description is based on limited data from City of Rocks National Reserve and on related plant communities that have been previously described. The descriptions provided herein may vary slightly from similar plant communities found elsewhere due to the local scale at which data were collected and the lack of a published standard in the NVC.

A13 Bluebunch Wheatgrass – Arrowleaf Balsamroot – Curly Bluegrass Herbaceous Vegetation

Pseudoroegneria spicata – Balsamorhiza sagittata – Poa secunda Herbaceous Vegetation





Description

This subxeric montane grassland association is characterized by a relatively open, tall herbaceous canopy dominated by *Balsamorhiza sagittata.* The native, perennial grasses *Pseudoroegneria spicata* and Poa *secunda* are consistently present in stands of this type, although cover of these species may be quite variable. Native graminoid diversity is relatively high and additional grass species are often a component of this plant community. Exotic annual bromes (primarily *Bromus tectorum*) and *Poa bulbosa* are also often present and may be abundant in degraded stands. Shrubs cover is generally sparse and often results from individual occurrences of *Symphoricarpos oreophilus, Purshia tridentata, Prunus virginiana, Chrysothamnus viscidiflorus,* and *Ceanothus velutinus.* As with grasses, forb diversity tends to be relatively high in this community type. In addition to *Balsamorhiza sagittata,* native perennial forbs like *Lupinus argenteus, Crepis acuminata, Allium acuminatum, Achillea millefolium* are common.

This grassland association occurs on foothills and canyon slopes. Slopes are generally steep with varying aspects on mid- to upper-slope positions of major ridge systems in highly dissected terrain. Soils are often gravelly with abundant cobbles and stones.

CONSERVATION RANK G2 DATABASE CODE CEGL001662

CHARACTERISTIC SPECIES (n = 2, AA)

Tree

None

Shrub

Symphoricarpos oreophilus (mountain snowberry)V.2, *Purshia tridentata* (antelope bitterbrush) V.2, *Prunus virginiana* (chokecherry) V.1, *Chrysothamnus viscidiflorus* (green rabbitbrush) V.1, *Opuntia polyacantha* (pricklypear) V.1, *Ceanothus velutinus* (tobacco-brush) III.8

Dwarf-shrub

None

Graminoid

Poa bulbosa (bulbous bluegrass) V.6, *Leymus cinereus* (basin wildrye) V.5, *Achnatherum nelsonii* (Columbia needlegrass) V.2, *Poa secunda* (curly bluegrass) V.2, *Pseudoroegneria spicata* (bluebunch wheatgrass) III.5

Forb

Balsamorhiza sagittata (arrowleaf balsamroot) V.20, *Lupinus argenteus* (silvery lupine) V.1, *Cirsium undulatum* (wavyleaf thistle) V.<1, *Comandra umbellata* (bastard toadflax) V.<1, *Machaeranthera canescens* (hoary tansyaster) V.<1

RANGE

City of Rocks National Reserve

This association is widespread throughout the project area; most common on west and southern reaches of the study area.

Global

The association is described primarily from the eastern and western portions, respectively, of the Blue Mountains and Idaho Batholith ecoregional sections, with an isolated stand reported from the Grand Teton Mountains of northwestern Wyoming.

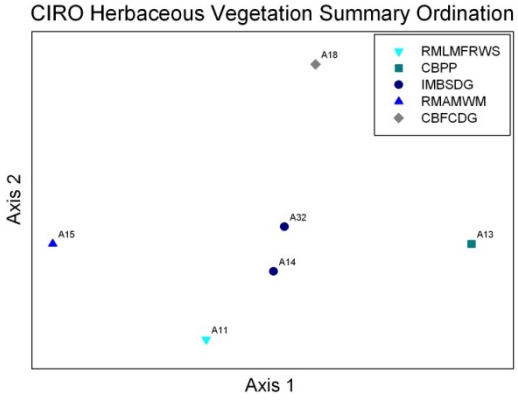
COMMENTS

This regionally endemic plant association is relatively common and widespread on suitable habitats within its range. Occurrences of the plant association are susceptible to the adverse effects of early season and excessive livestock use and altered fire disturbance regimes and are prone to invasion by exotic annual grass species. While the number and range of occurrences and rangewide acreage of the plant association appear relatively stable, nearly all of the stands treated by inventory data are degraded by the presence of exotic annual grass species. Pristine stands are extremely rare.

A14 Bulbous Bluegrass Herbaceous Vegetation

Poa bulbosa Herbaceous Vegetation





Description

The vegetation in this herbaceous association is dominated by *Poa bulbosa*, an introduced, perennial grass species. Total vegetation cover may be highly variable, generally with less than half from native species. *Poa pratensis* occurs frequently in this plant community and is also a non-native, perennial grass species. Native shrubs may occur sporadically with low total cover. *Poa secunda* and *Juncus balticus* are the most frequently occurring and abundant native graminoids in this community type. Several native, perennial and annual forb species may also be sparse and variable across stands of this type. Non-native forb species are common, but again, species composition is variable and total cover is generally low.

This association can occur across a wide range of environmental conditions in semi-arid ecosystems and is not tightly constrained by slope, aspect, soil texture, or soil depth. This association often occurs on or near sites that have been disturbed.

CONSERVATION RANK N/A DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 6, AA)

Tree

None

Shrub

None

Dwarf-shrub

None

Graminoid

Poa bulbosa (bulbous bluegrass) V.43, *Poa pratensis* (Kentucky bluegrass) V.3, *Juncus balticus* (Baltic rush) IV.3, *Poa secunda* (curly bluegrass) IV.1

Forb

Danthonia unispicata (onespike danthonia) III.2

RANGE

City of Rocks National Reserve

This association is widespread throughout the project area.

Global

This association has the potential to occur across much of western North America from the western Great Plains to the intermountain and southwestern U.S where disturbance history and abiotic conditions are conducive to the establishment and spread of *Poa bulbosa*.

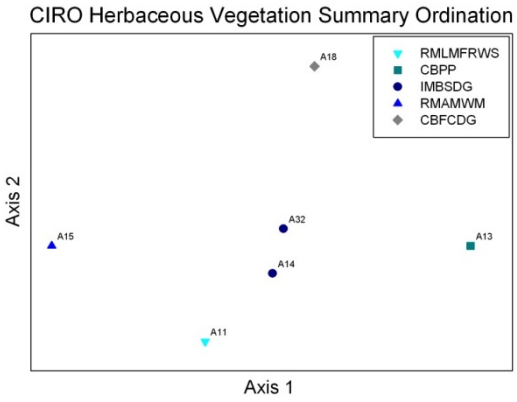
COMMENTS

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2010) at the time this document was produced. Therefore, the plant community description is based on data from City of Rocks National Reserve and on related plant communities that have been previously documented. The descriptions provided herein may vary slightly from similar plant communities found elsewhere due to the local scale at which data were collected and the lack of a published standard in the NVC.

A15 Nebraska Sedge Herbaceous Vegetation

Carex nebrascensis Herbaceous Vegetation





Description

These wetlands are characterized by a moderately dense to dense perennial graminoid layer dominated or co-dominated by *Carex nebrascensis*. Stands can range from near monocultures of *Carex nebrascensis* to relatively diverse mixtures of graminoids and forbs. Other graminoid species that occur regularly in this vegetation type include *Juncus balticus, Phleum pratense,* and *Poa pratensis*. Forb cover is generally low, but may range to moderate in especially moist locations. Forbs can be diverse in these plant communities and common forbs include *Iris missouriensis, Veratrum californicum, Arnica sororia,* and *Thermopsis rhombifolia*. Thistles such as *Cirsium arvense* and *Cirsium vulgare* may also be common. Individual shrubs occur sporadically and species may include *Rosa woodsii, Salix boothii,* and *Ericameria nauseosa*.

Stands form open meadows that occur along the margins of streambanks, flat floodplains, and lakes, often forming a band along the alluvial terrace. Stands have also been sampled from marshy areas surrounding springs and below seeps on lower hillslopes. This association is often found on well-developed soil, but occurs on a wide variety of soil types ranging from saturated organics to drier more mesic soil types. Soils tend to be fine-textured alluvium, ranging from sandy, silty loam, clay loam, or clay to organic and are typically gleyed and mottled near the surface because of the high water table during most of the growing season.

CONSERVATION RANK G4 DATABASE CODE CEGL001813

CHARACTERISTIC SPECIES (n = 4, AA)

Tree

None

Shrub

Salix boothii (Booth's willow) III.3

Dwarf-shrub

Rosa woodsii (Woods' rose) IV.1

Graminoid

Carex nebrascensis (Nebraska sedge) V.36, *Juncus balticus* (Baltic rush) V.19, *Poa pratensis* (Kentucky bluegrass) IV.4, *Phleum pretense* (timothy) III.4

Forb

Iris missouriensis (Rocky Mountain iris) V.6, *Veratrum californicum* (California false hellebore) III.3, *Arnica sororia* (twin arnica) III.3, *Thermopsis rhombifolia* (prairie thermopsis) III.3

RANGE

City of Rocks National Reserve

This association is widespread in small population throughout the project area.

Global

This sedge-dominated meadow type is widely distributed from the western Great Plains into the western mountains of the United States, ranging from South Dakota and Montana to possibly as far west as Washington, south to California and east to New Mexico.

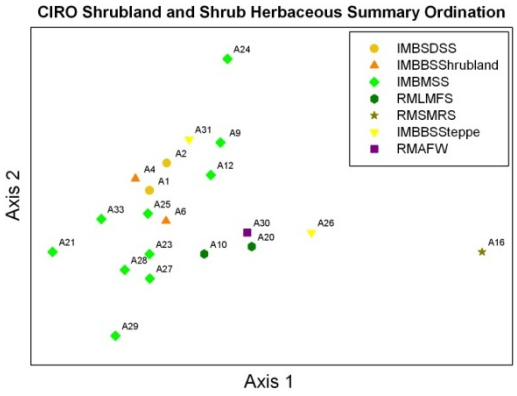
COMMENTS

This vegetation type is widely distributed, but many examples have been heavily grazed by cattle, lowering their floristic quality.

A16 Booth's Willow / Mesic Forbs Shrubland

Salix boothii / Mesic Forbs Shrubland





Description

The vegetation of this association is characterized by a tall-shrub layer that often forms extensive thickets, or willow carrs, on broad montane floodplains. The overstory of this shrubland vegetation type is dominated by *Salix boothii*. *Salix exigua* and/or *Salix lucida* may co-dominate some stands. *Ribes aureum, Ribes setosum,* and *Rosa woodsii* commonly form a lower-shrub layer. The dense herbaceous understory of this plant community is dominated by forbs. Forb species composition varies greatly from one stand to the next; however, total forb cover is typically greater than the total graminoid cover. Some of the more common forb species in this association typically include; *Maianthemum stellatum, Cirsium arvense, Urtica dioica,* and *Geum macrophyllum*. *Poa pratensis, Carex nebrascensis,* and *Juncus balticus* are some of the most regularly occurring graminoid species in stands of this type.

Stands are found in riparian areas on stream benches, meadows, and seeps located in valley bottoms ranging from narrow to broad. Soils are often organic.

CONSERVATION RANK G3 DATABASE CODE CEGL001180

CHARACTERISTIC SPECIES (n = 3, AA)

Tree

None

Shrub

Salix boothii (Booth's willow) V.25, *Salix exigua* (narrowleaf willow) IV.13, *Salix lucida* (greenleaf willow) IV.5, *Ribes aureum* (golden current) IV.4, *Ribes setosum* (inland gooseberry) IV.2

Dwarf-shrub

Rosa woodsii (Woods' rose) V.4

Graminoid

Poa pratensis (Kentucky bluegrass) IV.7, *Carex nebrascensis* (Nebraska sedge) IV.2, *Juncus balticus* (Baltic rush) IV.2

Forb

Urtica dioica (stinging nettle) V.1, *Geum macrophyllum* (largeleaf avens) V.<1, *Maianthemum stellatum* (starry false lily of the valley) IV.1, *Cirsium arvense* (Canada thistle) IV.1

RANGE

City of Rocks National Reserve

This association is widespread in the riparian zones of the project area.

Global

This association occurs occasionally in Idaho and California; it is widespread across Utah and Colorado, where most of the known occurrences are located.

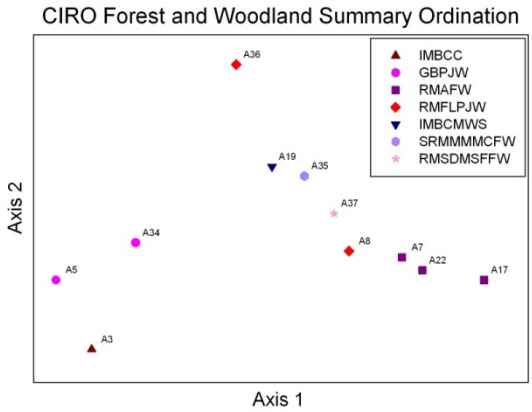
COMMENTS

In many parts of its range this association is threatened by livestock overgrazing, stream flow alterations, and heavy recreational use.

A17 Quaking Aspen / Mountain Snowberry / Fendler's Meadow-rue Forest

Populus tremuloides / Symphoricarpos oreophilus / Thalictrum fendleri Forest





Description

The dominant species in the tree stratum of this forest association is *Populus tremuloides*, which forms a relatively open canopy. Other tree species may occur sporadically and include *Abies lasiocarpa* and *Pseudotsuga menziesii*. A distinct shrub stratum is strongly dominated by *Symphoricarpos oreophilus*. Other shrubs that occur occasionally and with low cover values include; *Artemisia tridentata ssp. vaseyana, Mahonia repens, Rosa woodsii, Amelanchier alnifolia*, and *Prunus virginiana*. The herbaceous layer of this vegetation type is relatively species rich and is generally dominated by forbs. The most abundant forbs are *Thalictrum fendleri, Nemophila breviflora, Collinsia parviflora, Valeriana acutiloba, Agastache urticifolia, Hydrophyllum capitatum, Senecio serra* and *Taraxacum officinale*. Common graminoids include *Elymus glaucus*, and the introduced perennial, *Poa pratensis*.

Stands grow on gentle slopes of less the 25%. They are found on all aspects and on soil derived from a variety of parent materials.

CONSERVATION RANK G5 DATABASE CODE CEGL000616

CHARACTERISTIC SPECIES (n = 5, AA)

Tree

Populus tremuloides (quaking aspen) V.33

Shrub

Symphoricarpos oreophilus (mountain snowberry) V.22, *Amelanchier alnifolia* (Saskatoon serviceberry) V.<1,

Dwarf-shrub

None

Graminoid

Poa pratensis (Kentucky bluegrass) IV.7, *Elymus glaucus* (blue wildrye) IV.1

Forb

Thalictrum fendleri (Fendler's meadow-rue) V.4, *Nemophila breviflora* (basin nemophila) V.1, *Lupinus argenteus* (silvery lupine) V.<1, *Collinsia parviflora* (maiden blue eyed Mary) V.<1, *Valeria acutiloba* (sharpleaf valerian) IV.3, *Agastache urticifolia* (nettleleaf giant hyssop) IV.1, *Hydrophyllum capitatum* (ballhead waterleaf)

IV.1, *Senecio serra* (tall ragwort) III.2

RANGE

City of Rocks National Reserve

This association is widespread throughout the project area in riparian zones.

Global

This is a major aspen forest association common in the mountains of the Colorado Plateau, the eastern Great Basin, and the central and southern Rocky Mountains from the Abajo Mountains in southern Utah, northern and eastern Nevada, eastern Idaho, and into western Wyoming and western Colorado.

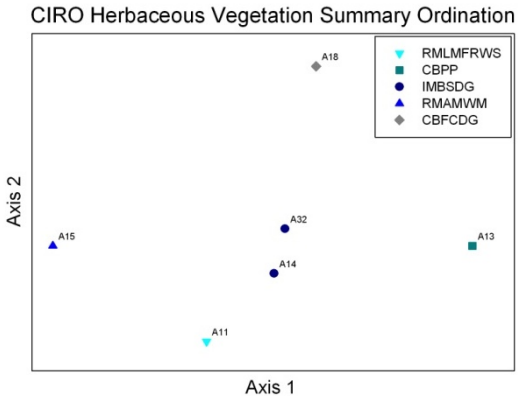
COMMENTS

None.

A18 Bluebunch Wheatgrass – Idaho Fescue Canyon Herbaceous Vegetation

Pseudoroegneria spicata – Festuca idahoensis Herbaceous Vegetation





Description

This grassland vegetation type is generally co-dominated by *Festuca idahoensis* and *Pseudoroegneria spicata*. However, *Festuca idahoensis* may be locally absent from some stands at City of Rocks National Reserve. Shrubs are rarely present in these stands and contribute very little cover where they occur. Total herbaceous cover in these plant communities ranges from moderate to dense. *Poa secunda* is consistently present in the understory. Important forb species include *Antennaria microphylla, Phlox hoodii, Sedum lanceolatum, Erigeron tener, Arnica sororia, Castilleja* spp., *Allium acuminatum, Achillea millefolium, Balsamorhiza sagittata, Crepis acuminata,* and *Lupinus* spp.

The association occurs on gentle to steep southeast-, north-, to southwest-facing, lower, mid, and upper slopes and ridgetops in highly dissected foothills and canyon slope terrain.

CONSERVATION RANK G3 DATABASE CODE CEGL001669

CHARACTERISTIC SPECIES (n = 4, AA)

Tree

None

Shrub

Chrysothamnus viscidiflorus (green rabbitbrush) V.1, *Pediocactus simpsonii* (mountain ball cactus) V.<1

Dwarf-shrub

Artemisia arbuscula (dwarf sagebrush) III.3

Graminoid

Pseudoroegneria spicata (bluebunch wheatgrass) V.9, *Poa secunda* (curly bluegrass) IV.3, *Festuca idahoensis* (Idaho fescue) III.10

Forb

Antennaria microphylla (littleleaf pussytoes) V.6, *Phlox hoodii* (Hood's phlox) V.2, *Sedum lanceolatum* (spearleaf stonecrop) V.1, *Erigeron tener* (slenderleaf fleabane) IV.1

RANGE

City of Rocks National Reserve

Widespread

Global

This plant association has been described from the Wallowa Mountains, Hells Canyon, Seven Devil Mountains, and Salmon River Mountains of the eastern and western portions, respectively, of the Blue Mountains and Idaho Batholith ecoregional sections.

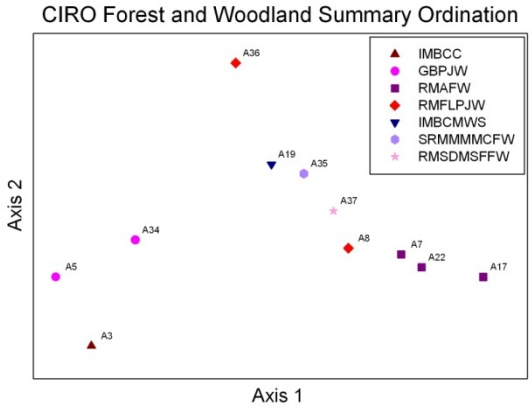
COMMENTS

This regionally endemic plant association is relatively common and widespread on suitable habitats within its range. Occurrences of the plant association are susceptible to the adverse effects of early season and excessive livestock use and altered fire disturbance regimes. While the number and range of occurrences and rangewide acreage of the plant association appear relatively stable, a large proportion of the stands reported in available data are degraded by the presence of exotic annual grass species. Pristine stands are rare.

A19 Curl-leaf Mountain-mahogany / Mountain Snowberry Woodland

Cercocarpus ledifolius / Symphoricarpos oreophilus Woodland





Description

The overstory of this association is dominated by *Cercocarpus ledifolius*. Canopies range from open to crowns nearly touching. *Symphoricarpos oreophilus, Ribes cereum, Chrysothamnus* spp., and *Artemisia tridentata ssp. vaseyana* are common lower-shrub species in this vegetation type and occur with varying abundance. Graminoid cover is generally spare, but the most constant species in this association are *Poa secunda* and *Pseudoroegneria spicata*.

Forbs tend to contribute greater cover and diversity to the herbaceous stratum. *Balsamorhiza sagittata, Hackelia patens*, and *Viola purpurea* are characteristic understory forb species.

This association occurs on moderate, south- to northeast-facing slopes; on upper slope positions; often in association with shallow soil or talus.

CONSERVATION RANK G2 DATABASE CODE CEGL000970

CHARACTERISTIC SPECIES (n = 6, AA)

Tree

None

Shrub

Cercocarpus ledifolius (curl-leaf mountain-mahogany) V.44, *Symphoricarpos oreophilus* (mountain snowberry) V.9, *Ribes cereum* var. *pedicellare* (whiskey current) IV.1

Dwarf-shrub

None

Graminoid

Poa secunda (curly bluegrass) V.1, *Pseudoroegneria spicata* (bluebunch wheatgrass) III.2

Forb

Balsamorhiza sagittata (arrowleaf balsamroot) V.9, *Hackelia patens* (spotted stickseed) V.2, *Viola purpurea* (goosefoot violet) V.1, *Mertensia oblongifolia* (oblongleaf bluebells) IV.1

RANGE

City of Rocks National Reserve

Association ion common in the north and west areas of CIRO. .

Global

The association is a regional endemic of the Owyhee Uplands and western portion of the Northwest Basin and Range ecoregional sections. A few stands have also been identified in the southern portion of the Challis Volcanics ecoregional section and the eastern portion of the Northwest Basin and Range section in Idaho.

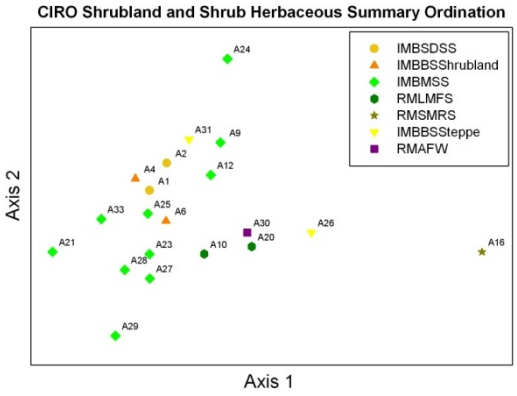
COMMENTS

The association occurs in relatively small stands that are geographically dispersed in discrete clusters of occurrence associated with higher elevation plateau and mountain formations. Many stands have been degraded or are threatened by impacts associated with livestock grazing.

A20 Chokecherry – (American Plum) Shrubland

Prunus virginiana - (Prunus americana) Shrubland





Description

Prunus virginiana is the dominant species in this tall-shrub association. The shrub stratum is typically moderate to dense in terms of cover. *Populus tremuloides* may occur sporadically, but is generally not abundant enough to form a tree canopy. Other shrubs occurring in the plant community may include; *Symphoricarpos oreophilus, Ribes aureum, Ribes cereum, Artemisia tridentata, Ericameria nauseosa, Juniperus scopulorum, Rosa woodsii,* and *Mahonia repens*. The herbaceous stratum is typically sparse, and species composition is variable. Graminoids may include *Poa secunda, Achnatherum nelsonii, Leymus cinereus*. Common forb species are; *Agastache urticifolia, Balsamorhiza sagittata, Mertensia oblongifolia,* and *Eriogonum* ssp. Exotic herbaceous species may also be present, especially on disturbed sites, and include; *Poa bulbosa, Cirsium arvense, Poa pratensis*, and *Bromus tectorum*.

This widespread small-patch shrubland occurs in the foothills and lower slopes of mountains, along higher creeks and upper alluvial terraces of perennial streams. This association often grows at the interface between larger riparian areas and the adjacent upland, as well as on higher ridges where snow collects, and occurs as small dense thickets, narrow bands or irregular patches. 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.

CONSERVATION RANK G4 DATABASE CODE CEGL001108

CHARACTERISTIC SPECIES (n = 3, AA)

Tree

Populus tremuloides (quaking aspen) IV.12

Shrub

Prunus virginiana (chokecherry) V.35, *Symphoricarpos oreophilus* (mountain snowberry) V.11

Dwarf-shrub

Mahonia repens (creeping barberry) IV.1

Graminoid

Poa secunda (curly bluegrass) IV.1

Forb

Agastache urticifolia (nettleleaf giant hyssop) IV.2, *Balsamorhiza sagittata* (arrowleaf balsamroot) IV.2, *Mertensia oblongifolia* (oblongleaf bluebells) IV.1

RANGE

City of Rocks National Reserve

Present in CRSP and CIRO in isolated pockets.

Global

This widespread shrubland is described from the Columbia Plateau of eastern Washington and eastern Oregon, throughout much of the western Great Plains, Rocky Mountain and interior western U.S.

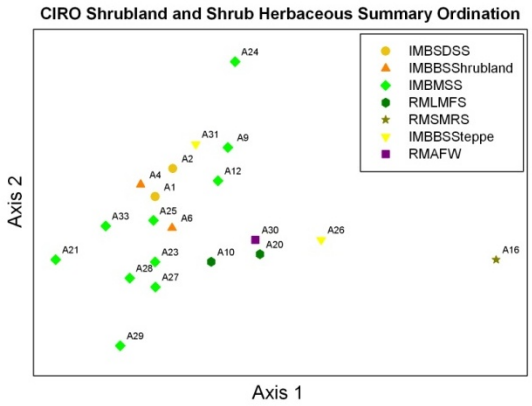
COMMENTS

None.

A21 Mountain Big Sagebrush – Antelope Bitterbrush / Sandberg Bluegrass Shrubland

Artemisia tridentata ssp. *vaseyana – Purshia tridentata / Poa secunda* Shrubland





Description

Artemisia tridentata ssp. *vaseyana* dominates the shrub stratum of this vegetation type and *Purshia tridentata* always co-occurs, often as a co-dominant. Other shrubs, such as *Chrysothamnus viscidiflorus* also common. The shrub canopy ranges from open to crowns nearly touching. The herbaceous layer is generally sparse, but *Poa secunda* is always present. *Agropyron desertorum* occurs in many stands, and where present, it may dominate or co-dominate the herbaceous stratum. *Bromus tectorum*, is also common this throughout the plant community, but generally occurs with low cover values. Common forbs include *Lupinus argenteus* and *Alyssum desertorum.*

This plant association is generally found on xeric sites with shallow soil, usually on, but not limited to, ridges and buttes. Soils may also include silt loams and sandy loams.

CONSERVATION RANK N/A DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 11, AA)

Tree

None

Shrub

Artemisia tridentata ssp. *vaseyana* (mountain big sagebrush) V.20, *Purshia tridentata* (antelope bitterbrush) V.8, *Chrysothamnus viscidiflorus* (green rabbitbrush) V.5, *Opuntia polyacantha* (pricklypear) V.1

Dwarf-shrub

None

Graminoid

Poa secunda (curly bluegrass) V.3, *Bromus tectorum* (cheatgrass) V.1, *Agropyron desertorum* (crested wheatgrass) IV.6

Forb

Lupinus argenteus (silvery lupine) V.1, *Alyssum desertorum* (desert alyssum) V.1

RANGE

City of Rocks National Reserve

Widespread

Global

This plant association likely occurs throughout much of the intermountain western U.S. The distribution of this association is probably somewhat discontinuous, due to the restriction of *Artemisia tridentata* ssp. *vaseyana* to cooler and more mesic higher elevations.

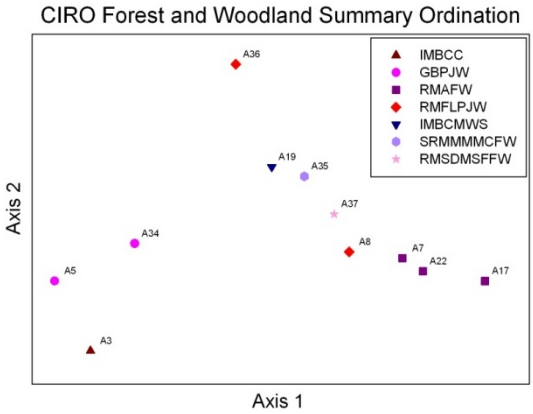
COMMENTS

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2010) at the time this document was produced. Therefore, the plant community description is based on limited data from City of Rocks National Reserve and on related plant communities that have been previously described. The descriptions provided herein may vary slightly from similar plant communities found elsewhere due to the local scale at which data were collected and the lack of a published standard in the NVC.

A22 Quaking Aspen / Kentucky Bluegrass Forest

Populus tremuloides / Poa pratensis Forest





Description

The vegetation of this association is simple both in structure and in composition. *Populus tremuloides* strongly dominates the overstory and cover ranges from moderate to high. Conifers, if present, are sporadic and include *Pinus monophylla, Juniperus scopulorum,* and *Pseudotsuga menziesii*. Shrubs such as *Symphoricarpos oreophilus, Rosa woodsii,* and *Ribes aureum* are occasionally present but are not abundant enough to form a distinct layer. The herbaceous undergrowth is strongly dominated by the introduced, sod-forming graminoid *Poa pratensis*. Several native, herbaceous species may occur as well, but they generally have very low cover. Non-native, weedy forbs such as *Taraxacum officinale, Cirsium arvense,* and *Verbascum thapsus* tend to occur with high frequency but low total cover in this vegetation type.

Populus tremuloides dominated stands represent a common deciduous forest type that occurs on benches and slopes irrespective of slope steepness or aspect. Stands are typically found on deep, well-developed, fine-textured soils that are topographically situated as to receive supplemental moisture in the form of runoff from adjacent slopes.

CONSERVATION RANK N/A DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 3, AA)

Tree

Populus tremuloides (quaking aspen) V.54, *Juniperus scopulorum* (Rocky Mountain juniper) IV.1

Shrub

Symphoricarpos oreophilus (mountain snowberry) IV.2, *Ribes aureum* (golden current) IV.1

Dwarf-shrub

Rosa woodsii (Woods' rose) IV.1

Graminoid

Poa pratensis (Kentucky bluegrass) V.58

Forb

Taraxacum officinale (common dandelion) V.1, *Achillea millefolium* (common yarrow) V.<1, *Cirsium arvense* (Canada thistle) IV.1

RANGE

City of Rocks National Reserve

Primarily located in or near riparian zones.

Global

The *Populus tremuloides* Forest Alliance is widespread in the western United States, the northern Great Plains, and extends into the western Great Lakes area. This *Poa pratensis* Semi-natural Herbaceous Alliance is widespread throughout the Great Plains and into the Midwestern United States and Canada, and can occur where in variety of human-disturbed and native habitats. Stands also occur in the Colorado Plateau and southern Rocky Mountains at montane elevations and elsewhere in the western U.S. where *Poa pratensis* has invaded native western rangeland. Thus, an association characterized by the dominance of these two species has the potential to be widely distributed across the greater range of *Populus tremuloides*, but restricted to stands where *Poa pratensis* has had the opportunity to invade the understory.

COMMENTS

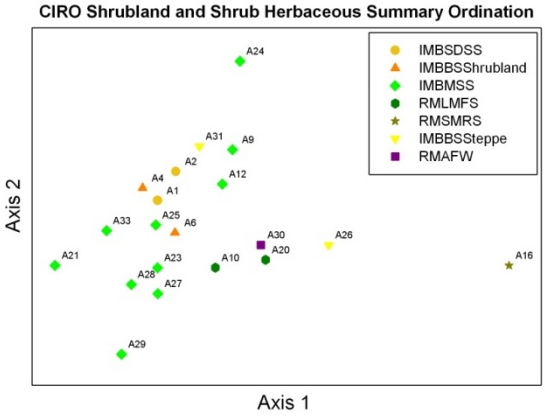
Poa pratensis is widespread in the western U.S. where, following disturbance, its extensive rhizome system allows it to spread and establish, out-competing many native graminoids. It is tolerant of heavy grazing and is adapted well to fire.

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2010) at the time this document was produced. Therefore, the plant community description is based on limited data from City of Rocks National Reserve and on related plant communities that have been previously described. The descriptions provided herein may vary slightly from similar plant communities found elsewhere due to the local scale at which data were collected and the lack of a published standard in the NVC.

A23 Mountain Big Sagebrush / Kentucky Bluegrass Sagebrush Shrubland

Artemisia tridentata ssp. vaseyana / Poa pratensis Sagebrush Shrubland





Description

This montane shrubland association is characterized by moderate cover of *Artemisia tridentata* ssp. *vaseyana* and the introduced, perennial sodgrass, *Poa pratensis*. Other species may be present in the shrub stratum, and include; *Purshia tridentata, Symphoricarpos oreophilus,* and *Chrysothamnus viscidiflorus*. Occasionally, an individual *Populus tremuloides* or *Juniperus scopulorum* tree also occurs within a stand of this vegetation type. The composition of the herbaceous layer varies considerably, both in species richness and in species composition. In addition to *Poa pratensis*, species in the herbaceous layer may include graminoids such as *Elymus lanceolatus, Poa secunda, Achnatherum nelsonii*, and *Bromus tectorum*. *Balsamorhiza sagittata, Lupinus argenteus,* and *Phlox* ssp. are commonly occurring forbs.

This association occurs primarily on valley floors with a few occurrences on moderate slopes with various aspects. Soil types range from sandy loam to clay loam, sometimes with gravel present. Some stands have bare, rocky soil. Most stands occur in close proximity to a variety of disturbances, which facilities establishment of the non-native species found in the assemblage.

CONSERVATION RANK GNR DATABASE CODE CEGL002528

CHARACTERISTIC SPECIES (n = 4, AA)

Tree

None

Shrub

Artemisia tridentata ssp. *vaseyana* (mountain big sagebrush) V.13, *Purshia tridentata* (antelope bitterbrush) IV.4, *Symphoricarpos oreophilus* (mountain snowberry) IV.2, *Chrysothamnus viscidiflorus* (green rabbitbrush) IV.2, *Artemisia tridentata* ssp. *tridentata* (basin big sagebrush) III.5

Dwarf-shrub

None

Graminoid

Poa pratensis (Kentucky bluegrass) V.18, *Elymus lanceolatus* (streambank wheatgrass) V.2, *Poa secunda* (curly bluegrass) IV.1, *Achnatherum nelsonii* (Columbia needlegrass) III.3

Forb

Lupinus argenteus (silvery lupine) IV.2

RANGE

City of Rocks National Reserve

Widespread

Global

This shrubland has been documented from Grand Teton National Park and Fossil Butte National Monument in western Wyoming but is expected to occur throughout the range of mountain big sagebrush where disturbance has converted native understory to introduced species such as *Poa pratensis*.

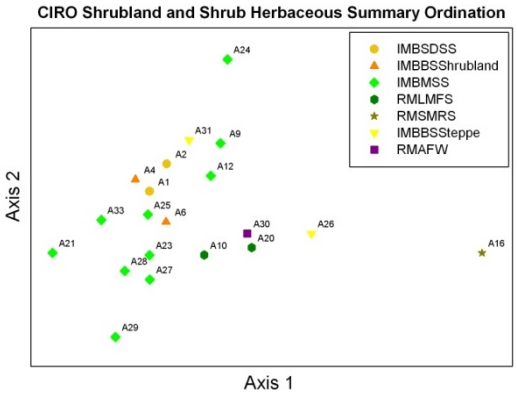
COMMENTS

Invasion of non-native *Poa pratensis* into *Artemisia tridentata ssp. vaseyana*-dominated shrubland stands is common after disturbance. The rhizomatous *Poa pratensis* forms a sod that is unusually resistant to heavy utilization and trampling by livestock. It is generally more tolerant of heavy grazing than native bunch grasses

A24 Black Sagebrush / Bluebunch Wheatgrass Shrubland

Artemisia nova / Pseudoroegneria spicata Shrubland





Description

This is a montane dwarf-shrub steppe association dominated by *Artemisia nova*. Cover of the shrub/dwarf-shrub stratum ranges from low to moderate and other shrubs are generally present. *Artemisia tridentata ssp. wyomingensis*, *Chrysothamnus viscidiflorus*, *Eriogonum microthecum*, *Krascheninnikovia lanata*, *Grayia spinosa*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, *Stenotus acaulis*, and *Symphoricarpos oreophilus* may occur in this vegetation type, but are usually sparse in term of cover. *Pseudoroegneria spicata* is the dominant grass in the herbaceous layer. *Poa secunda* and *Bromus tectorum* are also commonly present. *Poa secunda* may occasionally replace *Pseudoroegneria spicata* as the most abundant grass species in some sites. Forbs tend to be less abundant than grasses and common species may include; *Phlox hoodii*, *Balsamorhiza sagittata*, and *Eriogonum* spp.

This dwarf-shrubland is located on gently to moderately sloping, dry, windswept hills and ridges that may be oriented to any aspect. Soils are shallow, gravelly and are often high in calcium carbonate. Rock and gravel cover much of the unvegetated ground surface with lesser cover of bare ground and litter.

CONSERVATION RANK G4 DATABASE CODE CEGL001424

CHARACTERISTIC SPECIES (n = 6, AA)

Tree

None

Shrub

Pediocactus simpsonii (mountain ball cactus) V.<1

Dwarf-shrub

Artemisia nova (black sagebrush) V.14, *Stenotus acaulis* (stemless mock goldenweed) V.1

Graminoid

Pseudoroegneria spicata (bluebunch wheatgrass) V.5, *Poa secunda* (curly bluegrass) V.4

Forb

Phlox hoodii (Hood's phlox) V.2

RANGE

City of Rocks National Reserve

Coomon in the northern half of CIRO and common in CRSP.

Global

This common and widespread association is distributed 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.

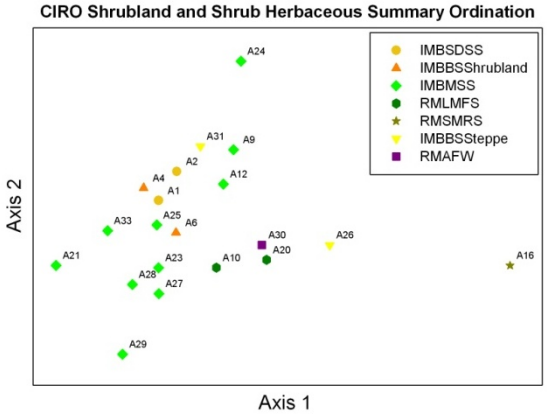
COMMENTS

This association is showing an increase in the presence of the invasive, annual species, *Bromus tectorum*. The invaion of *Bromus tectorum* may be due in part, to the proximity and succebtibility of these plant communities to disturbances.

A25 Mountain Big Sagebrush / Blubunch Wheatgrass Shrubland

Artemisia tridentata ssp. *vaseyana* / *Pseudoroegneria spicata* Shrubland





Description

This shrubland association is co-dominated by *Artemisia tridentata* ssp. *vaseyana* and *Pseudoroegneria spicata.* The shrub canopy is typically open and other shrubs are usually present, but have variable species compositions and are sparse in terms of cover. Additional shrub species may include *Chrysothamnus viscidiflorus*, *Purshia tridentata*, and *Symphoricarpos oreophilus*. The herbaceous stratum is clearly dominated by grasses, which can contribute as much or more cover to the plant community as the shrub stratum. In addition to *Pseudoroegneria spicata*, *Bromus tectorum* can be abundant in or around disturbed stands. Other component grass species may include *Poa bulbosa*, *Poa secunda*, and *Leymus cinereus*. The species composition of forbs in the herbaceous stratum is highly variable from one stand to another, but total forb cover is generally very sparse.

This plant community can occur across a range of slopes and aspects, usually on the upper part of the slope, and on ridgetops, with northeast- to south-facing aspects. Soils are generally deep, with texture ranging from loams to gravely clays.

CONSERVATION RANK G5 DATABASE CODE CEGL001030

CHARACTERISTIC SPECIES (n = 4, AA)

Tree

None

Shrub

Artemisia tridentata ssp. *vaseyana* (mountain big sagebrush) V.11, *Chrysothamnus viscidiflorus* (green rabbitbrush) V.1

Dwarf-shrub

None

Graminoid

Pseudoroegneria spicata (bluebunch wheatgrass) V.13, *Bromus tectorum* (cheatgrass) III.3, *Poa bulbosa* (bulbous bluegrass) III.3

Forb

None

RANGE

City of Rocks National Reserve

Widespread

Global

This is a common, abundant, and widespread sagebrush community in the western U.S. It is described from Nevada, Oregon, Idaho, Montana, Wyoming, Colorado and Utah.

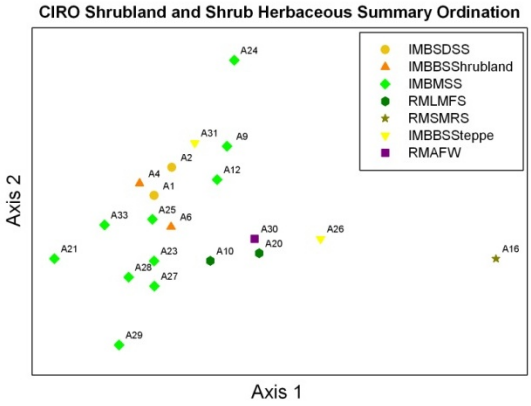
COMMENTS

None.

A26 Basin Big Sagebrush / Kentucky Bluegrass Shrub Herbaceous Vegetation

Artemisia tridentata ssp. *tridentata / Poa pratensis* Shrub Herbaceous Vegetation





Description

Artemisia tridentata ssp. *tridentata* forms a shrub layer up to 1.5-2 m tall, with a relatively open canopy in this shrub herbaceous association. Other shrub species such as *Ericameria nauseosa*, *Salix lutea*, and *Rosa woodsii* are often present, but with lower cover values. *Juniperus scopulorum* occurs sporadically in some stands. *Poa pratensis* is the dominant herbaceous species in the moderate to dense understory. Other common grass species include *Elymus lanceolatus* and *Poa bulbosa*, which tend to occur with high frequency, but low abundance. A number of forbs may also occur in the herbaceous understory and tend to be quite variable in both species composition and abundance.

Stands of this type grow in deep, generally alluvial soils of fans, swales, and draws in intermountain basins and in the foothills of the surrounding mountains. Sites are flat to moderate sloping and are found on all aspects.

CONSERVATION RANK N/A DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 4, AA)

Tree

Juniperus scopulorum (Rocky Mountain juniper) III.7

Shrub

Artemisia tridentata ssp. *tridentata* (basin big sagebrush) IV.16, *Ericameria nauseosa* (rubber rabbitbrush) IV.3, *Salix lutea* (yellow willow) III.4

Dwarf-shrub

Rosa woodsii (Woods' rose) V.2

Graminoid

Poa pratensis (Kentucky bluegrass) V.36, *Elymus lanceolatus* (streambank wheatgrass) IV.2, *Poa bulbosa* (bulbous bluegrass) III.2

Forb

Achillea millefolium (common yarrow) V.1, *Taraxacum officinale* (common dandelion) V.1, *Cirsium arvense* (Canada thistle) III.2

RANGE

City of Rocks National Reserve

Widespread

Global

The *Artemisia tridentata* ssp. *tridentata* Shrub Herbaceous Alliance in known from deep soils in basins and foothills of Idaho, Montana and Wyoming Rocky Mountains west to eastern Washington, eastern Oregon, and northeastern California. The distribution of this association is likely restricted to locations where disturbance regimes have facilitated the establishment and persistence of *Poa pratensis*.

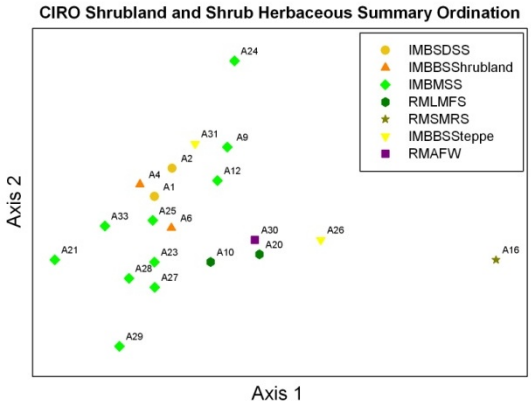
COMMENTS

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2010) at the time this document was produced. Therefore, the plant community description is based on limited data from City of Rocks National Reserve and on related plant communities that have been previously described. The descriptions provided herein may vary slightly from similar plant communities found elsewhere due to the local scale at which data were collected and the lack of a published standard in the NVC.

A27 Mountain Big Sagebrush – Mountain Snowberry Shrubland

Artemisia tridentata ssp. *vaseyana* – *Symphoricarpos oreophilus* Shrubland





Description

This shrubland association is co-dominated by *Artemisia tridentata* ssp. *vaseyana* and *Symphoricarpos oreophilus*; sometimes one is more dominant than the other, but both are always abundant. Total cover of the shrub stratum ranges from moderate to dense. *Chrysothamnus viscidiflorus* is also common in the shrub canopy. Herbaceous cover of this plant community is moderate. Graminoids and forbs both tend to be abundant and diverse. Where present, *Achnatherum nelsonii* typically has relatively high cover values. Other grasses may include; *Poa pratensis, Pseudoroegneria spicata,* and *Poa secunda. Balsamorhiza sagittata, Lupinus argenteus,* and *Mertensia oblongifolia* are the most constant and abundant forbs in this vegetation type.

This sagebrush community generally occurs on higher elevation, more mesic sites, and the abundance of *Symphoricarpos oreophilus* generally restricts distributions to southern exposures. Soils are deep and tend to have fine loam texture with gravel fragments.

CONSERVATION RANK N/A DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 10, AA)

Tree

Pinus monophylla (singleleaf pinyon) IV.2

Shrub

Artemisia tridentata ssp. *vaseyana* (mountain big sagebrush) V.17, *Symphoricarpos oreophilus* (mountain snowberry) V.12, *Chrysothamnus viscidiflorus* (green rabbitbrush) V.6

Dwarf-shrub

N/A

Graminoid

Poa pratensis (Kentucky bluegrass) IV.5, *Achnatherum nelsonii* (Columbia needlegrass) III.8

Forb

Balsamorhiza sagittata (arrowleaf balsamroot) V.4, *Lupinus argenteus* (silvery lupine) V.1, *Mertensia oblongifolia* (oblongleaf bluebells) IV.1

RANGE

City of Rocks National Reserve

Widespread

Global

This distribution of this association is likely limited to microsites with appropriate abiotic conditions conducive for mountain snowberry co-dominance within the greater range of mountain big sagebrush. Patch size is probably small to moderate but the association has the potential to occur across much of the intermountain western U.S.

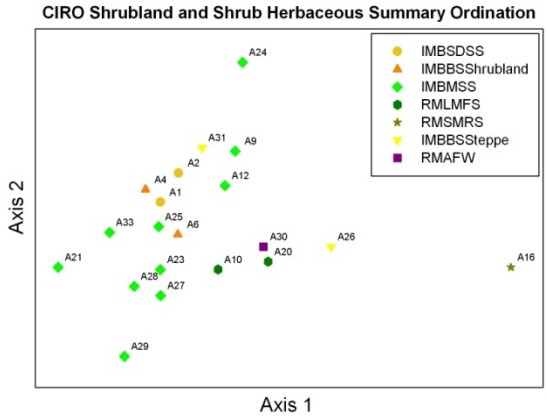
COMMENTS

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2010) at the time this document was produced. Therefore, the plant community description is based on limited data from City of Rocks National Reserve and on related plant communities that have been previously described. The descriptions provided herein may vary slightly from similar plant communities found elsewhere due to the local scale at which data were collected and the lack of a published standard in the NVC.

A28 Mountain Big Sagebrush / Idaho Fescue Shrub Herbaceous Vegetation

Artemisia tridentata ssp. *vaseyana* / *Festuca idahoensis* Shrub Herbaceous Vegetation





Description

This herbaceous shrubland is characterized by an open shrub layer of *Artemisia tridentata* ssp. *vaseyana* and moderate cover of perennial graminoids in the understory. In addition to *Artemisia tridentata* ssp. *vaseyana*, associated shrubs often include *Symphoricarpos oreophilus*, *Chrysothamnus viscidiflorus*, *Eriogonum heracleoides*, and *Eriogonum microthecum.* The herbaceous layer is dominated by *Festuca idahoensis*. Other important graminoid species include *Pseudoroegneria spicata* and *Poa secunda*. Forb cover and species composition are variable; species of *Castilleja, Phlox, Balsamorhiza, Antennaria, Comandra, Mertensia, Astragalus, Lupinus, Collinsia, Delphinium, Achillea*, *Penstemon* and *Eriogonum* may be common.

This *Artemisia tridentata* ssp. *vaseyana*-dominated shrub herbaceous association occupies the coolest and most mesic climate zone of the *Artemisia tridentata* shrubland and shrub herbaceous complex. This open shrubland often occurs above lower treeline as patches within montane or subalpine coniferous forests. The climate regime is cool, semi-arid to subhumid. Much of the yearly precipitation falls as snow, which may cover the ground for long periods in winter. Appropriate habitats include deep-soiled to stony flats, valley bottoms, flat terraces, ridges, nearly flat ridgetops, and mountain slopes. Soils generally are moderately deep to deep, somewhat well-drained, and of loam, sandy loam, clay loam, or gravelly loam textural classes, often having a substantial volume of coarse fragments.

CONSERVATION RANK G5 DATABASE CODE CEGL001533

CHARACTERISTIC SPECIES (n = 6, AA)

Tree

Pinus monophylla (singleleaf pinyon) IV.1

Shrub

Artemisia tridentata ssp. *vaseyana* (mountain big sagebrush) V.20, *Symphoricarpos oreophilus* (mountain snowberry) V.5, *Chrysothamnus viscidiflorus* (green rabbitbrush) V.2

Dwarf-shrub

Eriogonum heracleoides (parsnipflower buckwheat) V.1, *Eriogonum microthecum* (slender buckwheat) V.<1

Graminoid

Festuca idahoensis (Idaho fescue) V.20, *Pseudoroegneria spicata* (bluebunch wheatgrass) V.3, *Poa secunda* (curly bluegrass) IV.1

Forb

Antennaria microphylla (littleleaf pussytoes) V.4, *Balsamorhiza sagittata* (arrowleaf balsamroot) V.2, *Comandra umbellata* (bastard toadflax) V.1, *Mertensia oblongifolia* (oblongleaf bluebells) V.1, *Lupinus argenteus* (silvery lupine) V.1, *Castilleja flava* (yellow Indian paintbrush) V.1, *Phlox hoodii* (Hood's phlox) V.<1

RANGE

City of Rocks National Reserve

Widespread

Global

This is a wide-ranging association, known throughout the northwestern U.S. It occurs in eastern Oregon, Nevada, Utah, Colorado, Wyoming, Montana, Idaho, possibly further north into Alberta and British Columbia. It may also occur occasionally in eastern California.

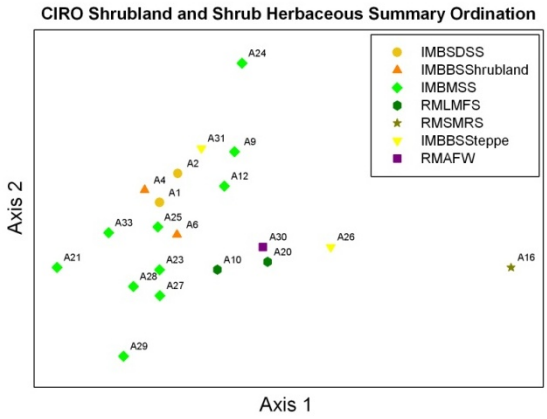
COMMENTS

None.

A29 Mountain Big Sagebrush / Spike Fescue Shrubland

Artemisia tridentata ssp. *vaseyana* / *Leucopoa kingii* Shrubland





Description

This sagebrush shrubland has a moderately open, mixed shrub canopy dominated by *Artemisia tridentata* ssp. *vaseyana*. *Chrysothamnus viscidiflorus*, *Symphoricarpos oreophilus*, and several other shrubs such as *Prunus virginiana* and *Ribes cereum* often contribute to the shrub stratum. The substantial herbaceous understory is dominated by *Leucopoa kingii*. *Leymus cinereus* also contributes significant cover to the herbaceous stratum in many, but not all stands. Common forbs include *Balsamorhiza sagittata*, *Lupinus argenteus*, *Viola purpurea*, *Eriogonum* ssp., and *Phlox* ssp.

This shrubland is found slopes ranging from gentle to steep and on various aspects. Lower elevation sites are restricted to cooler northerly slopes or locally relatively mesic sites. Litter covers much of the unvegetated ground surface with low to moderate bare ground cover. Soils are of a sedimentary substrate.

CONSERVATION RANK G3 DATABASE CODE CEGL001025

CHARACTERISTIC SPECIES (n = 5, AA)

Tree

None

Shrub

Artemisia tridentata ssp. *vaseyana* (mountain big sagebrush) V.21, *Symphoricarpos oreophilus* (mountain snowberry) V.2, *Chrysothamnus viscidiflorus* (green rabbitbrush) V.2

Dwarf-shrub

None

Graminoid

Leucopoa kingii (spike fescue) IV.14, *Leymus cinereus* (basin wildrye) III.10

Forb

Lupinus argenteus (silvery lupine) V.1, *Viola purpurea* (goosefoot violet) V.<1, *Balsamorhiza sagittata* (arrowleaf balsamroot) IV.3

RANGE

City of Rocks National Reserve

Widespread

Global

This shrubland association is found in southern Idaho and north-central Colorado, as well as in western Wyoming. It may also occur in Nevada but has not been formally documented.

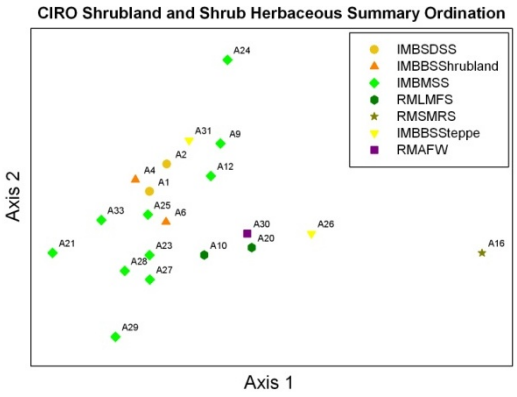
COMMENTS

A decline in the number, condition, and size of stands is due to intensive livestock grazing, introduction of exotic species, land-use conversion, and alteration in fire regime. Off-road vehicle recreation also results in an increase of two-track road development and fragmentation of stands.

A30 Tobacco-brush Shrubland

Ceanothus velutinus Shrubland





Description

The composition of this shrubland association is strongly dominated by a dense canopy of *Ceanothus velutinus.* Other shrubs may occur sporadically and include; *Symphoricarpos oreophilus*, *Prunus virginiana, Mahonia repens, Artemisia tridentata, Cercocarpus ledifolius,* and *Rosa* spp. A variety of herbaceous species may be present, including; *Achnatherum nelsonii*, *Elymus* spp., *Balsamorhiza sagittata, Viola purpurea, Eriogonum umbellatum.* The herbaceous stratum tends to be sparse and component grass and forb species generally occur in the looser "openings" in the shrub layer.

Patches of this montane shrubland occur on mesic slopes and mountains. 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 and tend to be located on cooler north or east aspects. Parent materials can be variable, and soils are well-drained, rocky and generally coarse in texture.

CONSERVATION RANK GNR DATABASE CODE CEGL002167

CHARACTERISTIC SPECIES (n = 3, AA)

Tree

None

Shrub

Ceanothus velutinus (tobacco-brush) V.62, *Prunus virginiana* (chokecherry) V.4, *Symphoricarpos oreophilus* (mountain snowberry) V.2

Dwarf-shrub

Mahonia repens (creeping barberry) V.<1

Graminoid

Achnatherum nelsonii (Columbia needlegrass) V.2

Forb

Balsamorhiza sagittata (arrowleaf balsamroot) V.<1, *Viola purpurea* (goosefoot violet) V.<1

RANGE

City of Rocks National Reserve

Common in the north and west parts of the study area

Global

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.

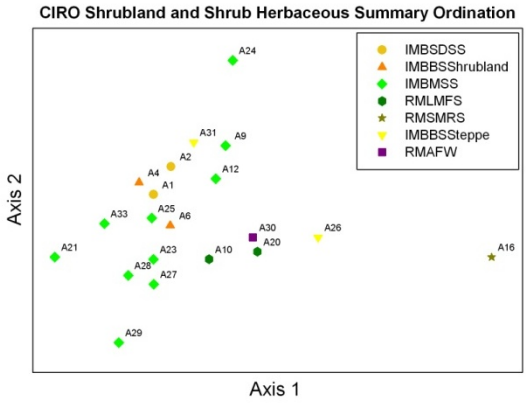
COMMENTS

This plant community generally occurs on mesic slopes that have experienced severe disturbance from either logging or burning. *Ceanothus velutinus* is known to resprout after disturbance, and its seeds require the intense heat of fire to germinate. As forests regenerate following fire, *Ceanothus velutinus* is gradually shaded out, but seeds of the shrub can remain viable for several centuries until the next fire cycle destroys the forest stand that replaced it.

A31 Antelope Bitterbrush / Bluebunch Wheatgrass Shrub Herbaceous Vegetation

Purshia tridentata / Pseudoroegneria spicata Shrub Herbaceous Vegetation





Description

Relatively open stands of *Purshia tridentata* characterize the shrub layer of this herbaceous shrubland. Other shrub species often occur but typically contribute very little cover. The herbaceous layer is very diverse and graminoids tend to dominate. *Pseudoroegneria spicata* is typically the most abundant grass; however, *Poa secunda, Koeleria macrantha, Elymus elymoides,* and *Achnatherum nelsonii* are often common to locally abundant. The non-native grasses, *Poa pratensis, Poa bulbosa,* and *Bromus tectorum* may also be dominant to co-dominant in individual stands of the association. *Alyssum desertorum* is most common forb in plant communities of this type at City of Rocks National Reserve, and total forb cover is generally sparse.

The association occurs on steep, south-facing, mid to upper slopes. Soils are typically dry, shallow, and rocky. A high exposure of rock and surface soil is common.

CONSERVATION RANK G3 DATABASE CODE CEGL001495

CHARACTERISTIC SPECIES (n = 4, AA)

Tree

Pinus monophylla (singleleaf pinyon) IV.1

Shrub

Purshia tridentata (antelope bitterbrush) V.15, *Amelanchier utahensis* (Utah serviceberry) V.1

Dwarf-shrub

Artemisia nova (black sagebrush) IV.3

Graminoid

Pseudoroegneria spicata (bluebunch wheatgrass) V.5, *Poa secunda* (curly bluegrass) V.4, *Koeleria macrantha* (prairie Junegrass) V.1, *Poa pratensis* (Kentucky bluegrass) IV.7, *Poa bulbosa* (bulbous bluegrass) IV.3, Bromus *tectorum* (cheatgrass) IV.2, *Elymus elymoides* (bottlebrush squirreltail) IV.1, *Achnatherum nelsonii* (Columbia needlegrass) III.5

Forb

Alyssum desertorum (desert alyssum) V.1

RANGE

City of Rocks National Reserve

Isolated pocket in the north and west parts of the study area..

Global

The association is reported for sites in the Eastern Cascades, Blue Mountains, and Bitterroot Valley ecoregional sections.

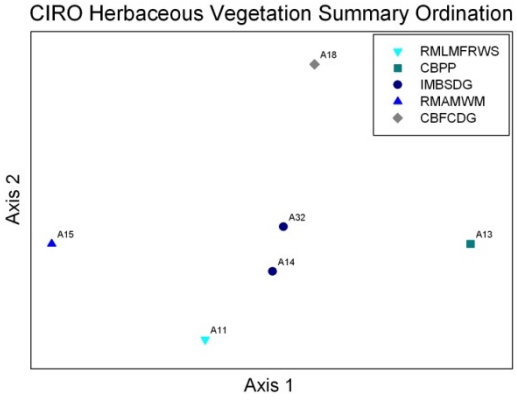
COMMENTS

Stands are clustered in discrete centers of occurrence. Very few, high-quality, representative stands are known. Nearly all of the known stands are reported to be in poor condition. The condition of occurrences is declining due to the cumulative effects of the establishment and increased abundance of exotic annual grass species, the decline in perennial bunch grass abundance, and the subsequent loss of resilience of stands to fire disturbance events.

A32 Cheatgrass Semi-natural Herbaceous Alliance

Bromus tectorum Semi-natural Herbaceous Alliance





Description

The vegetation in this association is dominated by *Bromus tectorum*, an introduced, annual grass species. Total vegetation cover may be highly variable. Native species persist in some stands, however cover and diversity are typically low, and component native species can be quite variable depending on the plant community that was present prior to the conversion to introduced herbaceous species. Native shrubs may occur sporadically with low densities. *Chrysothamnus viscidiflorus* and *Ericameria nauseosa* are the most constant native shrubs in this association. *Poa secunda* is the most frequently occurring and abundant native grass in this community type, although many other native grass species may occur with sparse cover and variable species composition as well. Several native perennial and annual forb species may also be sparse and variable across stands of this type. *Sisymbrium altissimum*, *Tragopogon dubius*, and *Alyssum desertorum* occur with the greatest frequency in this vegetation type.

This association can occur across a wide range of environmental conditions in semi-arid ecosystems and is not tightly constrained by slope, aspect, soil texture, or soil depth. This association often occurs on or near sites that have been disturbed.

CONSERVATION RANK N/A DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 6, AA)

Tree

None

Shrub

Ericameria nauseosa (rubber rabbitbrush) III.3

Dwarf-shrub

None

Graminoid

Bromus tectorum (cheatgrass) V.37, *Poa secunda* (curly bluegrass) V.1

Forb

Sisymbrium altissimum (tall tumblemustard) V.3, *Tragopogon dubius* (yellow salsify) V.<1, *Alyssum desertorum*

(desert alyssum) IV.1

RANGE

City of Rocks National Reserve

Heaviest concentration in the southern area outside of CIRO boundary. Populations in all areas but not common in CIRO or CRSP.

Global

The distribution of this association coincides with the range the *Bromus tectorum* Semi-natural Herbaceous Alliance, which occurs throughout much of western North America from the western Great Plains to the intermountain and southwestern U.S.

COMMENTS

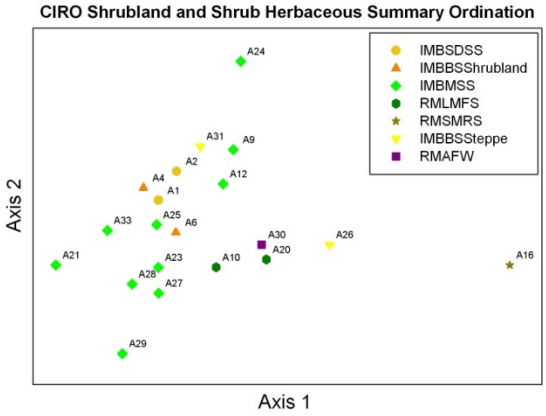
The unique life history characteristics of *Bromus tectorum* and the altered ecological process associated with this species have promoted the spread of it and other exotic annual bromes at the expense of sagebrush shrublands and related assemblages in large parts of the western U.S. Consequently, this species tends to dominate or codominate primarily on sites that have been severely impacted.

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2010) at the time this document was produced. Therefore, the plant community description is based on limited data from City of Rocks National Reserve and on related plant communities that have been previously described. The descriptions provided herein may vary slightly from similar plant communities found elsewhere due to the local scale at which data were collected and the lack of a published standard in the NVC.

A33 Mountain Big Sagebrush – Antelope Bitterbrush / Streambank Wheatgrass Shrubland

Artemisia tridentata ssp. *vaseyana – Purshia tridentata / Elymus lanceolatus* Shrubland





Description

Artemisia tridentata ssp. *vaseyana* dominates the shrub stratum of this vegetation type with *Purshia tridentata* generally occurring as a co-dominant. Other shrubs, such as *Chrysothamnus viscidiflorus, Eriogonum microthecum, Cercocarpus ledifolius,* and *Symphoricarpos oreophilus* are also common, contributing to a relatively diverse shrub layer. *Elymus lanceolatus* often dominates the somewhat sparse herbaceous understory. However, other perennial grasses, such as *Poa bulbosa, Poa secunda*, *Pseudoroegneria spicata*, and *Bromus tectorum* may be locally abundant in stands throughout the vegetation type. Common forbs include; *Balsamorhiza sagittata, Alyssum desertorum, Allium acuminatum, Phlox longifolia,* and *Zigadenus paniculatus*. Total forb cover is typically low.

This plant association is generally found on xeric sites with shallow soil, usually on, but not limited to, ridges and hillsides. Soils include silt loams and sandy loams.

CONSERVATION RANK N/A DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 5, AA)

Tree

None

Shrub

Artemisia tridentata ssp. *vaseyana* (mountain big sagebrush) V.5, *Purshia tridentata* (antelope bitterbrush) V.4, *Opuntia polyacantha* (pricklypear) V.2, *Chrysothamnus viscidiflorus* (green rabbitbrush) V.2, *Cercocarpus ledifolius* (curl-leaf mountain mahogany) III.2

Dwarf-shrub

Eriogonum microthecum (slender buckwheat) V.1

Graminoid

Elymus lanceolatus (streambank wheatgrass) V.3, *Poa bulbosa* (bulbous bluegrass) V.3, *Bromus tectorum* (cheatgrass) V.2, *Poa secunda* (curly bluegrass) V.2, *Pseudoroegneria spicata* (bluebunch wheatgrass) V.1

Forb

Balsamorhiza sagittata (arrowleaf balsamroot) V.1, *Alyssum desertorum* (desert alyssum) V.1, *Allium acuminatum* (tapertip onion) V.<1, *Phlox longifolia* (longleaf phlox) V.<1, *Zigadenus paniculatus* (foothill

deathcamas) V.<1

RANGE

City of Rocks National Reserve

Widespread

Global

This association likely occurs as limited patches within the greater overlapping ranges of the co-dominant shrub species throughout much of the intermountain western U.S. The distribution of this association is probably discontinuous, partly due to the restriction of *Artemisia tridentata* ssp. *vaseyana* to cooler and more mesic higher elevations.

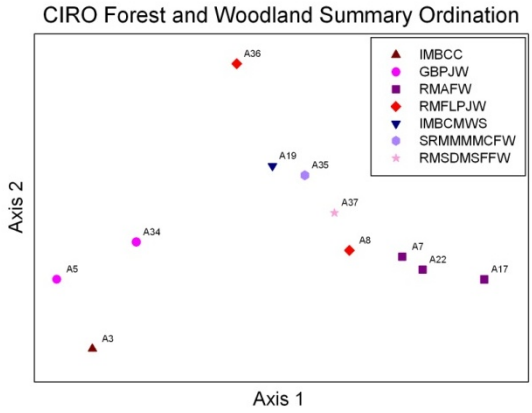
COMMENTS

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2010) at the time this document was produced. Therefore, the plant community description is based on limited data from the City of Rocks and on related plant communities that have been previously described. The descriptions provided herein may vary slightly from similar plant communities found elsewhere due to the local scale at which data were collected and the lack of a published standard in the NVC.

A34 Singleleaf Pinyon / Curl-leaf Mountain-mahogany Woodland

Pinus monophylla / *Cercocarpus ledifolius* Woodland





Description

The vegetation of this association is characterized by an open tree canopy dominated by *Pinus monophylla* with a significant tall-shrub layer of *Cercocarpus ledifolius*. Stands of this pinyon-shrub type may contain several additional shrub species, including; *Symphoricarpos oreophilus*, *Purshia tridentata*, *Artemisia tridentata* ssp. *vaseyana*, and *Eriogonum microthecum*. Although these associated shrubs species occur frequently in the plant community, total cover is usually low. Herbaceous cover is generally sparse and results from a mix of grasses and forbs. *Poa secunda* is the most common grass species and *Balsamorhiza sagittata* is the most constant forb. Forb composition can be diverse and is variable from one stand to another.

Stands occur on flat to moderately sloping sites on all aspects. The soils are variable, but are typically shallow and rocky. Litter from trees often covers about half the ground surface. Cover of rock, pavement or bare ground may also be significant depending on the site.

CONSERVATION RANK G5 DATABASE CODE CEGL00828

CHARACTERISTIC SPECIES (n = 5, AA)

Tree

Pinus monophylla (singleleaf pinyon) V.11

Shrub

Cercocarpus ledifolius (curl-leaf mountain-mahogany) V.12, *Symphoricarpos oreophilus* (mountain snowberry) IV.2, *Opuntia polyacantha* (pricklypear) IV.2, *Purshia tridentata* (antelope bitterbrush) IV.1, *Artemisia tridentata* ssp. *vaseyana* (mountain big sagebrush) IV.1

Dwarf-shrub

Eriogonum microthecum (slender buckwheat) IV.1

Graminoid

Poa secunda (curly bluegrass) V.1

Forb

Balsamorhiza sagittata (arrowleaf balsamroot) IV.1

RANGE

City of Rocks National Reserve

Widespread

Global

This woodland association typically occurs in the Great Basin and northern Mojave Desert. However, its presence in Idaho has been documented at the City of Rocks National Reserve and likely occurs in other areas around the state.

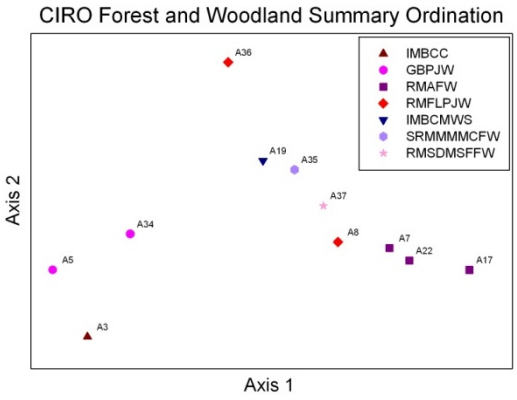
COMMENTS

None.

A35 Douglas-fir / Rocky Mountain Maple Forest

Pseudotsuga menziesii / Acer glabrum Forest





Description

This forest association is characterized by a *Pseudotsuga menziesii*-dominated tree canopy with *Acer glabrum* conspicuous in a shorter tree layer. The evergreen needle-leaved tree canopy is generally moderately dense to dense, although some stands may occasionally have relatively open canopies. Other tree species such as *Juniperus scopulorum* and *Pinus contorta* may be present but sparse. An open to moderately dense shrub layer is usually present and is often comprised of *Mahonia repens*, *Prunus virginiana*, *Rosa* spp., *Ribes cereum*, and *Symphoricarpos oreophilus* or some combination thereof. Herbaceous cover is generally low and results primarily from forbs. Common forb species include; *Smilacina racemosa*, *Osmorhiza occidentalis*, *Thalictrum fendleri*, and *Galium* ssp.

This association occurs in the montane zone. Sites are cool and moist, generally occurring on northern or eastern aspects, on steep, mid to lower slopes, and ravines or stream bottoms where cold-air drainage is a factor. Substrates are variable and may be gravelly, with soil texture ranging from sandy loam to clay derived from colluvium. The ground surface has high cover of litter 3-7 cm deep, sometimes with significant cover of rock, and low cover of bare soil.

CONSERVATION RANK G4 DATABASE CODE CEGL000418

CHARACTERISTIC SPECIES (n = 3, AA)

Tree

Pseudotsuga menziesii (Douglas-fir) V.44, *Acer glabrum* (Rocky Mountain maple) V.7, *Juniperus scopulorum* (Rocky Mountain juniper) V.1

Shrub

Prunus virginiana (chokecherry) V.4, *Ribes cereum* (whiskey current) IV.2, *Symphoricarpos oreophilus* (mountain snowberry) IV.1

Dwarf-shrub

Mahonia repens (creeping barberry) V.5

Graminoid

None

Forb

Smilacina racemosa (feathery false lily of the valley) IV.5, *Osmorhiza occidentalis* (western sweetroot) IV.4, *Thalictrum fendleri* (Fendler's meadow-rue) IV.1, *Galium aparine* (stickywilly) IV.1, *Claytonia perfoliata* (miner's lettuce) IV.1

RANGE

City of Rocks National Reserve

Common in northwest area of CIRO

Global

This forest association occurs in the montane zone in the southern, central and northern Rocky Mountains from northern Colorado, through Utah, Wyoming, and Idaho, extending into Oregon and Alberta, and Montana

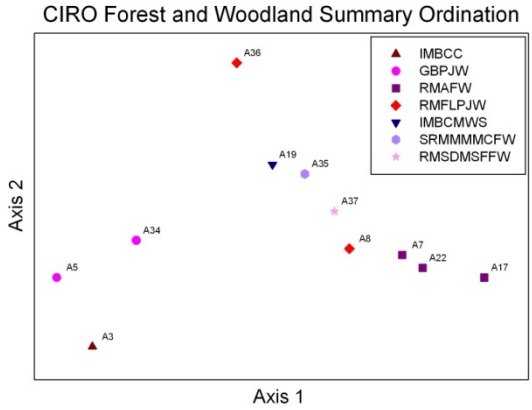
COMMENTS

None

A36 Limber Pine Woodland Alliance

Pinus flexilis Woodland Alliance





Description

Stands of this alliance are dominated the evergreen needle-leaved tree, *Pinus flexilis*. Other trees species that may be present, or occasionally co-dominant, include; *Pseudotsuga menziesii, Pinus contorta, Juniperus scopulorum* and *Populus tremuloides.* Understory vegetation is typically sparse because sites are dry and have a large cover of rock. The sparse shrub layer may include *Artemisia tridentata, Cercocarpus ledifolius, Symphoricarpos oreophilus, Prunus virginiana, Chrysothamnus viscidiflorus* and *Mahonia repens*. A sparse herbaceous layer is often characteristic of this plant community and herbaceous species are generally a mix of grasses and forbs. The most common grasses are *Poa secunda, Elymus lanceolatus,* and *Pseudoroegneria spicata*. Forbs may include species of *Achillea, Collinsia,* and *Viola*.

Woodlands included in this alliance occur intermittently from timberline to lower montane and foothill zones. Sites are typically xeric on exposed, windswept rocky slopes and ridges. These open woodlands occur on all aspects, but are most common on dry south- and west-facing slopes. Soils are typically shallow, skeletal and coarse-textured such as gravelly, sandy loams or loams, but may include alkaline clays.

CONSERVATION RANK N/A DATABASE CODE A.540

CHARACTERISTIC SPECIES (n = 2, AA)

Tree

Pinus flexilis (limber pine) V.19, *Pseudotsuga menziesii* (Douglas-fir) III.3, *Pinus contorta* (lodgepole pine) III.3

Shrub

Symphoricarpos oreophilus (mountain snowberry) V.2, *Cercocarpus ledifolius* (curl-leaf mountain-mahogany) III.5, *Prunus virginiana* (chokecherry) III.3

Dwarf-shrub

None

Graminoid

Poa secunda (curly bluegrass) V.3, *Elymus lanceolatus* (streambank wheatgrass) III.3

Forb

Collinsia parviflora (maiden blue eyed Mary) V.<1, *Viola purpurea* (goosefoot violet) V.<1, *Mertensia oblongifolia* (oblongleaf bluebells) III.3

RANGE

City of Rocks National Reserve

Present in northern part of CIRO

Global

Stands included in this widespread woodland alliance occur intermittently throughout the Rocky Mountains and on mountains and plateaus in the Great Basin and Colorado Plateau, and on breaks in basins and plains in Wyoming and the northwestern Great Plains. The alliance ranges from Montana to New Mexico and from western North Dakota to southern California. It also occurs in Alberta, where the species reaches its northern limit in North America.

This alliance is uncommon at City of Rocks National Reserve. Due to the limited spatial extent of occurrence and associated low sample size, the classification of this plant community is considered provisional. Consequently, the characteristic species list for this plant community at City of Rocks also limited.

This plant community was only classified to the alliance level at City of Rocks due to limited plot data and high variability among stands.

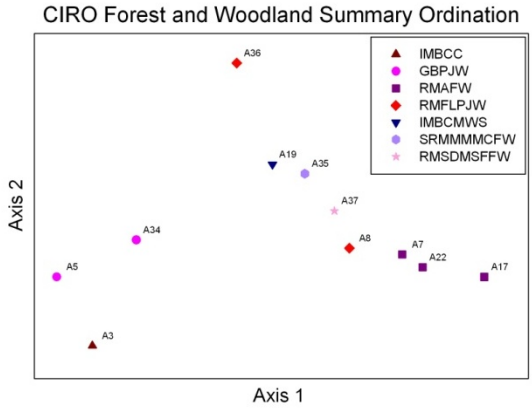
COMMENTS

None.

A37 Subalpine fir / Sparse Woodland

Abies lasiocarpa / Sparse Woodland





Description

Older stands of these woodlands are characterized by *Abies lasiocarpa* dominating an open tree canopy, often with *Populus tremuloides* occurring sporadically throughout. In younger stands, other conifers such as *Pinus contorta* can be present but do not contribute significantly to cover. This association has a distinct, but generally sparse shrub layer. *Ribes viscosissimum* and *Symphoricarpos oreophilus* occur regularly. The herbaceous layer is sparse in terms of cover but diverse with respect to species richness and tends to be comprised of primarily forbs. Common forbs include; *Osmorhiza depauperata, Hackelia floribunda, Viola purpurea, Thalictrum fendleri,* and *Smilacina racemosa*.

These upper montane or subalpine woodlands are found in cool and relatively dry climate regimes. Similar microsites are necessary for *Abies lasiocarpa* to successfully occupy a location near the lower elevation limits of its distribution, on droughty substrates like scree slopes or lava fields, or on southerly or westerly slopes and ridgetops. Snowpacks can be deep, but often melt quickly, and summers are cool. Soils are typically shallow, poorly developed, with significant amounts of rock and gravel in the profile.

CONSERVATION RANK N/A DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 3, AA)

Tree

Abies lasiocarpa (subalpine fir) V.31, *Populus tremuloides* (quaking aspen) V.2, *Pinus contorta* (lodgepole pine) IV.2

Shrub

Ribes viscosissimum (sticky current) V.2, *Symphoricarpos oreophilus* (mountain snowberry) IV.1

Dwarf-shrub

Mahonia repens (creeping barberry) IV.1

Graminoid

Carex rossii (Ross' sedge) IV.1

Forb

Osmorhiza depauperata (bluntseed sweetroot) V.1, *Hackelia floribunda* (manyflower stickseed) V.<1, *Viola purpurea* (goosefoot violet) V.<1, *Thalictrum fendleri* (Fendler's meadow-rue) IV.1, *Smilacina racemosa* (feathery false lily of the valley) IV.1

RANGE

City of Rocks National Reserve

Primarily found in Northeast part of study area..

Global

These subalpine woodlands likely occur as scattered patches throughout the range of *Abies lasiocarpa*, including locations, from southern British Columbia, Canada, the Olympic Peninsula of Washington, east into the northern Rocky Mountains, and south into the southern Rocky Mountains of Arizona and New Mexico.

COMMENTS

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2010) at the time this document was produced. Therefore, the plant community description is based on limited data from City of Rocks National Reserve and on related plant communities that have been previously described. The descriptions provided herein may vary slightly from similar plant communities found elsewhere due to the local scale at which data were collected and the lack of a published standard in the NVC.

Appendix E – Plant Species List for CIRO

[Source: UCBN 2008]

Family, Genus, Species, Subspecies, Variety	Common Name
Aceraceae:	**Maple Family**
Acer glabrum var. douglasii	Douglas maple
Acer negundo	boxelder
Amaranthaceae:	**Amaranth Family:**
Amaranthus albus	prostrate pigweed
Amaranthus blitoides	mat amaranth
Amaranthus retroflexus	redroot pigweed
Apiaceae:	**Carrot Family:**
Carum carvi	wild caraway
Cicuta maculata	water hemlock
Conium maculatum	Poison hemlock
Cymopterus davisii	Davis' springparsley
Cymopterus purpurascens	widewing springparsley
Heracleum lanatum	cow parsnip
Heracleum maximum	cow parsnip
Lomatium dissectum var. eatonii	biscuitroot
Lomatium foeniculaceum var. macdougalii	biscuitroot
Lomatium nudicaule	barestem biscuitroot
Lomatium triternatum var. platycarpum	biscuitroot
Orogenia linearifolia	Indianpotato
Osmorhiza berteroi	sweet cicely
Osmorhiza chilensis	sweetroot
Osmorhiza depauperata	bluntseed sweetroot
Osmorhiza occidentalis	western sweetroot
Pastinaca sativa	wild parsnip
Perideridia montana	yampah
Asclepiadaceae:	**Milkweed Family:**
Asclepias speciosa	showy milkweed
Asteraceae:	**Aster or Sunflower Family:**
Achillea millefolium var. lanulosa	common yarrow
Achillea millefolium var. occidentalis	western yarrow
Ageratina occidentalis	western eupatorium
Agoseris aurantiaca	orange agoseris
Agoseris glauca var. dasycephala	pale agoseris
Agoseris glauca var. glauca	pale agoseris
Agoseris glauca var. laciniata	pale agoseris
Agoseris heterophylla	annual goatsbeard
Antennaria dimorpha	low pussytoes
Antennaria microphylla	littleleaf pussytoes
Arctium minus	common burdock
Arnica cordifolia	heartleaf arnica
Arnica sororia	meadow arnica
Artemisia arbuscula	low sagebrush
Artemisia biennis	biennial sagewort
Artemisia dracunculus	false tarragon
Artemisia ludoviciana var. incompta	prairie sagebrush
Artemisia ludoviciana var. latifolia	prairie sagebrush
Artemisia ludoviciana var. ludoviciana	prairie sagebrush
Artemisia nova	black sagebrush
Artemisia tridentata ssp. tridentata	basin big sagebrush
Artemisia tridentata ssp. vaseyana	mountain big sagebrush
Aster foliaceus	leafy aster
Aster hesperius	ditchbank aster
Balsamorhiza hookeri var. hispidula	hairy balsamroot
Balsamorhiza sagittata	arrowleaf balsamroot
Brickellia californica	California brickellbush
Brickellia grandiflora	mountain brickellbush
Carduus nutans	musk thistle
Centaurea biebersteinii	spotted knapweed

Chaenactis douglasii	Douglas' pincushion
Chrysothamnus nauseosus ssp. albicaulis	rubber rabbitbrush
Chrysothamnus nauseosus ssp. consimilis	rubber rabbitbrush
Chrysothamnus viscidiflorus ssp. lanceolatus	lanceleaf low rabbitbrush
Chrysothamnus viscidiflorus ssp. puberulus	yellow rabbitbrush
Cichorium intybus	chicory
Cirsium arvense	Canada thistle
Cirsium arvense var. horridum	Canada thistle
Cirsium neomexicanum var. utahense	Utah thistle
Cirsium undulatum	wavyleaf thistle
Cirsium vulgare	bull thistle
Conyza canadensis	Canada horseweed
Crepis acuminata	long-leaf hawksbeard
Crepis intermedia	gray hawksbeard
Crepis modocensis ssp. modocensis	Modoc hawksbeard
Ericameria nana	dwarf goldenbush
Erigeron asperugineus	Idaho daisy
Erigeron compositus var. glabratus	fernleaf fleabane
Erigeron divergens	spreading daisy
Erigeron lonchophyllus	low-meadow fleabane
Erigeron nanus	dwarf fleabane
Erigeron peregrinus ssp. callianthemus var. eucallianthemus	mountain daisy
Erigeron pumilus ssp. concinnoides var. euconcinnoides	low fleabane
Erigeron speciosus var. macranthus	aspen daisy
Erigeron tener	slender daisy
Eriophyllum lanatum var. integrifolium	common woolly sunflower
Eucephalus elegans	elegant aster
Eurybia integrifolia	thickstem aster
Gnaphalium palustre	cudweed
Grindelia squarrosa var. serrulata	curly-cup gumweed
Gutierrezia sarothrae	broom snakeweed
Haplopappus acaulis	stemless goldenweed
Haplopappus macronema	whitestem goldenweed
Haplopappus uniflorus	goldenweed
Helianthella uniflora	oneflower helianthella
Helianthus annuus	common sunflower
Helianthus nuttallii	Nuttall sunflower
Heterotheca villosa	hairy false goldaster
Hieracium cynoglossoides	houndstongue hawkweed
Ionactis alpina	crag aster
Iva axillaris	poverty weed
Iva xanthifolia	burweed marshelder
Lactuca serriola	prickly lettuce
Machaeranthera canescens	hoary aster
Madia glomerata	cluster tarweed
Madia gracilis	grassy tarweed
Microseris nutans	nodding microceris
Onopordum acanthium	cotton thistle
Packera cana	woolly groundsel
Packera multilobata	lobeleaf groundsel
Packera streptanthifolia	Rocky Mountain groundsel
Rudbeckia occidentalis	western coneflower
Senecio integerrimus var. exaltatus	Columbia groundsel
Senecio pseudaureus	falsegold groundsel
Senecio serra	butterweed groundsel
Solidago canadensis	Canada goldenrod
Solidago missouriensis	Missouri goldenrod
Solidago velutina	sparse goldenrod
Sonchus asper	perennial sowthistle
Stephanomeria minor var. myrioclada	narrowleaf wirelettuce
Stephanomeria spinosa	spiny skeletonweed
Symphyotrichum ascendens	western aster
Taraxacum officinale	common dandelion
Tetradymia canescens	spineless horsebrush
Tragopogon dubius	common salsify
Tragopogon porrifolius	common salsify
Wyethia amplexicaulis	mule'sear wyethia
Xanthium strumarium	common cocklebur
Berberidaceae:	**Barberry Family:**
Mahonia repens	creeping barberry

Betulaceae:	**Birch Family:**
Alnus incana ssp. rugosa var. occidentalis	mountain alder
Boraginaceae:	**Borage Family:**
Amsinckia menziesii	smallflower fiddleneck
Asperugo procumbens	German mugwort
Cryptantha ambigua	basin cryptantha
Cryptantha circumscissa	cushion catseye
Cryptantha humilis	round-spike catseye
Cryptantha watsonii	Watson cryptantha
Hackelia floribunda	many-flower stickseed
Hackelia micrantha	meadow stickseed
Hackelia patens	common stickseed
Lappula redowskii	desert stickweed
Lithospermum ruderale	western gromwell
Mertensia ciliata	mountain bluebells
Mertensia oblongifolia	oblongleaf bluebells
Myosotis stricta	strict forget me not
Pectocarya penicillata	shortleaf combseed
Plagiobothrys scouleri var. hispidulus	meadow popcorn-flower
Brassicaceae:	**Mustard Family:**
Alyssum desertorum	desert alyssum
Arabis drummondii	Drummond rockcress
Arabis glabra	tower rockcress
Arabis hirsuta	hairy rockcress
Arabis hirsuta var. glabrata	mountain rockcress
Arabis hirsuta var. pycnocarpa	creamflower rockcress
Arabis holboellii var. retrofracta	Holboell rock-cress
Arabis lignifera	desert rockcress
Arabis microphylla	littleleaf rockcress
Arabis sparsiflora	fewleaf rockcress
Barbarea orthoceras	wintercress
Camelina microcarpa	false flax
Capsella bursa-pastoris	shepherd's purse
Cardamine pensylvanica	Pennsylvania bittercress
Cardaria pubescens	globe-pod hoarycress
Caulanthus crassicaulis	thick-stem wild cabbage
Chorispora tenella	blue mustard
Descurainia californica	Sierra tansymustard
Descurainia pinnata var. filipes	tansy mustard
Descurainia richardsonii var. brevipes	tansy mustard
Descurainia richardsonii var. sonnei	tansy mustard
Descurainia sophia	flixweed
Draba nemorosa	wood draba
Draba verna	spring draba
Erysimum asperum	wallflower
Lepidium campestre	field pepperweed
Lepidium perfoliatum	clasping pepperweed
Lepidium virginicum var. pubescens	hairy pepperweed
Rorippa curvisiliqua	curved yellowcress
Rorippa nasturtium-aquaticum	watercress
Schoenocrambe linifolia	flaxleaf plainsmustard
Sisymbrium altissimum	Jim Hill mustard
Thlaspi arvense	field pennycress
Thlaspi montanum	alpine pennycress
Cactaceae:	**Cactus Family:**
Opuntia polyacantha	plains pricklypear
Pediocactus simpsonii	Simpson hedgehog cactus
Caprifoliaceae:	**Honeysuckle Family:**
Sambucus cerulea	blue elderberry
Sambucus racemosa var. racemosa	red elderberry
Symphoricarpos oreophilus	mountain snowberry
Caryophyllaceae:	**Pink Family:**
Arenaria congesta	ballhead sandwort
Arenaria fendleri	Fendler sandwort
Cerastium nutans	common chickweed
Lychnis drummondii	Drummond catchfly
Pseudostellaria jamesiana	sticky starwort
Silene douglasii	Douglas' campion
Silene menziesii var. menziesii	Menzies' campion

Silene menziesii var. viscosa	Menzies' campion
Spergularia rubra	purple sandspurry
Stellaria crispa	crisp starwort
Stellaria longipes	longstalk starwort
Chenopodiaceae:	**Goosefoot Family:**
Atriplex patula var. hastata	fat hen saltbush
Atriplex rosea	redscale saltbush
Chenopodium album	common lambsquarters
Chenopodium capitatum var. parvicapitatum	mountain goosefoot
Chenopodium glaucum	oak-leaf goosefoot
Halogeton glomeratus	halogeton
Kochia scoparia	common kochia
Monolepis nuttalliana	Nuttall's poverty-weed
Salsola iberica	prickly Russian-thistle
Sarcobatus vermiculatus	black greasewood
Clusiaceae:	**St. Johnswort Family:**
Hypericum formosum var. scouleri	western St. Johnswort
Convolvulaceae:	**Morning-glory Family:**
Convolvulus arvensis	field bindweed
Cornaceae:	**Dogwood Family:**
Cornus sericea	redosier dogwood
Crassulaceae:	**Stonecrop Family:**
Sedum lanceolatum	lance-leaf stonecrop
Cupressaceae:	**Cypress Family:**
Juniperus osteosperma	Utah juniper
Juniperus scopulorum	Rocky Mountain juniper
Cyperaceae:	**Sedge Family:**
Carex aquatilis	water sedge
Carex douglasii	Douglas sedge
Carex hoodii	Hood's sedge
Carex microptera	ovalhead sedge
Carex multicostata	manyrib sedge
Carex nebrascensis	Nebraska sedge
Carex petasata	Liddon sedge
Carex praegracilis	clustered field sedge
Carex raynoldsii	Raynold's sedge
Carex rossii	Ross sedge
Carex vallicola	valley sedge
Eleocharis bolanderi	Bolander's spikerush
Eleocharis microcarpa	smallfruit spikerush
Eleocharis palustris	common spikerush
Eleocharis pungens	spikerush
Eleocharis quinqueflora	few-flower spike-rush
Dryopteridaceae:	**Male Fern Family:**
Cystopteris fragilis	brittle bladder fern
Dryopteris filix-mas	male fern
Polystichum kruckebergii	Kruckeberg's hollyfern
Polystichum scopulinum	mountain holly fern
Equisitaceae:	**Scouring-rush Family:**
Equisetum arvense	field horsetail
Equisetum laevigatum	smooth horsetail
Fabaceae:	**Pea Family:**
Astragalus agrestis	purple milkvetch
Astragalus beckwithii	Beckwith's milkvetch
Astragalus calycosus	matted poison milkvetch
Astragalus cibarius	browse milkvetch
Astragalus convallarius	lesser rushy milkvetch
Astragalus lentiginosus var. salinus	salty loco milkvetch
Astragalus purshii var. purshii	Pursh's milkvetch
Astragalus tenellus	looseflower milkvetch
Glycyrrhiza lepidota	wild licorice
Lupinus argenteus var. argentatus	silver lupine
Lupinus argenteus var. holosericeus	silver lupine
Lupinus leucophyllus	velvet lupine
Medicago lupulina	black medic
Medicago sativa	alfalfa
Melilotus alba	white sweetclover
Melilotus officinalis	yellow sweet-clover

Thermopsis rhombifolia	goldenpea
Trifolium cyathiferum	cup clover
Trifolium microcephalum	littlehead clover
Trifolium pratense	red clover
Trifolium repens	Dutch clover
Trifolium variegatum	white-tip clover
Fumariaceae:	**Fumitory Family:**
Dicentra uniflora	steershead
Gentianaceae:	**Gentian Family:**
Frasera speciosa	monument plant
Gentiana affinis	pleated gentian
Geraniaceae:	**Geranium Family:**
Erodium cicutarium	redstem filaree
Geranium viscosissimum var. incisum	sticky purple geranium
Geranium viscosissimum var. nervosum	sticky purple geranium
Grossulariaceae:	**Gooseberry Family:**
Ribes aureum	golden currant
Ribes cereum var. pedicellare	squaw currant
Ribes montigenum	alpine prickly currant
Ribes setosum	Missouri gooseberry
Ribes viscosissimum	sticky currant
Hydrophyllaceae:	**Waterleaf Family:**
Hesperochiron californicus	California hesperochiron
Hydrophyllum capitatum var. alpinum	alpine waterleaf
Nemophila breviflora	baby blueeyes
Phacelia hastata	silver-leaf scorpion-weed
Iridaceae:	**Iris Family:**
Iris missouriensis	wild iris
Sisyrinchium idahoense	Idaho blue-eyed grass
Juncaceae:	**Rush Family:**
Juncus balticus var. montanus	mountain rush
Juncus bufonius	toad rush
Juncus confusus	Colorado rush
Juncus ensifolius var. brunnescens	rush
Juncus ensifolius var. montanus	rush
Juncus mertensianus	Merten's rush
Juncus torreyi	Torrey's rush
Lamiaceae:	**Mint Family:**
Agastache urticifolia	horsemint giant hyssop
Dracocephalum parviflorum	small-flowered dragon head
Marrubium vulgare	horehound
Mentha arvensis	field mint
Nepeta cataria	catnip
Prunella vulgaris	common selfheal
Lemnaceae:	**Duckweed Family:**
Lemna minor	lesser duckweed
Liliaceae:	**Lily Family:**
Allium acuminatum	taper-tip onion
Allium brandegeei	Brandegee's onion
Calochortus eurycarpus	bigpod mariposa lily
Calochortus nuttallii	sego lily
Fritillaria atropurpurea	leopard lily
Fritillaria pudica	yellow bells
Maianthemum stellatum	false Solomons seal
Smilacina racemosa	false Solomons seal
Veratrum californicum	California false hellebore
Zigadenus paniculatus	foothill deathcamas
Zigadenus venenosus var. venenosus	meadow deathcamas
Limnanthaceae:	**Limnanthus Family:**
Floerkea proserpinacoides	false mermaid-weed
Linaceae:	**Flax Family:**
Linum lewisii	blue flax
Loasaceae:	**Loasa Family:**
Mentzelia albicaulis	whitestem blazingstar
Malvaceae:	**Mallow Family:**
Iliamna rivularis	streambank globemallow
Malva neglecta	cheeseweed

Sidalcea neomexicana	New Mexico checkermallow
Sphaeralcea grossulariifolia	currant-leaf globe-mallow
Onagraceae:	**Evening-primrose Family:**
Camissonia parvula	little camissonia
Camissonia subacaulis	diffuseflower eveningprimrose
Epilobium brachycarpum	autumn willowherb
Epilobium ciliatum	fringed willowherb
Gayophytum decipiens	deceptive groundsmoke
Gayophytum diffusum	bigflower groundsmoke
Gayophytum ramosissimum	muchbranched groundsmoke
Oenothera biennis	common evening primrose
Oenothera caespitosa var. marginata	evening primrose
Orchidaceae:	**Orchid Family:**
Habenaria dilatata var. leucostachys	bog orchid
Habenaria hyperborea	bog orchid
Orobanchaceae:	**Broomrape Family:**
Orobanche fasciculata	clustered broom-rape
Paeoniaceae:	**Paeony Family:**
Paeonia brownii	brown peony
Pteridaceae:	**Cliffbrake Family:**
Pellaea breweri	Brewer's cliffbrake
Pinaceae:	**Pine Family:**
Abies lasiocarpa	balsam fir
Pinus contorta var. latifolia	lodgepole pine
Pinus flexilis	limber pine
Pinus monophylla	singleleaf pinyon pine
Pseudotsuga menziesii var. glauca	Douglas-fir
Plantaginaceae:	**Plantain Family:**
Plantago lanceolata	buckhorn plantain
Plantago major	broadleaf plantain
Poaceae:	**Grass Family:**
Achnatherum hymenoides	Indian ricegrass
Achnatherum lettermanii	Letterman needlegrass
Achnatherum nelsonii	Columbia needlegrass
Achnatherum nevadense	Nevada needlegrass
Achnatherum occidentale	western needlegrass
Agropyron cristatum	crested wheat grass
Agropyron desertorum	clustered wheat grass
Agropyron fragile	Siberian wheatgrass
Agrostis exarata	spike bentgrass
Agrostis scabra	rough bent
Agrostis stolonifera	carpet bentgrass
Alopecurus aequalis	short foxtail
Apera interrupta	dense silky-bent
Avena fatua	flaxgrass
Beckmannia syzigachne	American sloughgrass
Bromus carinatus	California brome
Bromus commutatus	hairy brome
Bromus inermis	smooth brome
Bromus japonicus	Japanese brome
Bromus tectorum	cheat grass
Dactylis glomerata	orchardgrass
Danthonia californica	California oatgrass
Danthonia unispicata	onespike oatgrass
Deschampsia danthonioides	annual hairgrass
Deschampsia elongata	slender hairgrass
Distichlis spicata	desert saltgrass
Echinochloa crus-galli	barnyard grass
Elymus elymoides var. elymoides	squirreltail
Elymus glaucus	blue wild rye
Elymus lanceolatus	streambank wheatgrass
Elymus repens	quackgrass
Elymus trachycaulus var. latiglumis	slender wheatgrass
Elymus trachycaulus var. trachycaulus	slender wheatgrass
Festuca idahoensis	Idaho fescue
Festuca rubra var. rubra	red fescue
Glyceria striata var. striata	fowl mannagrass
Hesperostipa comata var. comata	needle-and-thread

Hordeum brachyantherum	meadow barley
Hordeum jubatum	foxtail barley
Koeleria macrantha	Junegrass
Leucopoa kingii	spike fescue
Leymus cinereus	basin wildrye
Lolium perenne	perennial ryegrass
Lolium pratense	meadow ryegrass
Melica bulbosa	bulbous oniongrass
Muhlenbergia richardsonis	mat muhly
Phalaris arundinacea	reed canary grass
Phleum alpinum	alpine timothy
Phleum pratense	common timothy
Poa annua	annual blue grass
Poa bolanderi	Bolander's bluegrass
Poa bulbosa	bulbous blue grass
Poa cusickii var. epilis	Cusick's bluegrass
Poa nervosa var. wheeleri	Wheeler's bluegrass
Poa pratensis	Kentucky bluegrass
Poa rupicola	timberline bluegrass
Poa secunda	Sandberg bluegrass
Polypogon monspeliensis	annual rabbit's-foot grass
Pseudoroegneria spicata	bluebunch wheatgrass
Puccinellia distans	European alkaligrass
Puccinellia nuttalliana	Nuttall alkaligrass
Sporobolus airoides	alkali sacaton
Sporobolus cryptandrus	sand dropseed
Thinopyrum ponticum	rush wheatgrass
Torreyochloa pauciflora	pale false mannagrass
Trisetum spicatum	spike trisetum
Vulpia microstachys var. pauciflora	Pacific fescue
Vulpia octoflora	sixweeks fescue
Polemoniaceae:	**Phlox Family:**
Collomia linearis	narrow-leaf mountain-trumpet
Eriastrum sparsiflorum var. wilcoxii	Great Basin eriastrum
Gilia aggregata var. macrosiphon	scarlet gilia
Gilia inconspicua	shy gilia
Gilia tenerrima	delicate gilia
Leptodactylon pungens	common pricklygilia
Linanthus harknessii	Harkness' flaxflower
Microsteris gracilis var. humilior	microsteris
Navarretia intertexta var. propinqua	Great Basin navarettia
Phlox hoodii var. canescens	carpet phlox
Phlox longifolia	longleaf phlox
Phlox multiflora	flowery phlox
Phlox pulvinata	cushion phlox
Polemonium pulcherrimum var. pulcherrimum	Jacob's ladder
Polygonaceae:	**Buckwheat Family:**
Eriogonum cernuum	nodding buckwheat
Eriogonum heracleoides	parsnipflower buckwheat
Eriogonum microthecum var. laxiflorum	slender buckwheat
Eriogonum ovalifolium	cushion buckwheat
Eriogonum umbellatum	sulfer flower buckwheat
Polygonum aviculare	prostrate knotweed
Polygonum bistortoides	American bistort
Polygonum douglasii var. douglasii	Douglas knotweed
Polygonum douglasii var. latifolium	Douglas knotweed
Rumex crispus	curly dock
Rumex paucifolius	alpine sheep sorrel
Rumex salicifolius ssp. triangulivalvis	willowleaf dock
Potamogetonaceae:	**Pondweed Family:**
Potamogeton pusillus	small pondweed
Portulacaceae:	**Purslane Family:**
Calyptridium umbellatum	pussy paws
Claytonia lanceolata	lanceleaf springbeauty
Claytonia perfoliata	miner's lettuce
Lewisia pygmaea	alpine bitterroot
Montia chamissoi	toadlily
Montia fontana var. tenerrima	littleseed miner's lettuce
Montia linearis	narrowleaf Indianlettuce

Primulaceae:	**Primrose Family:**
Dodecatheon pulchellum	dark-throat shootingstar
Glaux maritima	sea milkwort
Pyrolaceae:	**Wintergreen Family:**
Pyrola secunda	one-sided wintergreen
Ranunculaceae:	**Buttercup Family:**
Aconitum columbianum	Columbia monkshood
Actaea rubra	red baneberry
Aquilegia caerulea	Colorado blue columbine
Aquilegia formosa	crimson columbine
Ceratocephala testiculata	bur buttercup
Clematis ligusticifolia	virgin'sbower
Delphinium andersonii	Anderson's larkspur
Delphinium depauperatum	slim larkspur
Delphinium nuttallianum	low larkspur
Delphinium occidentale	tall larkspur
Myosurus minimus	mousetail
Ranunculus andersonii	Anderson's buttercup
Ranunculus aquatilis	water buttercup
Ranunculus glaberrimus var. ellipticus	elliptical buttercup
Ranunculus macounii	Macoun buttercup
Ranunculus sceleratus	celeryleaf buttercup
Thalictrum fendleri	Fendler meadowrue
Rhamnaceae:	**Buckthorn Family:**
Ceanothus velutinus	snowbrush ceanothus
Rosaceae:	**Rose Family:**
Amelanchier alnifolia	Saskatoon serviceberry
Amelanchier utahensis	Utah serviceberry
Argentina anserina	silverweed cinquefoil
Cercocarpus ledifolius	curl-leaf mountain mahogany
Geum macrophyllum var. perincisum	large-leaf avens
Holodiscus dumosus	bush oceanspray
Potentilla arguta	tall cinquefoil
Potentilla biennis	biennial cinquefoil
Potentilla glandulosa var. intermedia	gland cinquefoil
Potentilla gracilis var. pulcherrima	showy cinquefoil
Potentilla recta	roughfruit cinquefoil
Prunus virginiana var. melanocarpa	black chokecherry
Purshia tridentata	antelope bitterbrush
Rosa woodsii var. ultramontana	Woods' rose
Rubiaceae:	**Bedstraw Family:**
Galium aparine	bedstraw
Galium bifolium	twin-leaf bedstraw
Galium triflorum	fragrant bedstraw
Salicaceae:	**Willow Family:**
Populus alba	white poplar
Populus angustifolia	narrowleaf cottonwood
Populus canadensis	Carolina poplar
Populus tremuloides	quaking aspen
Salix boothii	blueberry willow
Salix drummondiana	Drummond's willow
Salix exigua ssp. exigua var. stenophylla	sandbar willow
Salix geyeriana	Geyer willow
Salix lasiandra	Pacific willow
Salix lutea	yellow willow
Salix scouleriana	Scouler willow
Santalaceae:	**Sandalwood Family:**
Comandra umbellata var. pallida	bastard toadflax
Saxifragaceae:	**Saxifrage Family:**
Heuchera cylindrica var. alpina	roundleaf alumroot
Heuchera parvifolia var. utahensis	Utah alumroot
Heuchera rubescens	pink alumroot
Lithophragma glabrum	bulbous woodland-star
Lithophragma parviflorum	smallflower woodland-star
Lithophragma tenellum	slender woodland-star
Scrophulariaceae:	**Figwort Family:**
Castilleja christii	Christ's Indian paintbrush
Castilleja angustifolia var. dubia	desert paintbrush

Castilleja angustifolia var. flavescens	northwestern Indian paintbrush
Castilleja exilis	annual paintbrush
Castilleja flava	yellow Indian paintbrush
Castilleja linariifolia	Wyoming Indian paintbrush
Castilleja miniata	giant red Indian paintbrush
Castilleja pallescens var. inverta	pale Indian paintbrush
Castilleja tenuis	hairy Indian paintbrush
Collinsia parviflora	blue-eyed Mary
Cordylanthus ramosus	Busby bird's-beak
Limosella aquatica	awl-leaf mudwort
Mimulus guttatus	common monkeyflower
Mimulus lewisii	Lewis monkeyflower
Orthocarpus luteus	golden-tongue owl-clover
Pedicularis contorta	coiled lousewort
Penstemon attenuatus var. militaris	South Idaho penstemon
Penstemon cyananthus var. subglaber	Wasatch beardtongue
Penstemon humilis	low beardtongue
Penstemon radicosus	matroot penstemon
Penstemon rydbergii	meadow beardtongue
Scrophularia lanceolata	lance-leaf figwort
Verbascum thapsus	common mullein
Veronica americana	American speedwell
Veronica anagallis-aquatica	blue water speedwell
Veronica biloba	bilobed speedwell
Veronica peregrina var. xalapensis	speedwell
Veronica serpyllifolia var. humifusa	thyme-leaved speedwell
Sellaginellaceae:	**Spikemoss Family:**
Selaginella watsonii	alpine spikemoss
Solanaceae:	**Nightshade Family:**
Hyoscyamus niger	black henbane
Nicotiana attenuata	coyote tobacco
Solanum dulcamara	bittersweet nightshade
Solanum triflorum	cut-leaf nightshade
Tamaricaceae:	**Salt-cedar Family:**
Tamarix ramosissima	Tamarisk; salt-cedar
Typhaceae:	**Cattail Family:**
Typha latifolia	broadleaf cattail
Valerianaceae:	**Valerian Family:**
Plectritis macrocera	longhorn plectritis
Valeriana acutiloba var. pubicarpa	hairyfruit valerian
Valeriana edulis	tobacco root
Valeriana occidentalis	western valerian
Verbenaceae:	**Verbena Family:**
Verbena bracteata	prostrate verbena
Violaceae:	**Violet Family:**
Viola adunca var. adunca	hookedspur violet
Viola purpurea	goose-foot yellow violet
Viola vallicola var. major	valley violet
Viola vallicola var. vallicola	sagebrush violet
Zannicheliaceae:	**Horned Pondweed Family:**
Zannichellia palustris	horned pondweed

Appendix F - Photo Interpretation Mapping Conventions and Visual Key

City of Rocks National Reserve - Map Units

This appendix describes the map units for the City of Rocks National Reserve (CIRO) Vegetation Inventory Project. Its purpose is to:

- Describe the vegetation of each map unit;
- Provide a representative ground photograph/image for each map unit;
- Describe the link between each map unit and the revised U.S. National Vegetation Classification System (NVCS);
- Provide visual examples of each map unit with digital overhead images and delineated overlays.

The map units for CIRO were based on a combination of NVCS plant associations, unique plant stands (i.e. Park Specials), the limitations of the digital imagery, and land use / land cover classes. The vegetation described in this section reflects the classification designed specifically for this project. Non-vegetated and land-use map units are not described in this key but polygon distribution maps are provided. For more information on the development of the mapping convention for CIRO please reference the mapping sections of this report and the digital information (i.e. lookup tables, metadata, etc.) included on the project DVD.

This key uses the physiognomic grouping of each map unit starting with forest and woodland types. Each map unit is fully described by a variety of characteristics and features: (1) common species found in the individual map classes, (2) the NVCS crosswalk (if applicable) to associations and/or alliance(s), (3) a description of the mapping concept, (4) a representative ground photograph, (4) a distribution map for each mapping unit across the study area, and (5) an imagery snapshot with representative polygon outlines on the 2009 National Agriculture Imagery Program (NAIP) true-color basemap. Many of the map unit descriptions rely on the vegetation classification plot data collected in 2009. The sample ground photographs were taken during the 2009 classification plot data collection or during the 2010 accuracy assessment by Northwest Management, Inc. (NMI) field crews.

Map Code ***Abies lasiocarpa*** **/ Sparse Woodland**
ABLA **Subalpine Fir / Sparse Woodland**

Common Species

Abies lasiocarpa, Populus tremuloides, Symphoricarpus oreophilus, Pinus contorta, Populus balsamifera ssp. *trichocarpa, Ribes viscosissimum, Thalictrum fendleri, Carex rossii*

NVCS Association

- *Abies lasiocarpa* / Sparse Woodland

Representative Ground Photo



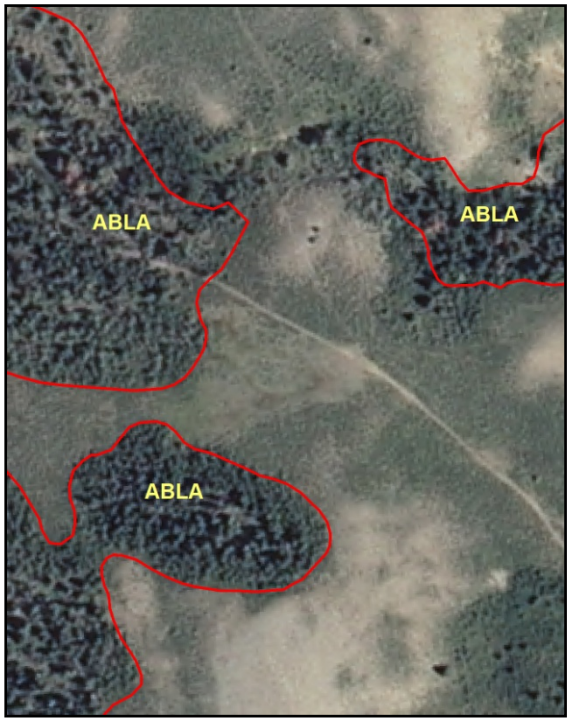
Description

Subalpine fir trees were rare in CIRO, only occurring at the highest elevations in the northern portion of the project area. For most of the subalpine fir polygons the trees formed a dense stand with pointed crowns. Stands of this type usually occurred on mesic sites such as north-facing slopes. In these habitats the subalpine fir trees appeared as a solid, dark green color, with a white-pebbly photo signature. Understory diversity was usually low (if any) consisting of primarily short deciduous shrubs and graminoids. Other conifers, especially Douglas-fir may have been confused with this type during the mapping.

Range and Distribution



Photo Signature Example



Map Unit ***Cercocarpus ledifolius* / *Symphoricarpos oreophilus* Woodland**
CELE **Curl-leaf Mountain-mahogany / Mountain Snowberry Woodland**

Common Species

Cercocarpus ledifolius, Pinus monophylla, Symphoricarpos oreophilus, Ribes cereum, Chrysothamnus viscidiflorus, Balsamorhiza sagittata, Carex rossii, Artemisia tridentata, Poa secunda, Elymus lanceolatus

Representative Ground Photo



NVCS Association

-*Cercocarpus ledifolius* / *Symphoricarpos oreophilus* Woodland

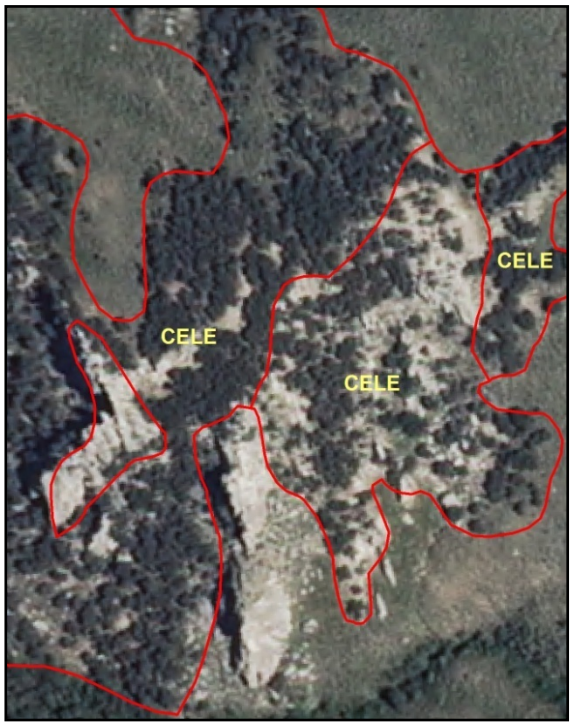
Description

Curl-leaf mountain-mahogany shrubs forming thick stands were common throughout CIRO and rare at Castle Rocks State Park. Within CIRO, curl-leaf mountain mahogany occurred on slopes, ridges and rock outcrops, often surrounded or intermingling with singleleaf pinyon pine and juniper species. The understory of this type was mostly dominated by a mix of shrubs, native grasses and forbs. This type had an unique signature that included large dark green spots indicating individual curl-leaf mountain mahogany shrubs against a lighter green or brown background. Curl-leaf mountain-mahogany stands had a similar appearance to short singleleaf pinyon trees and some confusion may have occurred between this map unit and the singleleaf pinyon pine / curl-leaf mountain-mahogany (PJ/CELE) type during delineation.

Range and Distribution



Photo Signature Example



Map Unit	***Pinus contorta* Woodland Alliance**
PICO	**Lodgepole Pine Woodland Alliance**

Common Species

Pinus contorta, Populus tremuloides, Ribes cereum, Poa pratensis

NVCS Alliance

-*Pinus contorta* Woodland Alliance

Representative Ground Photo



Description

Lodgepole pine with a sparse understory occured in one documented site wihin CIRO. Lodgepole pine occurred as a dense stand on a mountain slope among quaking aspen and other coniferous tree species. Other locations with lodgepole pine likely exist within CIRO but were either too small to map, were mixed with other dominant trees, or were not reconizable on the 2009 NAIP imagery. On the ortho-imagery this map unit signature appeared as raised, dark green spots (pine trees) interspersed with light green splotches (shrubs) in the canopy openings.

Range and Distribution

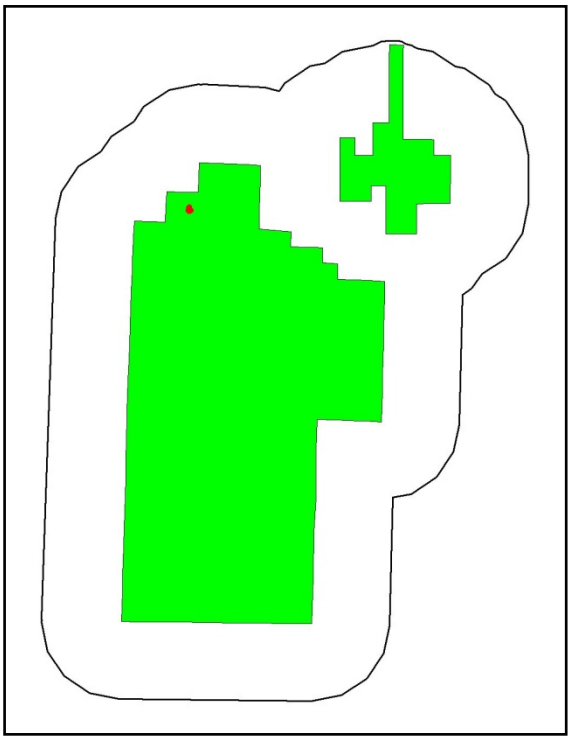
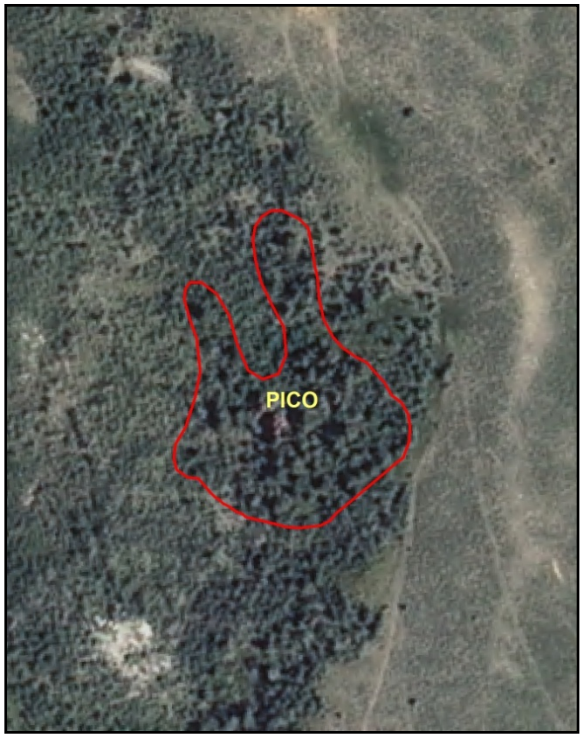


Photo Signature Example



Map Code	*Pinus flexilis* Woodland Alliance
PIFL	Limber Pine Woodland Alliance

Representative Ground Photo



Common Species

Pinus flexilis, Pinus contorta, Pseudotsuga menziesii, Cercocarpus ledifolius, Mahonia repens, Symphoricarpos oreophilus, Poa secunda

NVCS Alliance

-*Pinus flexilis* Woodland Alliance

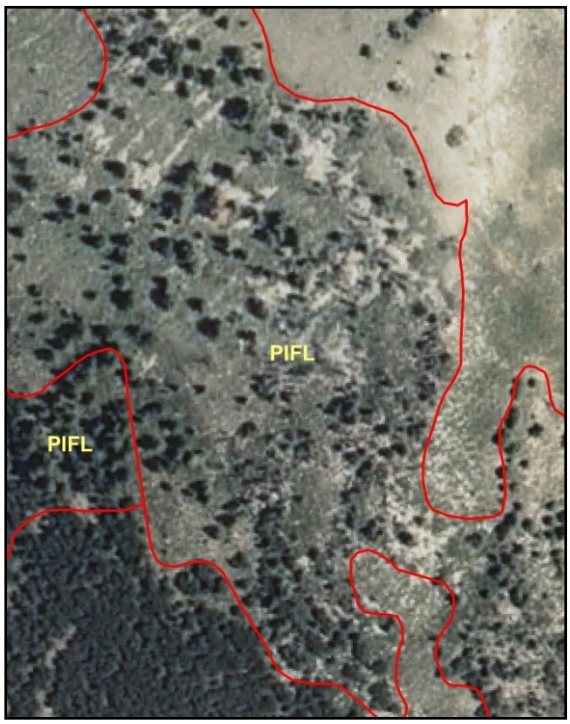
Description

Limber pine occurred as a rare woodland type on rocky slopes and ridges. This map unit typically had a low density of trees (open canopy to scattered trees) when compared to the other coniferous map units. Stands supported an understory of low, thick shrubs and grasses amid rock outcrops and boulders. This map unit was expressed as a dark green, coarse, and pebbly photo signature, with apparent individual trees against a tan (rock) or green (shrub) background color. The limber pine map unit may have been confused with other woodland map units, particularly subalpine fir or curl-leaf mountain mahogany.

Range and Distribution



Photo Signature Example



Map Unit ***Pinus monophylla - Juniperus osteosperma*** **/ Sparse Understory Woodland**
PJ/SPRS **Singleleaf Pinyon - Utah Juniper / Sparse Understory Woodland**

Common Species

Pinus monophylla, Juniperus osteosperma, Pseudoroegneria spicata, Cercocarpus ledifolius, Artemisia tridentata ssp. *vaseyana, Poa secunda, Phlox hoodii, Opuntia polyacantha, Pseudoroegneria spicata*

NVCS Association

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

Representative Ground Photo



Description

Singleleaf pinyon and Utah juniper was common throughout the eastern and southern sections of the mapping area occurring on hillslopes, toeslopes, and foothills. Singleleaf pinyon and Utah juniper trees ranged from dense cover with little understory to sparse canopy cover on rocky ground. Many stands in this map class formed large, homogeneous polygons that were devoid of understory shrubs. The photo signature for this type was unique, containing large dark-green dots (singleleaf pinyon – Utah juniper trees) on a tan, brown, or gray background. The absence of tall and short understory shrubs (big sagebrush, curl-leaf mountain-mahogany, etc.) was key to mapping this association. The similarity of this map unit to the other singleleaf pinyon and Utah juniper mapping units likely resulted in some confusion during map attribution.

Range and Distribution

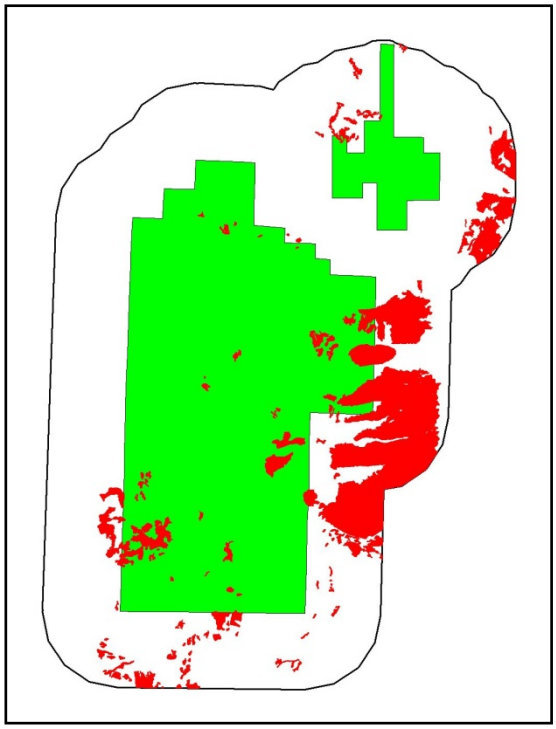
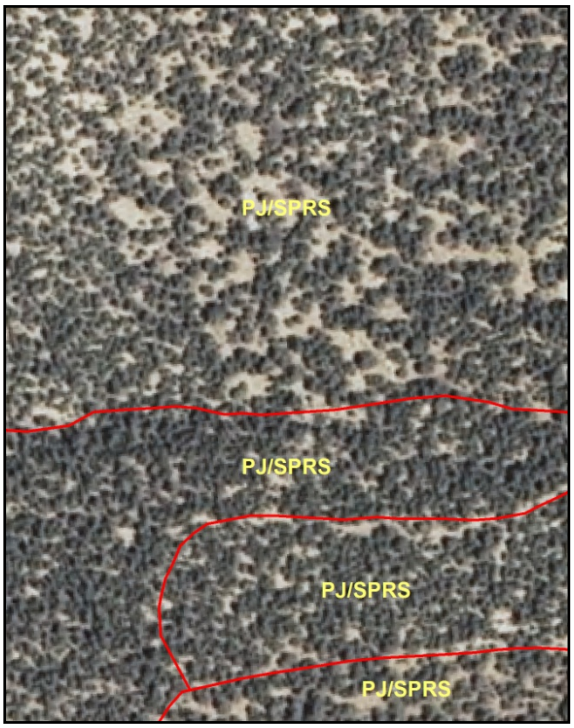


Photo Signature Example



Map Code	*Pinus monophylla* / *Cercocarpus ledifolius* Woodland
PJ/CELE	Singleleaf Pinyon / Curl-leaf Mountain-mahogany Woodland

Common Species

Pinus monophylla, Cercocarpus ledifolius, Juniperus osteosperma, Purshia tridentata, Symphoricarpos oreophilus, Opuntia polyacantha, Pseudoroegneria spicata, Poa secunda, Poa bulbosa

Representative Ground Photo



NVCS Association

-*Pinus monophylla* / *Cercocarpus ledifolius* Woodland

Description

Singleleaf pinyon with curl-leaf mountain-mahogany in the understory was common throughout the project area. This map unit occurred primarily on rocky slopes, cliffs, and outcrops and was intermixed with the other singleleaf pinyon - Utah juniper and curl-leaf mountain-mahogany map units. This type was expressed on the imagery as rough, dark-green colored trees on a tan or green matrix with smooth light green understory representing the curl-leaf mountain-mahogany. Mapping of this association was based primarily on the photo signature and secondarily on topographic position.

Range and Distribution

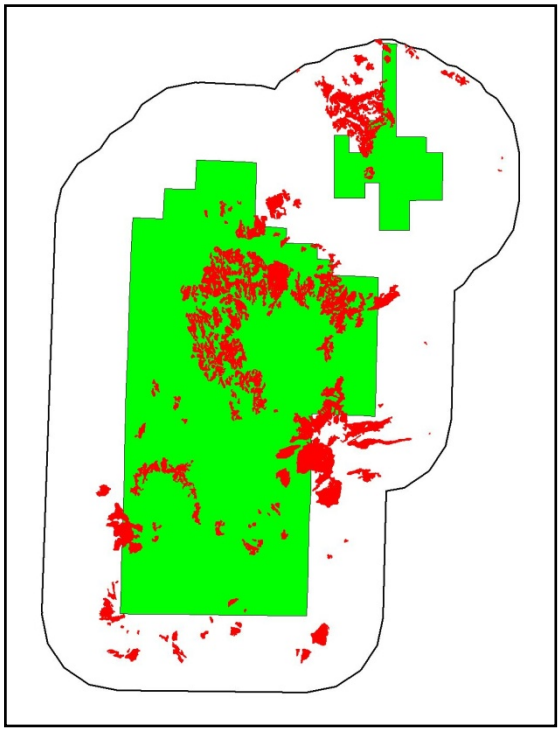
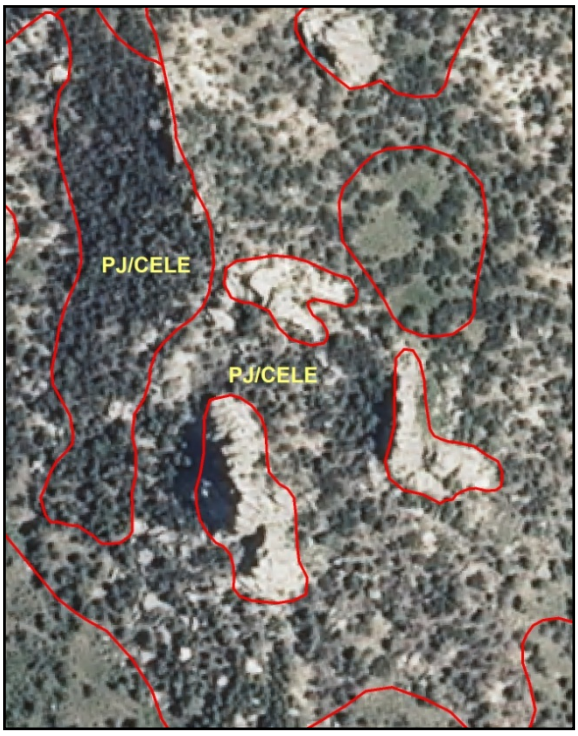


Photo Signature Example



Map Code ***Pinus monophylla*** **Woodland**
PIMO **Singleleaf Pinyon Woodland**

Common Species

Pinus monophylla, Cercocarpus ledifolius, Artemisia tridentata ssp. *tridentata, Artemisia tridentata* ssp. *vaseyana Purshia tridentata, Pseudoroegneria spicata, Delphinium andersonii, Poa secunda*

Representative Ground Photo



NVCS Association

-*Pinus monophylla* Woodland

Description

Singleleaf pinyon pine with predominately big sagebrush and bitterbrush in the understory was common across the project area. Stands of this map unit typically occurred on hillslopes and alluvial fans supporting understory mountain big sagebrush (mid to upper elevations), basin big sagebrush (lower elevations), and grassland polygons throughout. Juniper trees were mostly absent from this type and the singleleaf pinyon pine provided moderate to sparse cover with sufficient canopy openings to allow establishment of big sagebrush and antelope bitterbrush. This map unit was expressed as dark green to black dots with a coarse, pebbly, gray photo signature due to the big sagebrush reflectance on the imagery. Very sparse stands supported high understory cover with a photo signature of thick gray (shrubs) on tan (herbaceous vegetation) background color. Stands of this map unit may have been confused with the other singleleaf pinyon - juniper woodland types especially if the understory big sagebrush was present in sparse cover.

Range and Distribution



Photo Signature Example



Map Unit	***Populus tremuloides* / Dry Herbaceous Forest Complex**
POTR/GRASS	**Quaking Aspen / Dry Herbaceous Forest Complex**

Common Species

Populus tremuloides, Juniperus scopulorum, Populus balsamifera ssp. *trichocarpa, Poa pratensis, Thalictrum fendleri, Elymus glaucus, Lactuca serriola*

Representative Ground Photo



NVCS Associations

-*Populus tremuloides* / *Poa pratensis* Forest
-*Populus tremuloides* / *Thalictrum fendleri* Forest
-*Juniperus scopulorum - Populus tremuloides* Woodland

Description

Quaking aspen trees with herbaceous understories of grass species occurred at higher elevations in the northern half of the CIRO project area. In these locations, aspens tended to grow on dry slopes, in between rock outcrops, and on alluvial fans. Polygons representing this map unit exhibited a characteristic dark green color with white specks (tree limbs and trunks) of quaking aspen in the overstory. The presence of graminoids in the understory provided canopy openings with a diagnostic dark green-to-gray color. The similarity of texture and color of quaking aspen trees to curl-leaf mountain mahogany trees and small shrubs may result in some misclassification. Quaking aspen with an understory of grasses was distinguished from the other quaking aspen map units due to the absence of short shrubs in the understory.

Range and Distribution



Photo Signature Example



Map Unit	***Populus tremuloides* / Mesic Herbaceous Forest**
POTR/MESC	**Quaking Aspen / Mesic Herbaceous Forest**

Common Species

Populus tremuloides, Populus balsamifera ssp. *trichocarpa, Symphoricarpos oreophilus, Amelanchier alnifolia, Mahonia repens, Thalictrum fendleri, Poa pratensis, Festuca idahoensis, Poa secunda, Leucopoa kingii*

Representative Ground Photo



NVCS Alliance

-Populus tremuloides / *Symphoricarpos oreophilus* /*Thalictrum fendleri* Forest

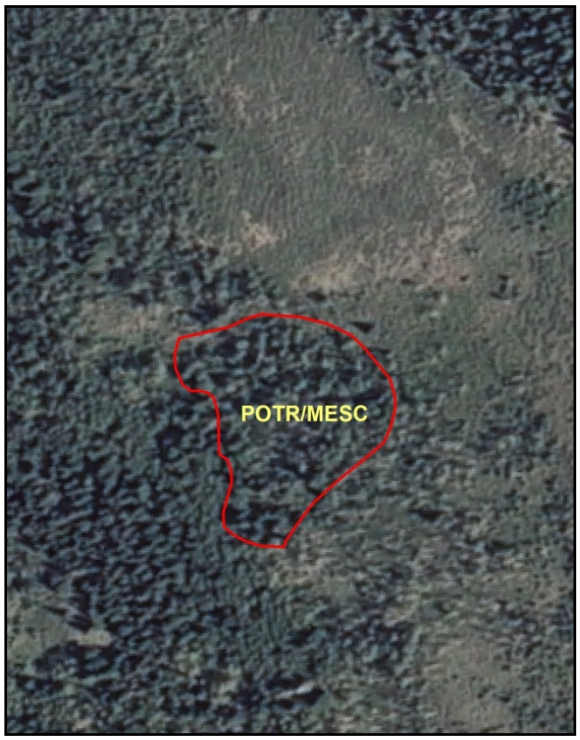
Description

Quaking aspen established under mesic conditions occurred at higher elevations throughout the northern half of the CIRO project area. Stands were established on north-facing slopes, in valley bottoms, and along drainages. Polygons representing this map unit exhibited the characteristic dark green color with white specks (tree limbs and trunks) of quaking aspen in the overstory. The presence of dense deciduous shrubs in the understory provided a diagnostic smooth dark green color in canopy openings. The similar texture and color of quaking aspen trees to gray/speckled alder, white poplar, and willow tall shrubs may result in some misclassification. This map unit distinguished quaking aspen with a shrub or mesic herbaceous understory from open quaking aspen stands with a dry, grass-dominated understory.

Range and Distribution



Photo Signature Example



Map Code	***Pseudotsuga menziesii* / *Acer glabrum* Forest**
PSME	**Douglas-fir / Rocky Mountain Maple Forest**

Common Species

Pseudotsuga menziesii, Juniperus scopulorum, Prunus virginiana, Acer glabrum, Symphoricarpos oreophilus Maianthemum racemosum, Mertensia oblongifolia, Mahonia repens, Thalictrum fendleri, Poa secunda

Representative Ground Photo



NVCS Association

-*Pseudotsuga menziesii* / *Acer glabrum* Forest

Description

Douglas-fir with a sparse shrub understory established on a few sites at higher elevations of northeastern CIRO. This map unit was characterized by mesic site conditions, typically north-facing slopes or drainage bottoms, supporting moderately dense-to-dense stands of Douglas-fir trees. Stands with closed canopies supported low understory diversity whereas moderate-to-sparse canopy cover supported deciduous shrubs of diverse species composition. Douglas-fir trees expressed a dark green, coarse-pebbly photo signature on the true color imagery. Open stands supported high understory cover resulting in a photo signature of rough dark green (trees and shadows) against a smooth green (shrub) background color. Stands of this map unit may be confused with the other coniferous map units or with the curl-leaf mountain mahogany map unit.

Range and Distribution

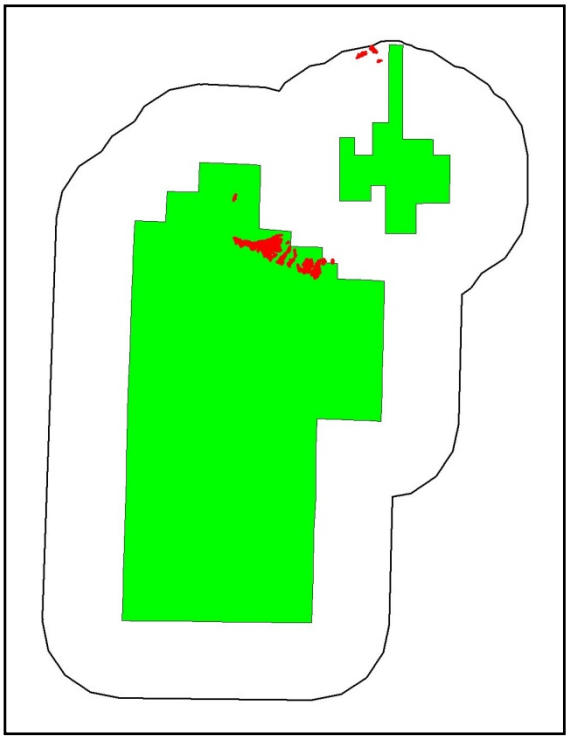
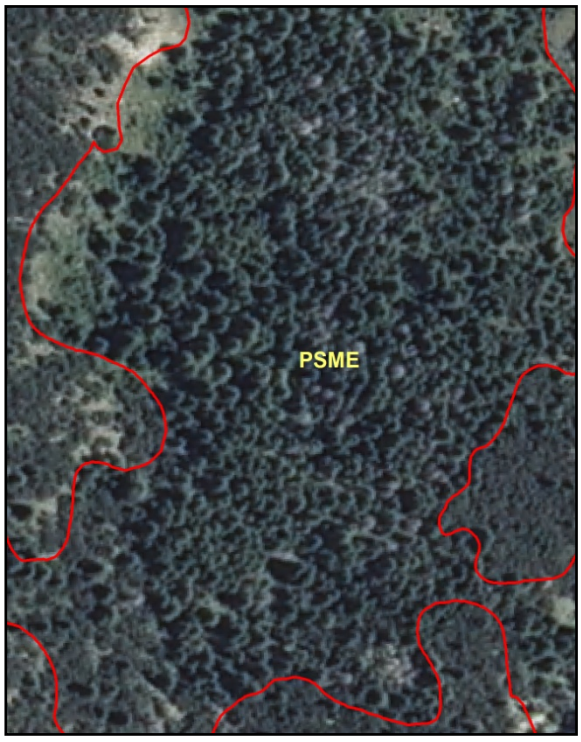


Photo Signature Example



Map Unit	***Populus alba* Woodland Stand**
POAL	**White Poplar Woodland Stand**

Common Species

Populus alba, Juniperus scopulorum, Populus balsamifera ssp. *trichocarpa Artemisia tridentata* ssp. *vaseyana, Poa pratensis*

NVCS Association

- [No Association – Park Special]

Representative Ground Photo



Description

White poplar woodland stands were small in size and rare the mapping area, occurring along drainages, streams, and in planted or landscaped settings. The mapping signature for this unit includes large poplar tree canopies appearing as dark green spots. Understory composition was mesic and varied by stand location; willow species and speckled alder were common in riparian settings and Kentucky bluegrass and sedges were common in wetlands. In some drainages, black cottonwood (*Populus balsamifera* ssp. *trichocarpa)* was co-dominant in the canopy and some confusion may occur between these two species. This map unit was used to attribute larger more mature trees located in and around the agricultural land and on developed agricultural sites, as well. On altered sites individual white poplar trees appeared as large green spots and the understory signature was typically reflected soil. This map unit may have included other planted deciduous tree species.

Range and Distribution

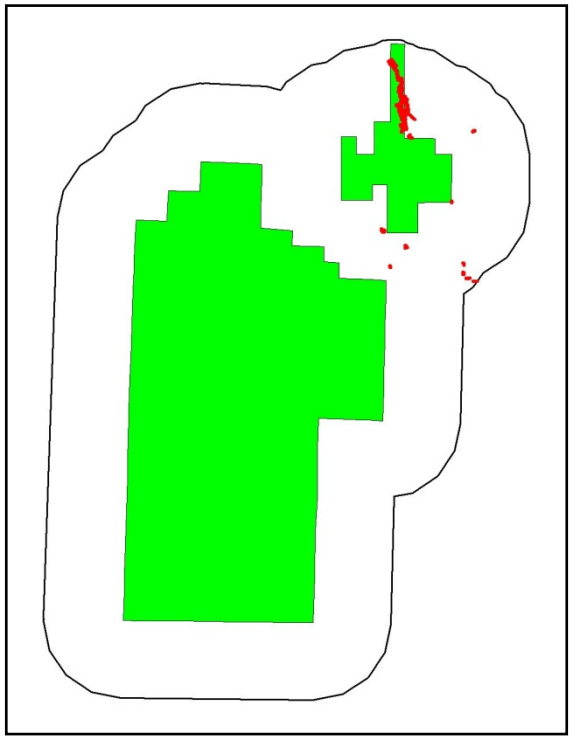


Photo Signature Example



Shrublands

Map Unit ***Alnus incana*** **Temporarily Flooded Shrubland Alliance**
ALIN **Speckled Alder Temporarily Flooded Shrubland Alliance**

Common Species
Alnus incana, Juniperus scopulorum, Rosa woodsii, Poa pratensis

Representative Ground Photo



NVCS Alliance
-*Alnus incana* Temporarily Flooded Shrubland Alliance

Description
Stands of speckled (gray) alder of sufficient size to interpret and map occurred in two CIRO drainages; it is likely a common riparian tall shrub within the project area. Speckled alder were co-dominant with, or occurred in the understory of white poplar, quaking aspen, and willow woodland and tall shrubland map units and some confusion in the mapping likely occurred between these similarly-structured riparian communities. Polygons of speckled alder were characterized by small to medium-size tall shrubs located in linear bands adjacent to streams and creeks. Young or small speckled alder tall shrubs exhibited a smooth, dark green signature which transitioned into a roughened green signature when more mature and larger tall shrubs occurred.

Range and Distribution

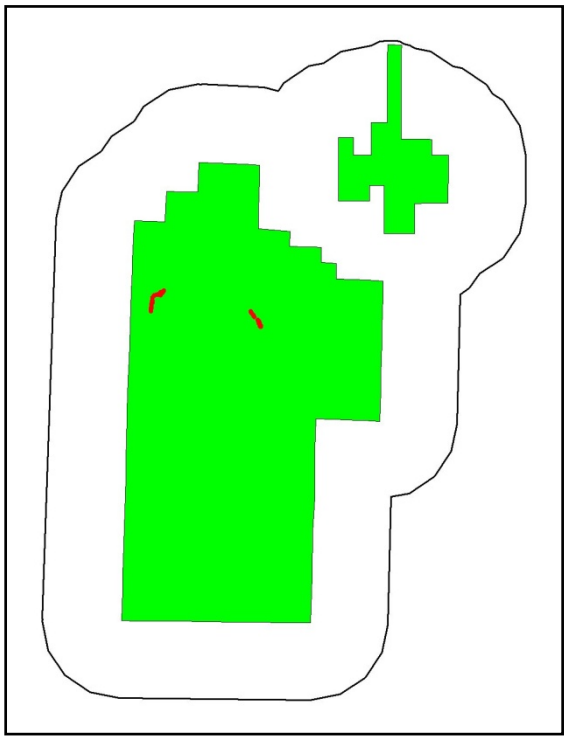
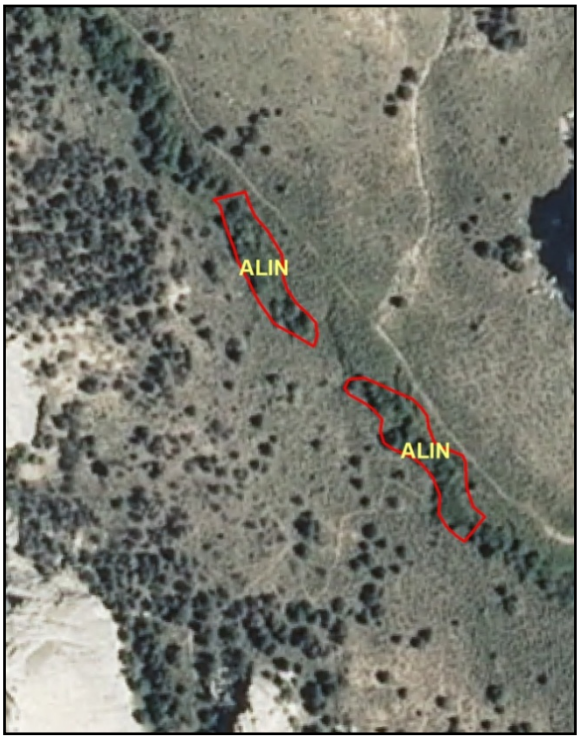


Photo Signature Example



Map Unit ***Artemisia arbuscula* ssp. *arbuscula* Shrub Herbaceous Alliance**
ARAR **Dwarf Sagebrush Shrub Herbaceous Alliance**

Common Species

Artemisia arbuscula ssp. *arbuscula, Chrysothamnus viscidiflorus, Artemisia tridentata* ssp. *vaseyana Phlox hoodii, Antennaria microphylla, Poa bulbosa, Poa secunda, Pseudoroegneria spicata, Festuca idahoensis, Koeleria macrantha*

NVCS Associations

-*Artemisia arbuscula / Poa bulbosa* Shrub Herbaceous Vegetation
-*Artemisia arbuscula / Poa secunda* Shrub Herbaceous Vegetation

Representative Ground Photo



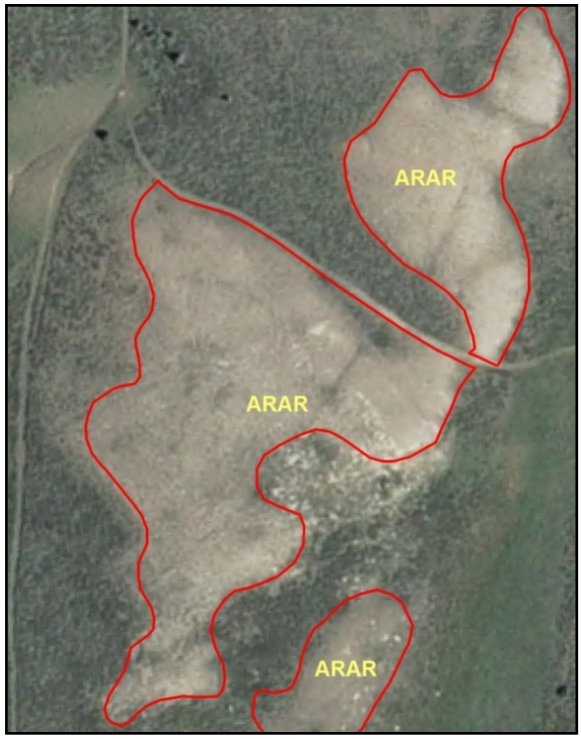
Description

Dwarf sagebrush stands were common on steep, rocky, dry, and wind-swept hillslopes in the northern portion of the project area. Stands were characterized by the low-growing stature and the regular spacing of individual shrubs. Polygons of this dwarf-shrub type typically had a smooth tan to gray appearance on the base imagery due to the high amount of reflectance from bare ground and rocks. The short stature and gray color of dwarf sagebrush was similar in appearance to black sagebrush and big sagebrush established on marginal sites which likely led to some confusion in interpretation and mapping.

Range and Distribution



Photo Signature Example



Map Unit ***Artemisia nova / Pseudoroegneria spicata*** **Shrubland**
ARNO **Black Sagebrush / Bluebunch Wheatgrass Shrubland**

Common Species

Artemisia nova, Phlox hoodii, Erigeron tener, Erigeron pumilus, Haplopappus spp., *Poa secunda, Pseudoroegneria spicata*

NVCS Association

-*Artemisia nova / Pseudoroegneria* spicata Shrubland

Representative Ground Photo



Description

Black sagebrush is a common dwarf-shrub that occurs as patches and stands on dry ridges, mid-slopes, and foothills within CIRO. This map class was often associated with high cover of large rocks or bare ground, likely indicating poorly developed, shallow soils. Associated dwarf-shrubs and low cover of native bunchgrasses commonly occurred. The low cover and low-growing nature of black sagebrush created a light gray to tan photo signature that was smooth in texture. Other sagebrushes especially dwarf sagebrush and young mountain big sagebrush shrubs had similar signatures and may have resulted in some errors in polygon attribution.

Range and Distribution

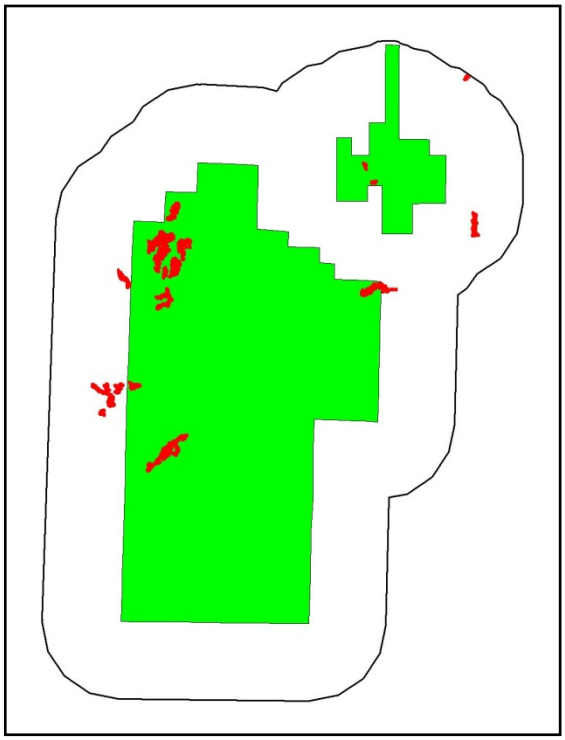


Photo Signature Example



Map Unit	***Artemisia tridentata* ssp. *tridentata* Shrub Herbaceous Alliance**
ARTRT	**Basin Big Sagebrush Shrub Herbaceous Alliance**

Common Species

Artemisia tridentata ssp. *tridentata, Ericameria nauseosa, Symphoricarpos oreophilus, Chrysothamnus viscidiflorus, Ribes cereum, Artemisia ludoviciana, Poa secunda, Poa pratensis, Achnatherum nelsonii, Elymus glaucus, Achillea millefolium, Opuntia polyacantha, Balsamorhiza sagittata*

Representative Ground Photo



NVCS Associations

-*Artemisia tridentata / Chrysothamnus viscidiflorus / Poa secunda* Shrubland
-*Artemisia tridentata* ssp. *tridentata / Poa secunda* Shrubland
-*Artemisia tridentata* ssp. *tridentata / Poa pratensis* Shrub Herbaceous Vegetation

Description

Basin big sagebrush short and tall shrublands are regularly distributed on deep valley floor soils primarily at lower elevations of the western and southern portions of the project area. Basin big sagebrush was often intermixed with mountain big sagebrush short shrubs and the possible hybridization between these species and ecotone issues may have resulted in some confusion in interpretation, delineation, and diagnostic shrub identification. This map unit exhibited dense cover by robust shrubs yielding a characteristic mottled or roughened signature with brown inclusions representing grass-dominated patches and green specks indicating scattered trees and deciduous shrubs. Basin big sagebrush occasionally supported the non-native annual cheatgrass in the understory.

Range and Distribution



Photo Signature Example



Map Unit ***Artemisia tridentata*** **ssp.** ***vaseyana - Purshia tridentata*** **Shrubland Alliance**
ARTR-PUTR **Mountain Big Sagebrush – Antelope Bitterbrush Shrubland Alliance**

Common Species

Artemisia tridentata ssp. *vaseyana, Purshia tridentata, Symphoricarpos oreophilus, Chrysothamnus viscidiflorus, Elymus lanceolatus, Poa secunda, Balsamorhiza sagittata*

Representative Ground Photo



NVCS Associations

-*Artemisia tridentata* ssp. *vaseyana - Purshia tridentata / Elymus lanceolatus* Shrubland
-*Artemisia tridentata* ssp. *vaseyana - Purshia tridentata / Poa secunda* Shrubland

Description

Mountain big sagebrush with antelope bitterbrush occurs throughout the entire project area forming large, dense stands on dry slopes, benches and uplands. Understory species varied by location consisting of a mix of native grasses and other shrubs. Cheatgrass and other non-native greases were common but did not dominate. Mountain big sagebrush with antelope bitterbrush was often associated with the other sagebrush species and in some cases its close proximity and signature may have led to some mapping confusion. In some areas this type may occur as a transition between pure stands of mountain big sagebrush and homogeneous stands of antelope bitterbrush. On the ortho-imagery, this map unit was characterized by small to medium-sized shrubs that appeared as dark grey circles. Where it was dense, the mountain bi sagebrush had a mottled to smooth appearance and when it was sparse it had a tan or grey background.

Range and Distribution



Photo Signature Example



Map Unit	***Artemisia tridentata* ssp. *vaseyana* - *Symphoricarpos oreophilus* Shrubland**
ARTRV	**Mountain Big Sagebrush – Mountain Snowberry Shrubland**

Common Species

Artemisia tridentata ssp. *vaseyana, Symphoricarpos oreophilus, Chrysothamnus viscidiflorus, Poa secunda, Festuca idahoensis, Antennaria microphylla, Pseudoroegneria spicata, Comandra umbellata, Balsamorhiza sagittata*

NVCS Association

-*Artemisia tridentata* ssp. *vaseyana* - *Symphoricarpos oreophilus* Shrubland

Representative Ground Photo



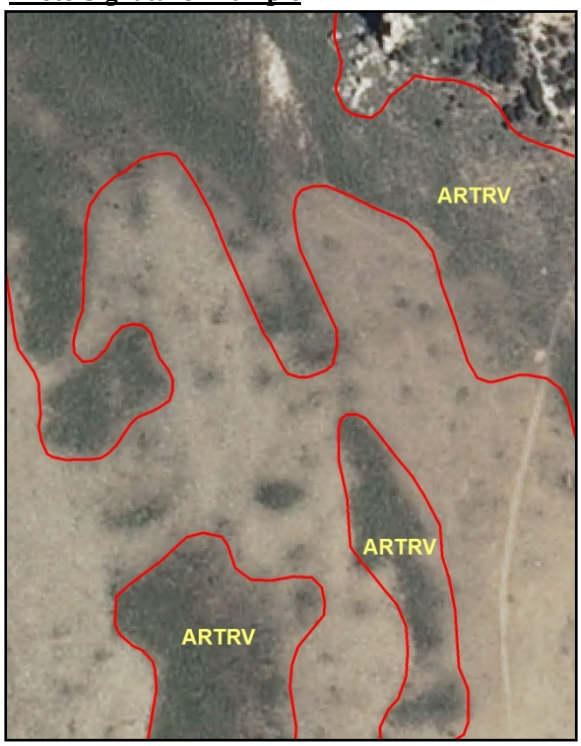
Description

Mountain big sagebrush with mountain snowberry present to codominant was common in the higher elevations of CIRO and in the northern and western environs. This short shrub type occurred on mountain and hillslopes, benches, and terraces. In addition to mountain snowberry short shrubs, native bunchgrasses were common in the understory. The presence of mountain snowberry and the absence of antelope bitterbrush distinguished this map unit from the other mountain big sagebrush map units (although some mixing of mountain big sagebrush map units likely exists). This map unit varied in photo signature from dispersed medium-sized gray dots against a light green or gray background to a homogenous gray mottled texture on a light tan background. Due to the similarity in size, shape, and color to basin big sagebrush and antelope bitterbrush confusion may have occurred during interpretation and mapping.

Range and Distribution



Photo Signature Example



Map Unit ARTRV/HERB	***Artemisia tridentata* ssp. *vaseyana* / Mixed Herbaceous Shrubland Complex** **Mountain Big Sagebrush / Mixed Herbaceous Shrubland Complex**

Common Species

Artemisia tridentata ssp. *vaseyana, Festuca idahoensis, Leucopoa kingii, Poa pratensis, Pseudoroegneria spicata*

Representative Ground Photo



NVCS Associations

-*Artemisia tridentata* ssp. *vaseyana / Festuca idahoensis* Shrub Herbaceous Vegetation
-*Artemisia tridentata* ssp. *vaseyana / Leucopoa kingii* Shrubland
-*Artemisia tridentata* ssp. *vaseyana / Poa pratensis* Shrubland
-*Artemisia tridentata* ssp. *vaseyana /Pseudoroegneria spicata* Shrubland

Description

Mountain big sagebrush with a native bunchgrass understory is common and distributed on well-developed soils throughout CIRO, Castle Rocks State Park, and surrounding areas. In some locations the mountain big sagebrush short shrubland established adjacent to and mixed with basin big sagebrush; hybridization may have occurred and resulted in confusion during interpretation, delineation, and field identification of big sagebrush species. The presence of native bunchgrasses and the lack of other shrub species separated this class from other mountain big sagebrush map units. Mature mountain big sagebrush short shrubs presented a characteristic mottled or roughened photo signature which often included patches of brown from grass-dominated inclusions and white specks indicating bare ground or rock reflectance. Additionally, this map unit often included low cover of antelope bitterbrush and other diagnostic shrubs within mountain big sagebrush map units.

Range and Distribution

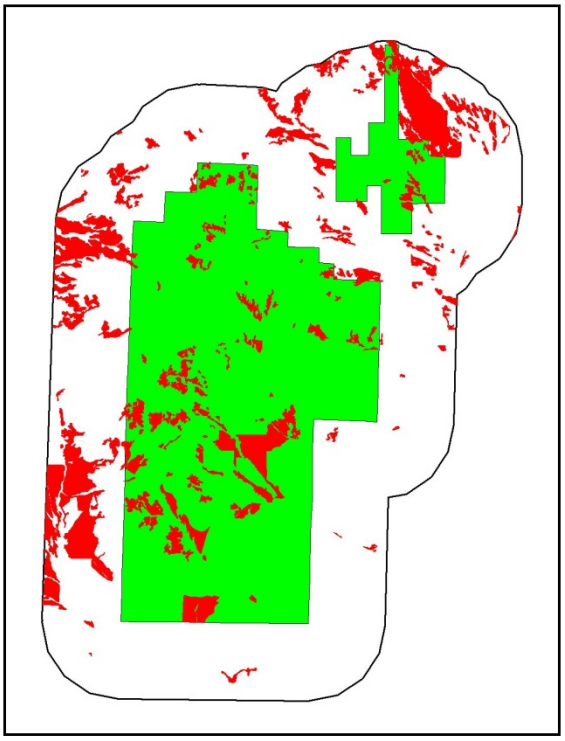
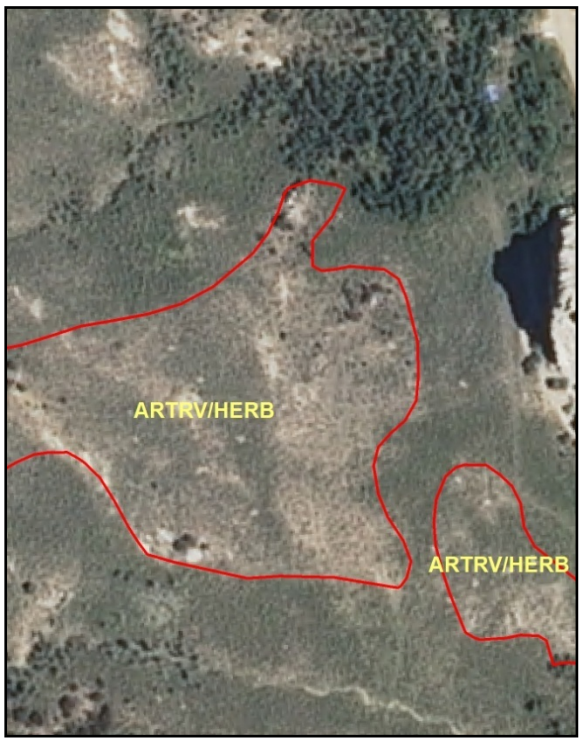


Photo Signature Example



Map Unit ARTR/BRTE	***Artemisia tridentata / Bromus tectorum - (Agropyron desertorum)*** **Semi-natural Shrubland Complex** **Big Sagebrush / Cheatgrass – (Desert Wheatgrass) Semi-natural Shrubland Complex**

Common Species

Artemisia tridentata ssp. *tridentata*, *Artemisia tridentata* ssp. *vaseyana*, *Bromus tectorum*, *Poa bulbosa*, *Agropyron desertorum*, *Poa pratensis*

NVCS Association

- [No Association – Park Special]

Representative Ground Photo



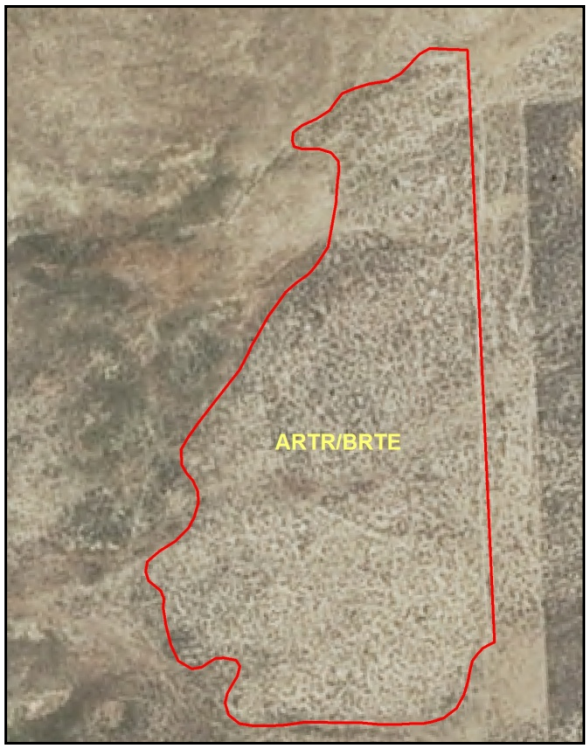
Description

Basin or mountain big sagebrush with a cheatgrass or desert wheatgrass understory occurred widely on lower to middle elevations within the project area established on benches, flats, and the valley floor. Sites often were disturbed from past ranching land use, active livestock grazing, and/or recent wildfires. The high cover of non-native annual cheatgrass in the understory distinguished this unit from other big sagebrush map units. The photo signature presents shrubs that appeared larger in diameter than do the other common big sagebrush subspecies (i.e. bigger grey dots) however the cheatgrass background color was similar to other map units (orange-brown). Because this map unit included the same understory species as other big sagebrush map units, some confusion likely occurred during interpretation and delineation.

Range and Distribution



Photo Signature Example



Map Unit ***Ceanothus velutinus*** **Shrubland**
CEVE **Tobacco-brush Shrubland**

Common Species

Ceanothus velutinus, Artemisia tridentata ssp. *vaseyana, Prunus virginiana, Symphoricarpos oreophilus, Purshia tridentata, Leymus cinereus, Achnatherum nelsonii, Poa secunda, Balsamorhiza sagittata, Lupinus argenteus*

NVCS Association

-*Ceanothus velutinus* Shrubland

Representative Ground Photo



Description

Stands of tobacco-brush short shrubs were rare within CIRO, occurring in a band trending from northeast to southwest. Tobacco-brush short shrubs occur in dense cover on steep to gentle slopes where it formed nearly monotypic patches and stands. This map unit typically occurred adjacent to curl-leaf mountain mahogany trees and tall shrubs and mountain big sagebrush short shrub polygons; it typically supported other deciduous shrubs including chokecherry and mountain snowberry. The tobacco-brush short shrub photo signature appeared as smooth dark green patches with little to no understory reflectance. Short-stature or young stands of quaking aspen trees may have been confused with this type within CIRO.

Range and Distribution

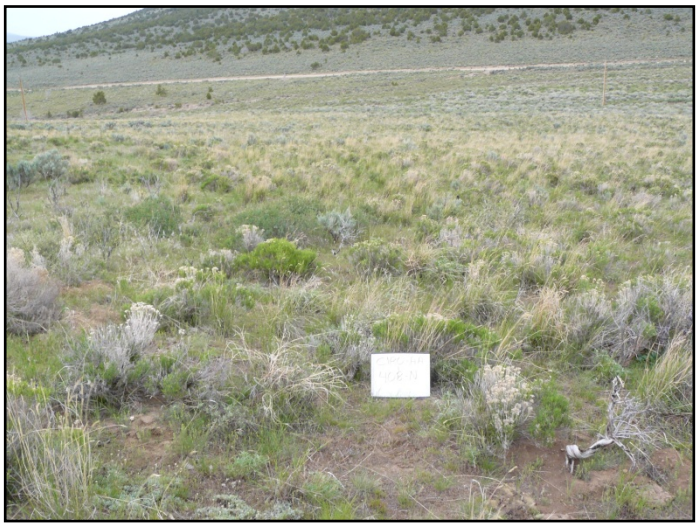


Photo Signature Example



Map Unit	***Chrysothamnus viscidiflorus* - (*Ericameria nauseosa*) Shrubland Alliance**
CHVI	**Green Rabbitbrush – (Rubber Rabbitbrush) Shrubland Alliance**

Representative Ground Photo



Common Species

Chrysothamnus viscidiflorus, Ericameria (=Chrysothamnus) nauseosa, Artemisia tridentata ssp. *vaseyana, Bromus tectorum, Agropyron desertorum, Iva axillaris, Elymus trachycaulus, Pseudoroegneria spicata, Poa pratensis, Poa bulbosa,*

NVCS Associations

-Chrysothamnus viscidiflorus / Agropyron desertorum Shrub Herbaceous Vegetation
- Chrysothamnus viscidiflorus / Elymus lanceolatus – Poa secunda Shrub Herbaceous Vegetation

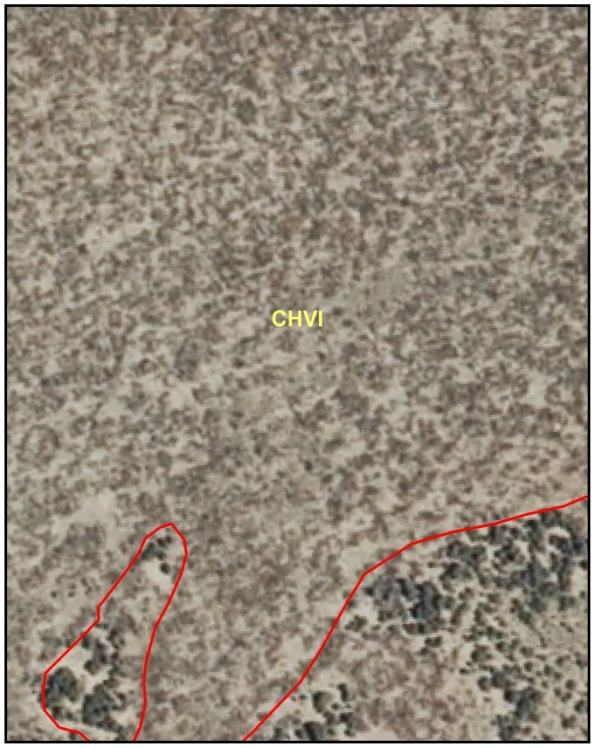
Description

Stands of green rabbitbrush commonly occurred as large polygons in the southern portion of project area; individual green rabbitbrush short shrubs also occurred as associates in most upland shrubland map units. Where green rabbitbrush short shrubs occurred as the diagnostic species it was typically associated with post-fire or disturbed sites. Common landscape positions supporting this type included upland flats, rolling hills, and valley floors. Rubber rabbitbrush short shrubs, which are larger in stature and often with more mesic site requirements than green rabbitbrush, were included with this map unit due to low accuracy as a result of similar photo signatures. The rabbitbrush species can codominate, however polygons with homogeneous stands of rubber rabbitbrush are indicated in the comments field of the corresponding vegetation map layer. On the imagery, rabbitbrush short shrubs presented as olive-green to brown flecks with an orange-brown background color. Dead trees and shrubs were often visible.

Range and Distribution



Photo Signature Example



Map Unit	***Prunus virginiana - (Prunus americana)* Shrubland**
PRVI	**Chokecherry – (American Plum) Shrubland**

Common Species

Prunus virginiana, Prunus americana, Mertensia oblongifolia, Populus balsamifera ssp. *trichocarpa, Symphoricarpos oreophilus, Achnatherum nelsonii, Poa pratensis, Balsamorhiza sagittata, Leucopoa kingii*

Representative Ground Photo



NVCS Association

-*Prunus virginiana* - (*Prunus americana*) Shrubland

Description

Small stands of chokecherry tall shrubs occurred in mesic drainages, small valleys, and at the base of rock formations throughout the project area. Chokecherry tall shrubs also occurred in linear riparian stands both as the dominant species, codominant to other tall shrubs, and as an understory component to woodland types. The chokecherry shrubland map unit was characterized by small- to medium-sized shrubs occurring in dense, closed-canopy stands with few associated species. The typical photo signature presented as a light green color with a smooth texture when small in stature and as a coarser olive-green when the shrubs were more mature and taller. Due to the similarity of photo signatures and association with diagnostic riparian tall shrub species, this map unit may have been confused with the Booth's willow and tobacco-brush map units.

Range and Distribution

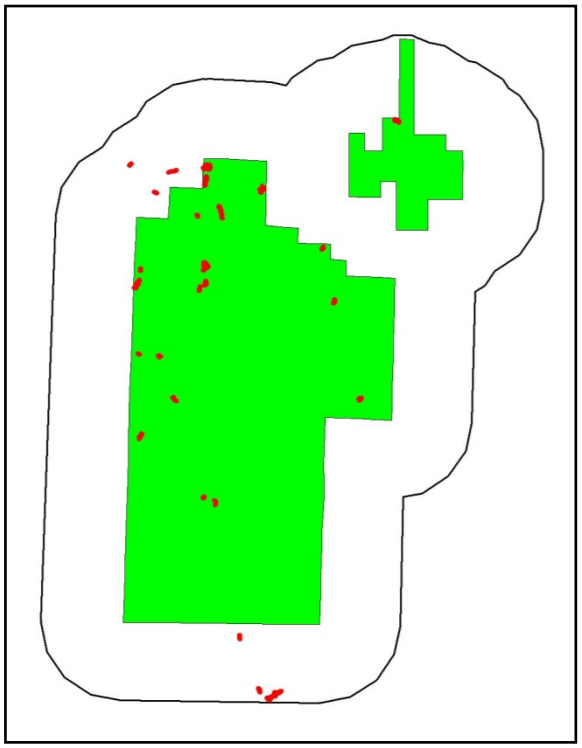
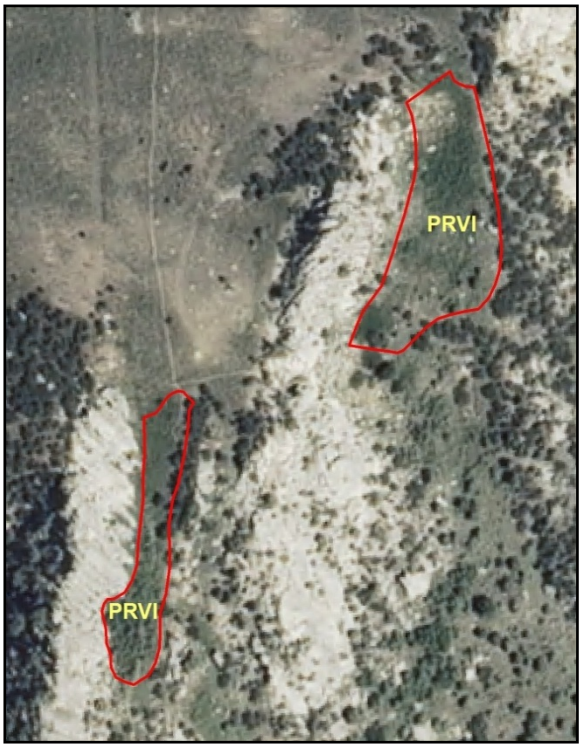


Photo Signature Example



Map Unit	***Purshia tridentata / Pseudoroegneria spicata* Shrub Herbaceous Vegetation**
PUTR	**Antelope Bitterbrush / Bluebunch Wheatgrass Shrub Herbaceous Vegetation**

Common Species

Purshia tridentata, Artemisia tridentata ssp. *vaseyana, Amelanchier utahensis, Packera streptanthifolia, Lupinus argenteus, Achnatherum nelsonii, Pseudoroegneria spicata, Bromus tectorum, Poa pratensis, Poa bulbosa*

NVCS Association

-Purshia tridentata / Pseudoroegneria spicata Shrub Herbaceous Vegetation

Representative Ground Photo



Description

Antelope bitterbrush was the diagnostic short shrub in stands established in valleys east and south of Castle Rocks State Park and on slopes in the western portion of CIRO. Polygons were typically uniform texture with regular spacing of individual bitterbrush short shrubs. Understory species varied by location and included a variety of shrubs and native bunchgrasses. Cheatgrass and other non-native grasses were present in low cover. Antelope bitterbrush was often associated with sagebrush dwarf- and short shrubs which resulted in some interpretation and mapping confusion. The diagnostic photo signature was characterized by small- to medium-sized shrubs that appeared as dark gray circles. Where stands were present in dense cover, the antelope bitterbrush presented a mottled to smooth appearance and when cover was sparse to low the signature presented as a tan or gray background.

Range and Distribution

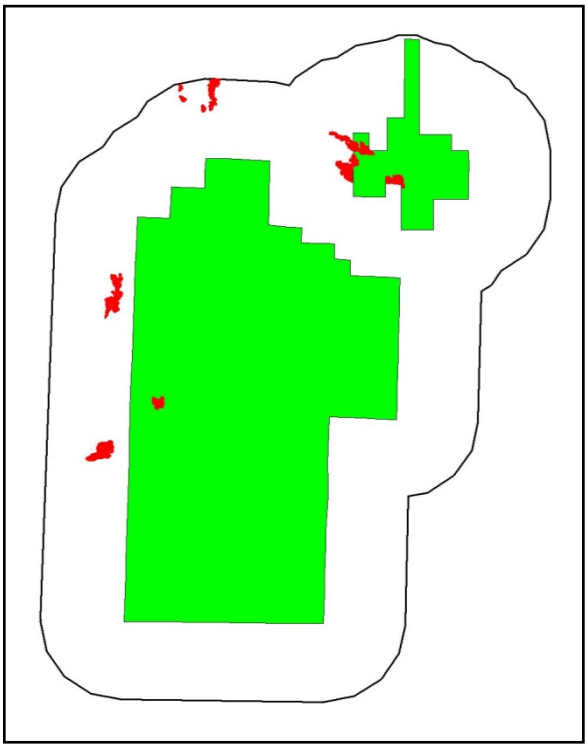
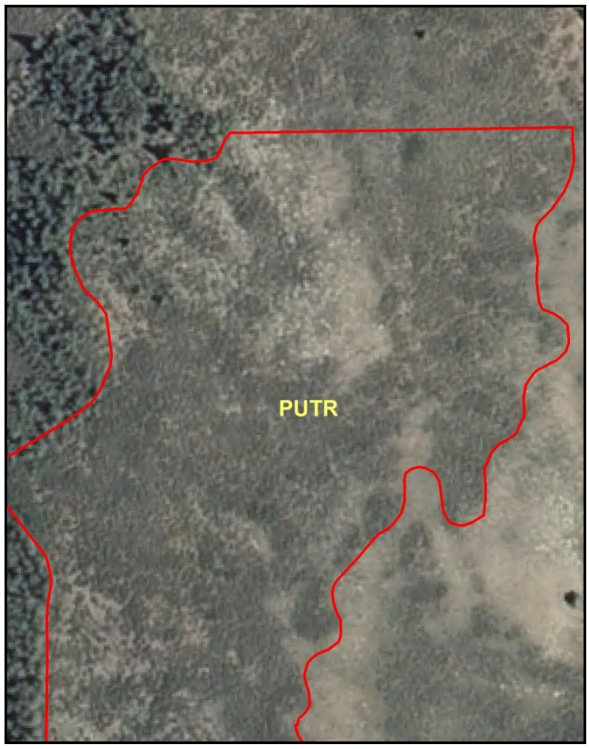


Photo Signature Example



Map Unit ***Salix boothii*** **/ Mesic Forbs Shrubland**
SABO **Booth's Willow / Mesic Forbs Shrubland**

Common Species

Salix boothii, Salix geyeriana, Salix lutea, Salix exigua, Salix lasiandra, Prunus virginiana, Populus balsamifera ssp. *trichocarpa, Juniperus scopulorum, Rosa woodsii, Ribes aureum, Artemisia tridentata* ssp. *tridentata, Poa bulbosa, Juncus balticus, Elymus lanceolatus, Poa pratensis*

NVCS Associations

-*Salix boothii* / Mesic Forbs Shrubland

Representative Ground Photo



Description

Booth's and associated willow species formed linear riparian tall shrub stands adjacent to streams and drainages with high ground water tables within the project area. Willow species were often intermixed and some hybridization may occur within CIRO, although Booth's willow was consistently the type dominant. Willow tall shrubs occurred adjacent to the white poplar woodland and speckled/gray alder tall shrubland map units likely resulting in some confusion in interpretation and mapping. This type is characterized by small- to medium-sized willow tall shrubs often with riparian trees in the overstory. When willow shrubs were of short-stature they appeared as a slightly mottled to smooth light green signature transitioning to a dark green and pebbled signature when tall, mature shrubs occur.

Range and Distribution



Photo Signature Example



Map Unit	***Symphoricarpos oreophilus* Shrubland**
SYOR	**Mountain Snowberry Shrubland**

Common Species

Symphoricarpos oreophilus, Chrysothamnus viscidiflorus, Ribes aureum, Amelanchier alnifolia, Amelanchier utahensis, Artemisia nova, Artemisia tridentata ssp. *tridentata Pseudoroegneria spicata, Poa secunda, Carex vallicola, Leymus cinereus, Festuca idahoensis*

NVCS Associations

-*Symphoricarpos oreophilus* Shrubland

Representative Ground Photos



Description

Mountain snowberry was a common short shrub occurring at middle to high elevations within CIRO as an associate to other shrublands and an understory species in woodland and forest stands. It occurred as an association on a few slopes west of CIRO and as large homogeneous polygons in the southern portion where large fires removed most of the big sagebrush short shrubs and singleleaf pinyon - Utah juniper trees. Where mountain snowberry occurred on disturbed and burned sites, it was often associated with non-native grasses and rabbitbrush short shrubs. Conversely in northern CIRO polygons, mountain snowberry established on mesic sites also supporting a native bunchgrass understory. This map unit was characterized by short shrubs that exhibit a smooth, dark green, mottled signature on the imagery. Due to the similarity of signatures and intermixing of diagnostic species, this map unit may have been confused with green rabbitbrush, black sagebrush, and big sagebrush units.

Range and Distribution

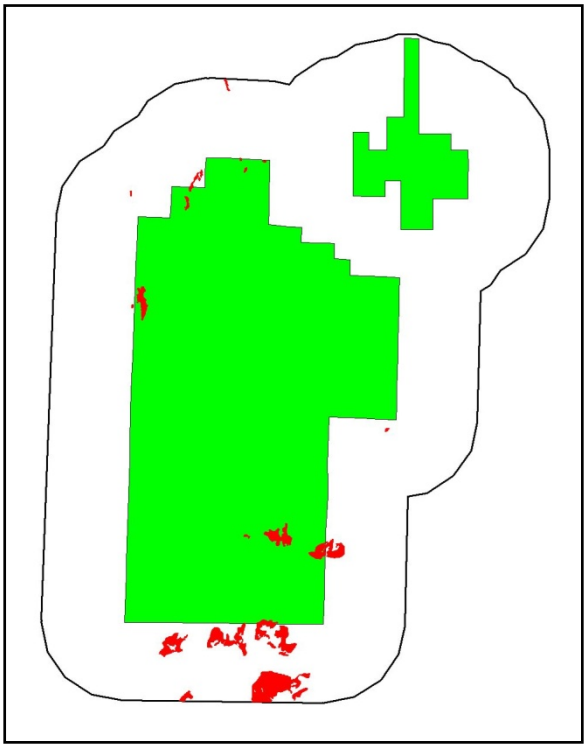


Photo Signature Example



Herbaceous Vegetation

Map Unit ***Agropyron desertorum*** **Semi-natural Herbaceous Vegetation**
AGDE **Desert Wheatgrass Semi-natural Herbaceous Vegetation**

Common Species

Agropyron desertorum, Artemisia tridentata ssp. *vaseyana, Ericameria nauseosa, Bromus tectorum*

NVCS Association

- [No Association – Park Special]

Representative Ground Photo



Description

This herbaceous map unit represents a few pastures and cultivated lands that were seeded with the non-native desert wheatgrasss. Stands occurred in valley bottoms and on flat terraces. Polygons of this type often contained dead or cleared sagebrush and rabbitbrush short shrubs indicating that stands were altered from shrubland or shrub herbaceous types. On the NAIP imagery this type exhibited a dark brown-tan (mocha) color and faint agricultural tilling (possibly a drill seeder) and irrigation lines were sometimes apparent. Polygons of this map unit likely include patches with high cheatgrass cover and possibly some pockets of native bunchgrasses. Other desert wheatgrass patches and stands likely occur within the project area but were not recognizable on the imagery.

Range and Distribution

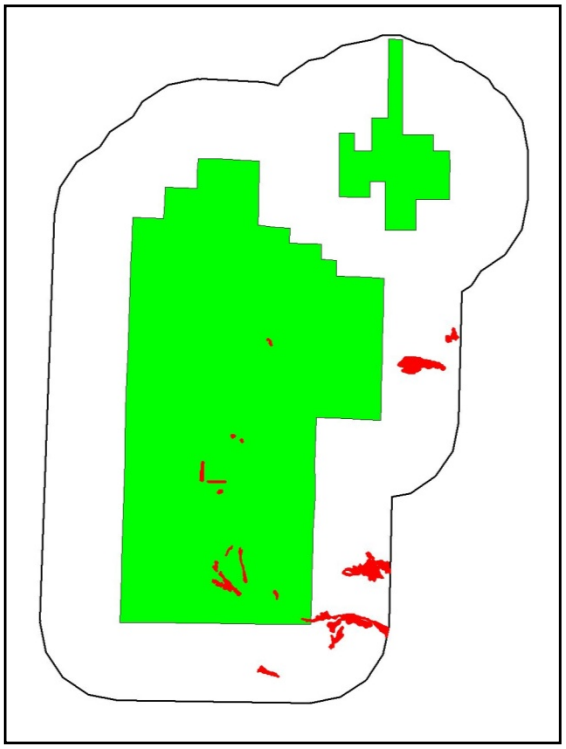


Photo Signature Example



Map Unit	*Bromus tectorum* Semi-natural Herbaceous Alliance
BRTE	Cheatgrass Semi-natural Herbaceous Alliance

Common Species

Bromus tectorum, Chrysothamnus viscidiflorus, Achnatherum hymenoides, Poa pratensis, Elymus lanceolatus

NVCS Alliance

-*Bromus tectorum* Semi-natural Herbaceous Alliance

Representative Ground Photo



Description

The invasive non-native annual cheatgrass occurred in nearly monotypic stands on broad plains, rolling hills, and slopes; on some sites it occurred with other non-native grass and forb species in abandoned pastures. Cheatgrass was common in the southern half of CIRO, established on previously burned sites and in the environs around agricultural and ranching operations. Stands of cheatgrass ranged from dense and tall on floodplains to low or spars cover on dry sites within valleys, on alluvial fans, and on hillslopes. On the NAIP imagery stands of cheatgrass with moderate cover (>20%) had a characteristic smooth, orange-tan color; there may be confusion with rabbitbrush shrub herbaceous stands and desert wheatgrass map units.

Range and Distribution

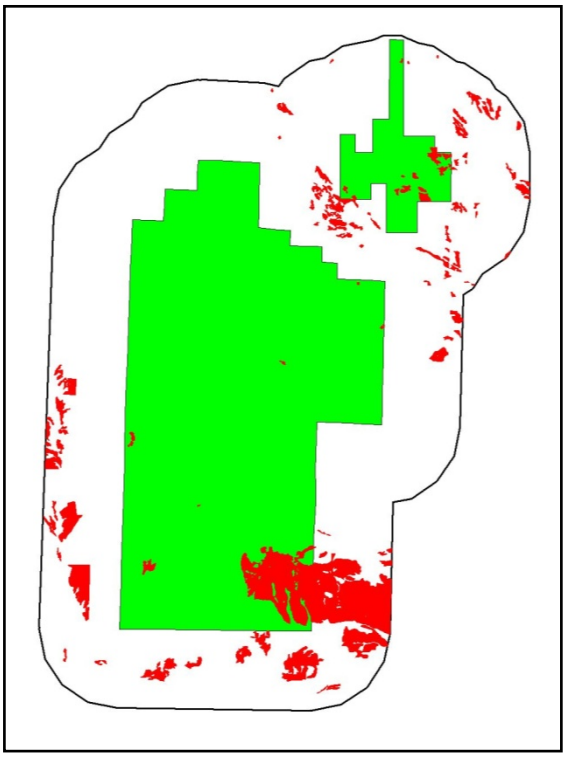


Photo Signature Example



Map Unit ***Carex nebrascensis*** **Herbaceous Vegetation**
CANE **Nebraska Sedge Herbaceous Vegetation**

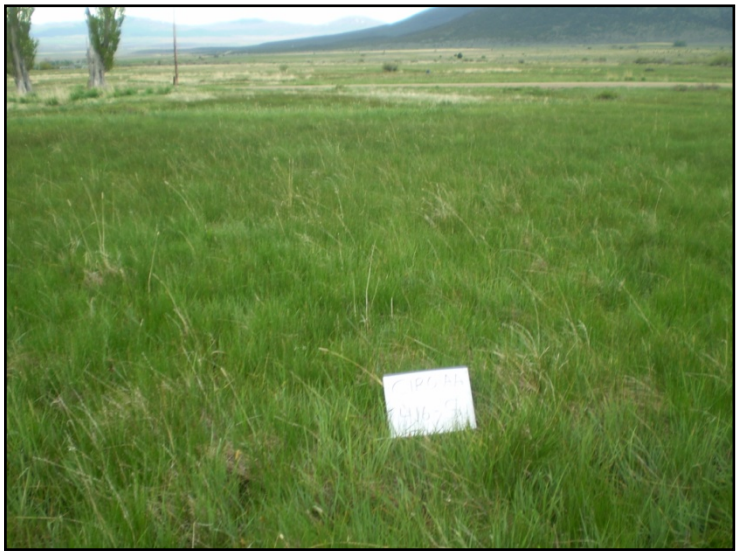
Common Species

Carex nebrascensis, Juncus balticus, Poa pratensis, Poa bulbosa, Polygonum bistortoides, Descurainia pinnata

NVCS Association

- *Carex nebrascensis* Herbaceous Vegetation

Representative Ground Photo



Description

This herbaceous emergent wetland was common at CIRO in mesic drainage bottoms, irrigated fields, seeps, and on the banks and first terraces of streams and tributary drainages with persistent ground water. Polygons typically contained nearly pure stands of Nebraska sedge with low cover of bluegrasses and Baltic rush. An attempt was made to separate this saturated soil type from the drier Kentucky bluegrass map unit but some overlap likely occurs. On the 2009 imagery this type was mapped partially by landscape position in drainage bottoms and partially by the characteristic mottled, dark green color with black flecks.

Range and Distribution

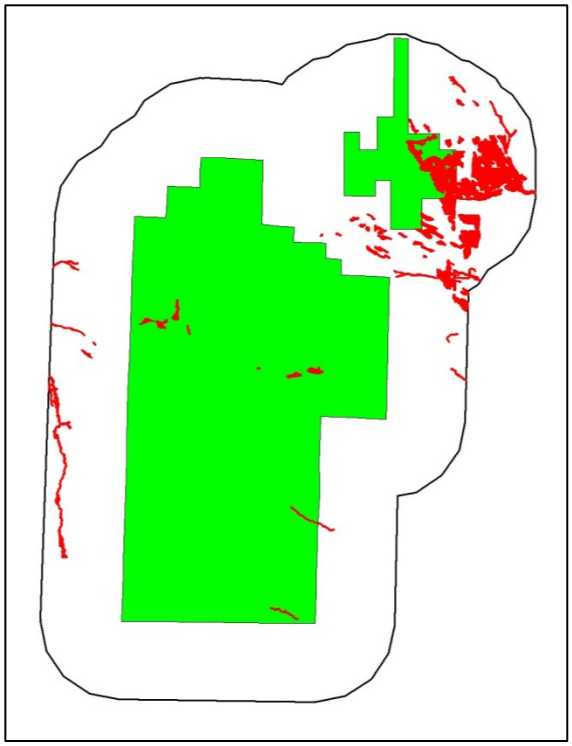


Photo Signature Example



Map Unit ***Elymus lanceolatus*** **Herbaceous Alliance**
ELLA **Streambank Wheatgrass Herbaceous Alliance**

Common Species

Elymus lanceolatus, Chrysothamnus viscidiflorus, Bromus tectorum, Achnatherum hymenoides, Hesperostipa comata, Pseudoroegneria spicata, Poa secunda

NVCS Alliance

-*Elymus lanceolatus* Herbaceous Alliance

Representative Ground Photo



Description

This native grassland type occurred on two post-burn polygons within CIRO. Streambank wheatgrass occurred as large bunches in association with low cover of rabbitbrush and low to moderate cover of non-native cheatgrass and native perennial grasses. It is likely that this type represents a transition from singleleaf pinyon – Utah juniper woodlands where the trees have been fire-killed and grass species are providing more cover due to less shading. On the 2009 imagery this type was mapped based on the mottled tan color with dead shrubs and trees apparent as dark flecks. The polygons contain some remnant living trees and shrubs, especially rabbitbrush. This type was similar in appearance to the rabbitbrush type and some overlap in mapping likely exists.

Range and Distribution

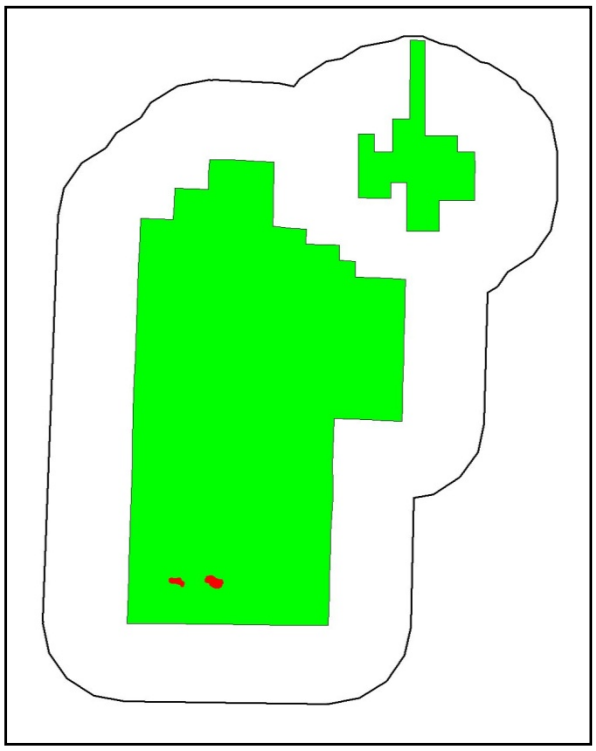


Photo Signature Example



Map Unit POPR	***Poa pratensis – (Poa bulbosa) - Juncus balticus* Semi-natural Herbaceous Vegetation** **Kentucky Bluegrass – (Bulbous Bluegrass) – Baltic Rush Semi-natural Herbaceous Vegetation**

Common Species

Poa bulbosa, Poa pratensis, Juncus balticus, Symphyotrichum ascendens, Sisymbrium altissimum, Bromus tectorum, Elymus lanceolatus, Iva axillaris

Representative Ground Photo



NVCS Association

-*Poa pratensis – Juncus balticus* Semi-natural Herbaceous Vegetation
-*Poa bulbosa* Semi-natural Herbaceous Vegetation

Description

This perennial rhizomatous graminoid type represents disturbed and grazed pastures occurring primarily in the environs; included are mesic sites in fallow fields, field margins, road edges, and irrigated pastures. Bulbous and Kentucky bluegrasses may have been seeded in these mesic areas for ground cover or livestock forage or became established from nearby seed sources, imported livestock forage, and persist due to continued grazing. This graminoid type likely replaced Baltic rush – mixed native grasslands or basin big sagebrush shrublands. Both species of bluegrass occurred with Baltic rush on moist sites; Nebraska sedge was present on saturated soils. Associated herbaceous species included weedy annuals and biennials varying in composition and density from site-to-site. Within CIRO a variety of photo signatures represented this type ranging from mottled tans, to blotchy greens; the signature was related to vegetation dryness and grazing patterns.

Range and Distribution

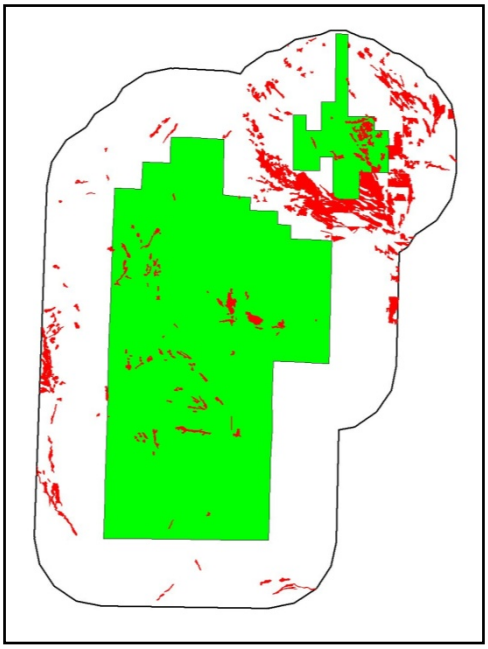
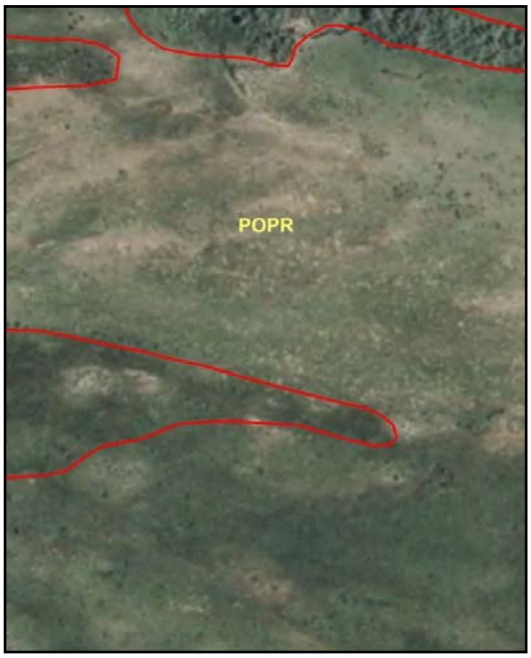


Photo Signature Example



Map Unit	***Pseudoroegneria spicata* Herbaceous Alliance**
PSSP	**Bluebunch Wheatgrass Herbaceous Alliance**

Common Species

Pseudoroegneria spicata, Sporobolus cryptandrus, Artemisia tridentata ssp. *wyomingensis, Artemisia nova, Artemisia arbuscula, Balsamorhiza sagittata, Leymus cinereus, Chrysothamnus viscidiflorus, Festuca idahoensis, Poa secunda*

NVCS Associations

-*Pseudoroegneria spicata - Poa secunda / Balsamorhiza sagittata* Herbaceous Vegetation
-*Pseudoroegneria spicata - Festuca idahoensis* Canyon Herbaceous Vegetation

Representative Ground Photo



Description

Bluebunch wheatgrass uncommonly occurred on steep, rocky slopes of mountains and hills within CIRO. Stands were somewhat patchy in distribution, intermixed with dwarf and black sagebrush short shrublands and woodland stands. This perennial bunchgrass type is characterized by bluebunch wheatgrass, Idaho fescue, and other native grasses. Non-native species, including the annual cheatgrass were sometimes present in low cover. The density of native bunchgrasses varied from sparse on thin soils to moderately dense on loams and other deeper soils. The photo signature for this map unit appeared as mottled and smooth due to the lack of shrubs and varied in color from brown, to light tan, and gray on eroded sites.

Range and Distribution

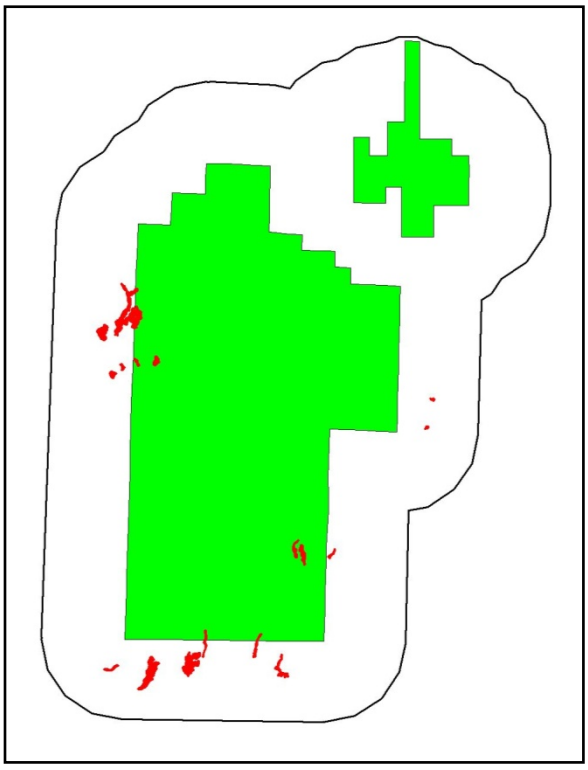
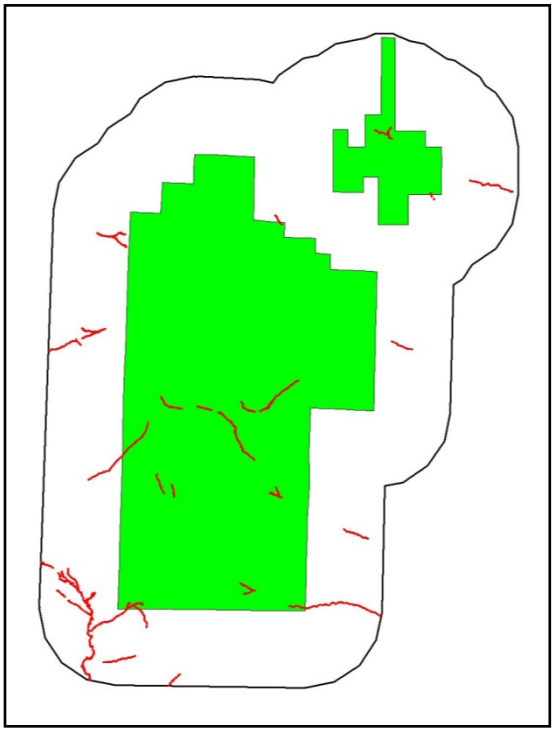


Photo Signature Example

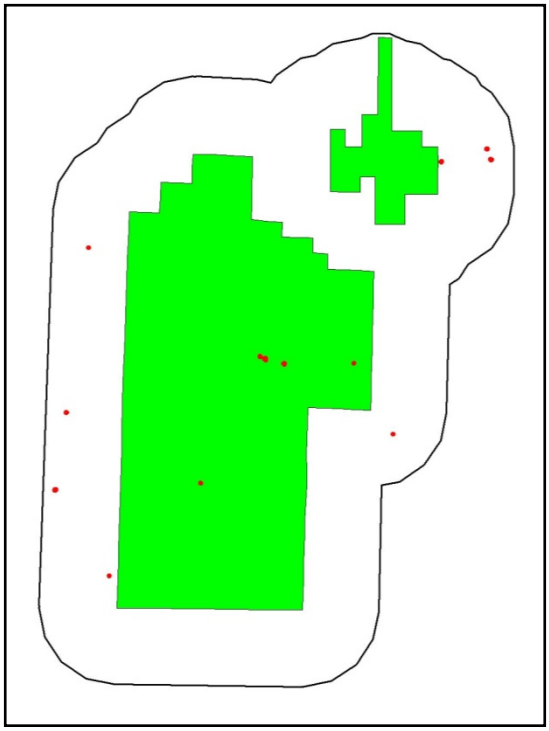


LAND COVER – LAND USE

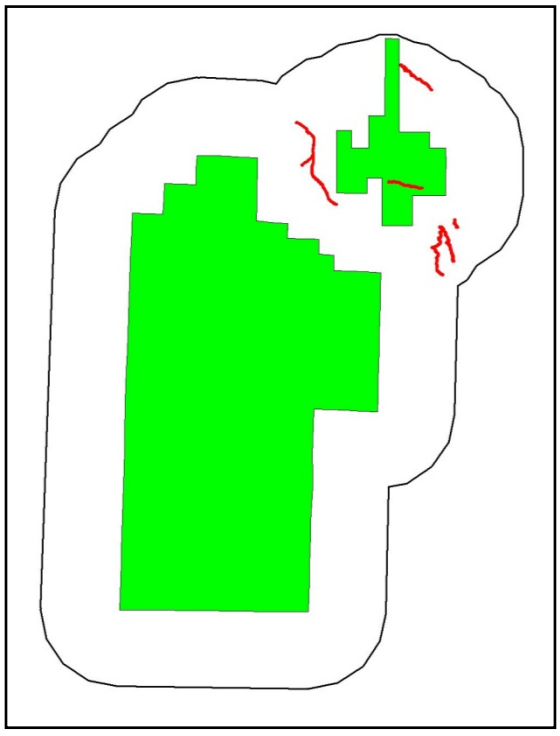
Stream / River



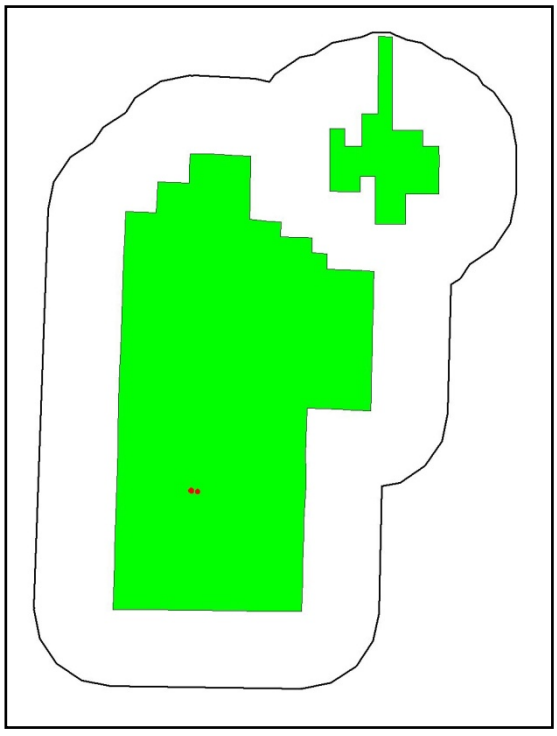
Lake / Pond



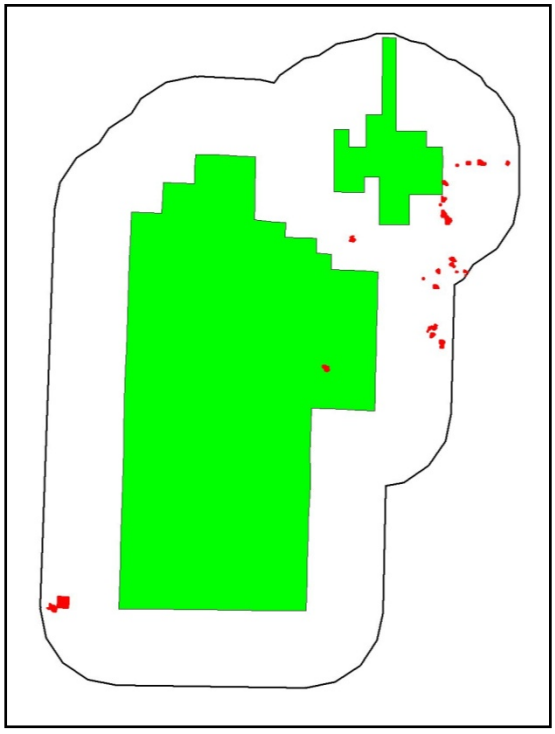
Canal / Ditch



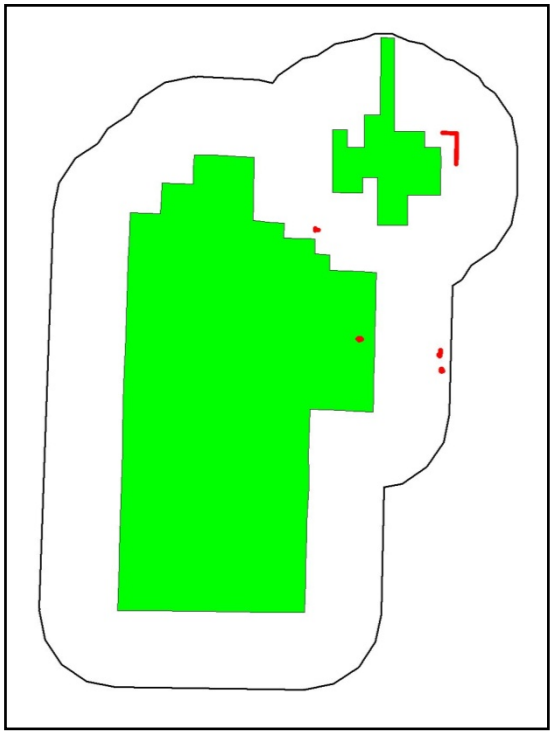
Residential



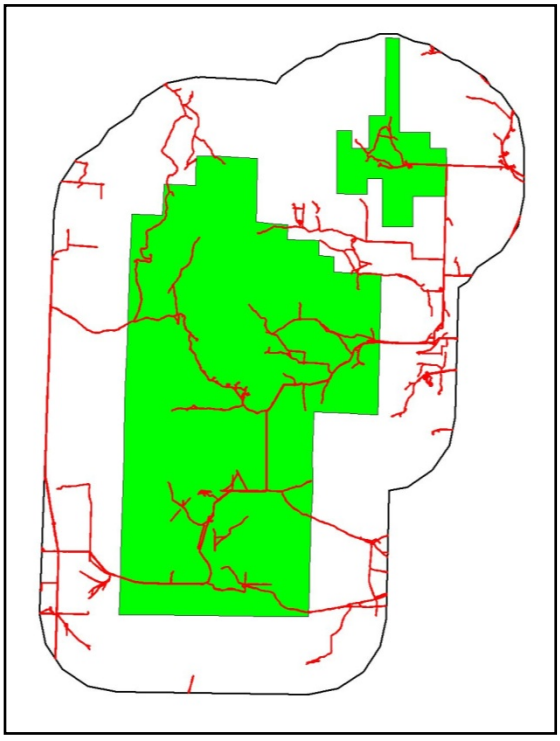
Agricultural Business



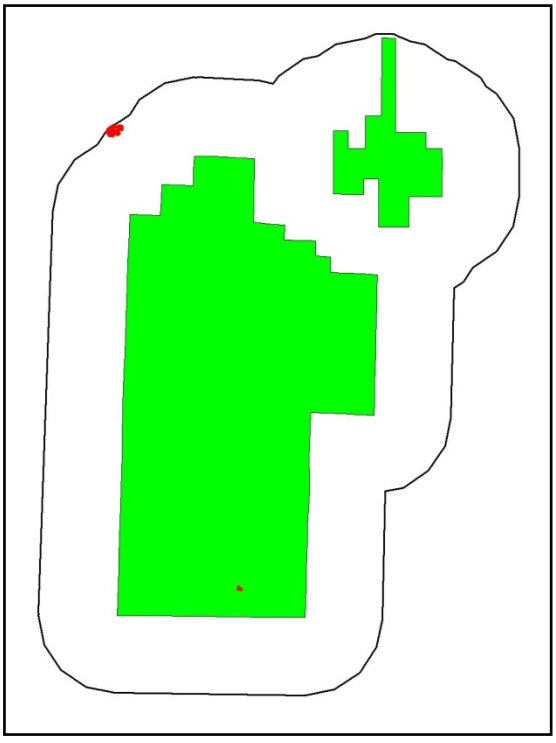
Transitional



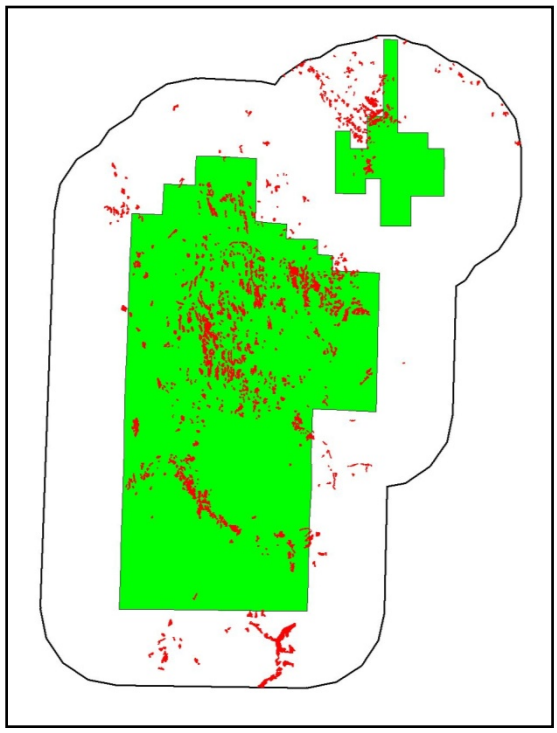
Transportation



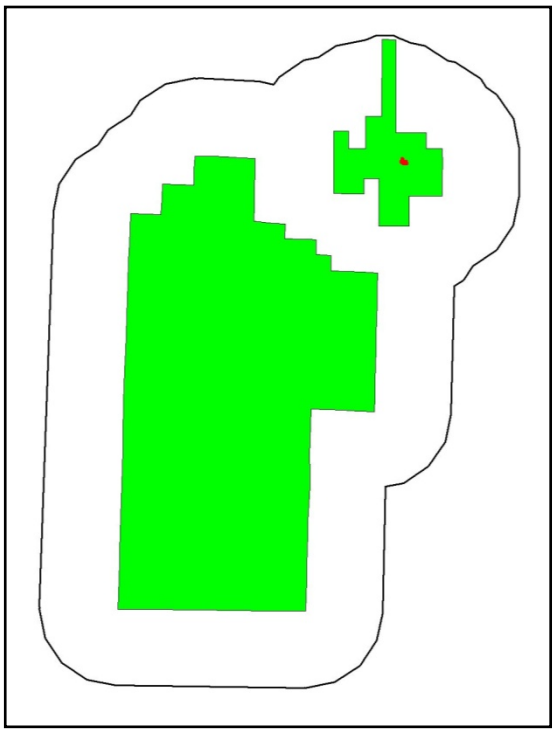
Quarries / Strip Mines / Gravel Pits



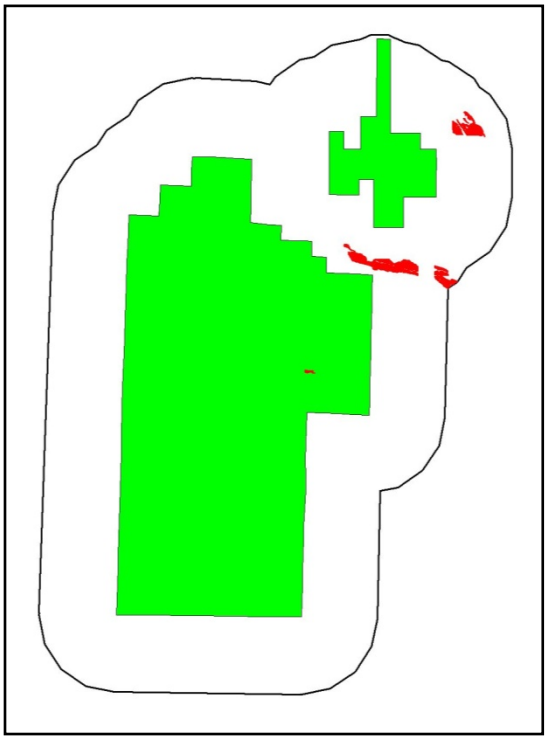
Bare Rock / Sand / Other Bare Ground



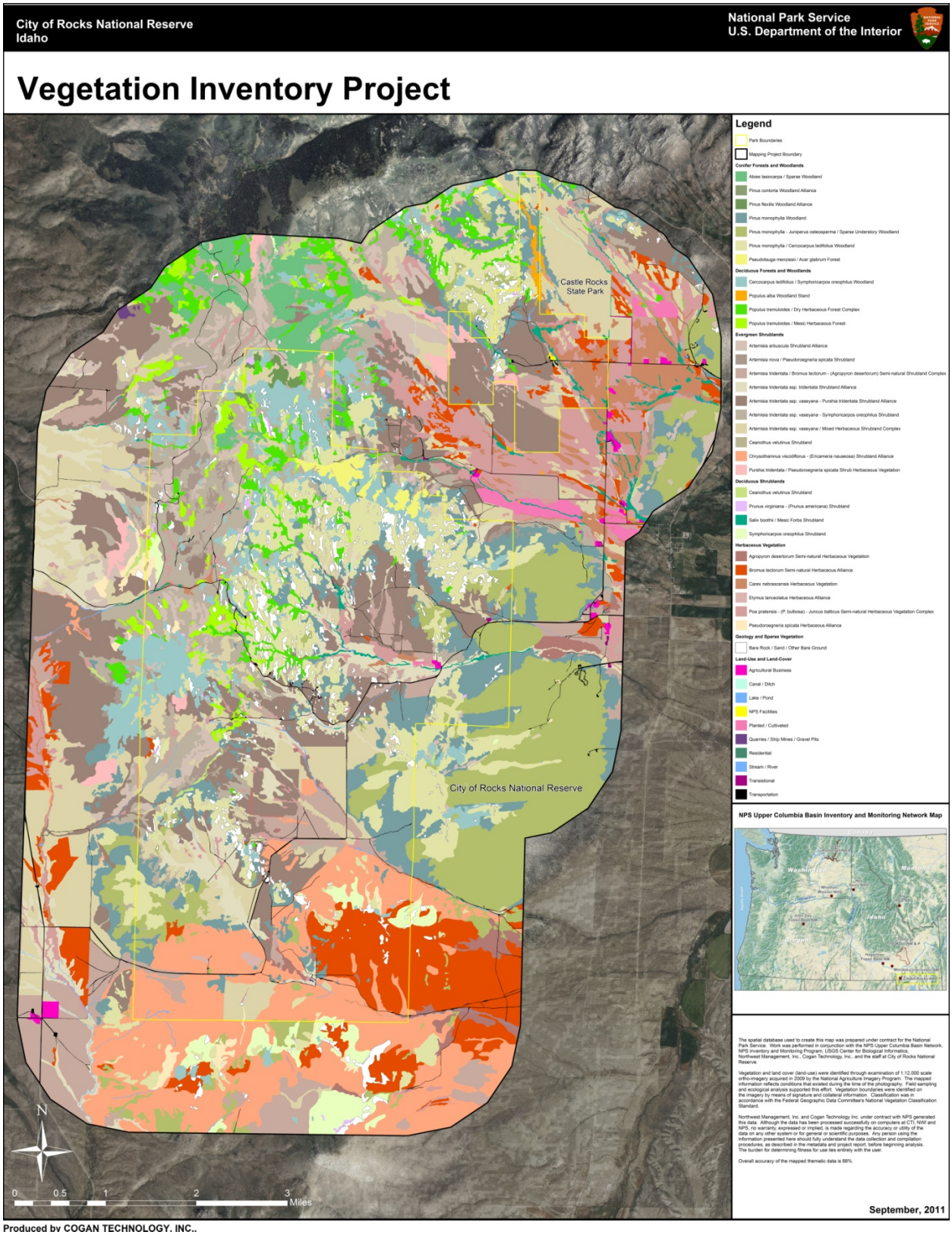
Park/Reserve Facilities



Planted / Cultivated



Appendix G – Final CIRO Vegetation Map



The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 003/10270, September 2011

National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

www.nature.nps.gov