National Park Service
U.S. Department of the Interior

Natural Resource Program Center

Vegetation Classification and Mapping

Hagerman Fossil Beds National Monument

Natural Resource Technical Report NPS/UCBN/NRTR—2009/212

ON THE COVER

Hagerman Fossil Beds National Park and the Snake River
Photograph by: Dan Cogan

Vegetation Classification and Mapping

Hagerman Fossil Beds National Monument

Natural Resource Technical Report NPS/UCBN/NRTR—2009/212

John A. Erixson
Northwest Management, Inc.
233 E. Palouse River Dr.
PO Box 9748
Moscow, ID 83843

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

April 2009

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

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

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

Printed copies of reports in these series may be produced in a limited quantity and they are only available as long as the supply lasts. This report is also available from Upper Columbia Basin Network and the Natural Resource Publications Management website (http://www.nature.nps.gov/publications/NRPM) on the Internet.

Please cite this publication as:

Erixson, J. A., and D. Cogan. 2009. Vegetation classification and mapping of Hagerman Fossil Beds National Monument. Natural Resource Technical Report NPS/UCBN/NRTR—2009/212. National Park Service, Fort Collins, Colorado.

NPS D-43, April 2009

Contents

Figures

Tables

Acknowledgements

A project of this size and complexity required the enthusiasm and energy of many people over several years. The dedication of all involved helped to produce a product that we, the authors, gratefully acknowledge.

We would like to specifically thank Lisa Garrett and her staff who provided contracting, data management, and technical review through all aspects of this project.

The staff at Hagerman Fossil Beds National Monument (HAFO) went out of their way to assist field crews in every way possible, including providing housing when needed. They were very professional and extremely helpful throughout the process.

Special recognition goes to Karl Brown with NPS for prioritizing the need for this project and providing funding. Without the financial support from the NPS Vegetation Mapping Program the project would not have been possible.

Executive Summary

Hagerman Fossil Beds National Monument (HAFO) encompasses approximately 4,351 acres in the Snake River canyon in central Idaho. HAFO is located approximately 35 miles west of Twin Falls, Idaho and 100 miles east of Boise. This unique terrain supports approximately 380 species of vascular plants and includes examples of native plant communities indigenous to this area. The park consists of two areas located on opposite sides of the Snake River. Approximately 60 acres is located on a relatively flat area east of the river (future monument's museum and interpretive center) with the balance of the monument located west of the river. To better understand the distribution of the plant assemblages located on these sites, the National Park Service (NPS) Upper Columbia Basin's Inventory and Monitoring Network (UCBN) started a vegetation mapping and classification effort at HAFO in 2006.

A three-year program was initiated to complete the task of mapping and classifying the vegetation at HAFO. Phase one, directed by HAFO and network staff in conjunction with NatureServe developed a vegetation classification using the National Vegetation Classification System (NVCS). Phase two, directed by Northwest Management, Inc.'s (NMI) GIS Laboratory and Cogan Technology, Inc (CTI) produced a digital vegetation map. To classify the vegetation, 85 representative plots located throughout the approximately 4,314 acre project area (parks + environs) were sampled during the summer of 2006. Analysis of the plot data by Idaho Conservation Data Center in the winter of 2006-2007 produced 34 distinct plant associations. In addition, CTI described two additional alliances and one distinctive stand of vegetation (i.e. Park Special) that primarily occurred outside of the park boundary in the environs. Vegetation descriptions and a field key for all 14 unique plant assemblages for HAFO are included in this report.

To produce the digital map, 1:12,000-scale true color digital ortho-imagery acquired in 2004 and 2006 by the U.S. Department of Agriculture - Farm Service Agency's Aerial Photography Field Office and the National Agriculture Imagery Program (NAIP) were used. In the end, 38 map units (21 vegetated and 17 land use) were developed and directly cross-walked or matched to their corresponding plant associations and land use classes. All of the interpreted and remotely sensed data were converted to Geographic Information System (GIS) databases using ArcGIS© software. Draft maps were printed, field tested, reviewed, and revised. Two hundred and seventy accuracy assessment (AA) data points were collected in 2008 and used to determine the maps' accuracy. After final revisions, the accuracy assessment revealed an overall thematic accuracy of 87%.

Products developed for HAFO are described and presented in this report, as well as stored on the accompanying DVD. These include:

- A *Final Report* that includes keys to the vegetation and imagery signatures, AA information, and all of the methods and results of the project;
- A *Spatial GIS Database* containing spatial data for the vegetation, 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 classes and associations/alliances.

In addition, HAFO and the UCBN both received copies of:
- Digital data files and hard copy data sheets of the observation points, vegetation field plots, and accuracy assessment points;
- Hardcopy vegetation maps.

Additional data not included in this report can be found on the attached DVD. This includes text and metadata files, keys, lists, field data, spatial data, the vegetation map, and ground photos. Please access the following USGS website for posting of this information: http://biology.usgs.gov/npsveg/index.html.

For more information on the National Vegetation Classification Standard (NVCS) and National Vegetaion Classification (NVC) alliances/associations in the United States please visit NatureServe's website: http://www.natureserve.org.

A summary of the project statistics is included below:

Field Work Summers of 2006 and 2008:

Plot Sampling = 85 Plots:

85 Vegetation Plots and 52 observation points were sampled in June and July 2006 by John Erixson and Jack Gunderman from Northwest Management, Inc. and Matt Smith and Karen Miller from Environmental Engineering, Inc.

Accuracy Assessment Points = 267 collected in 2008 by Drake Barton, Jack Bell and Brad Tucker from NMI.

Classification:

34 NVCS Plant Associations and Alliances

GIS Database 2002-2005:

Project Size = 21,522 acres
Hagerman Fossil Beds National Monument = 4,351

Base Imagery acquired from the USDA FSA Aerial Photography Field Office acquired through the National Agriculture Imagery Program:

2006 - 1:12,000-scale true color ortho-rectified imagery, compressed county mosaic, 2 meter pixel resolution
2004 - 1:12,000-scale color infrared digital ortho-imagery, compressed county mosaic, 1 meter pixel resolution

38 Map Classes

21 Vegetated
17 Non-vegetated

Minimum Mapping Unit = ½ hectare is the program standard but this was modified at HAFO to ¼ acre for most map units.

Total Size = 2,619 Polygons

Average Polygon Size = 8.2 acres

Overall Thematic Accuracy = 87%

Project Completion Date: May 2009

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 United States National Parks. The goals of this program 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, Grossman et al. 1998).

In the same year, the USGS-NPS Vegetation Mapping Program also 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). 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 United States at physiognomic levels. It also 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 United States. The FGDC standard requires that federally funded vegetation classification efforts collect data in a manner that enables crosswalking 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 maintains a treatment of floristic units (alliances and associations), which, though not a federal standard, are used as classification and mapping units by the vegetation mapping program whenever feasible. For purposes of this document, the federal standard (FGDC 1997) is denoted as the NVCS; the USNVC will refer exclusively to NatureServe's 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 this national program. This system:

- 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 USGS-NPS vegetation mapping protocols facilitate effective resource stewardship by ensuring compatibility and widespread use of the information throughout the NPS as well as by other federal and state agencies. These 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 twenty years (TNC 1994a; Grossman et al. 1998). The NCVS 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 2-volume publication presenting the standardized classification, providing a thorough introduction to the classification, its structure, and the list of vegetation types found across the United States as of April 1997 (Grossman et al. 1998). *Volume I: The National Vegetation Classification Standard* can be found 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 United States and Canada. This online database server, NatureServe Explorer®, can also be found on the Internet at: http://www.natureserve.org/explorer .

NPS-USGS Vegetation Mapping Inventory Program

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

The Vegetation Mapping Inventory 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 United States. Vegetation species and communities are unique from park to park. The inventory of these resources helps park managers conserve plant biodiversity; manage challenges such as exotic species, insect outbreaks, and diseases; and understand resources and processes such as wildlife habitat relationships and wildland fires.

The primary objective of the Vegetation Mapping Inventory is to produce high-quality, standardized maps and associated data sets of vegetation and other land cover occurring within parks. This information fills datgaps 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 the parks with tools to better manage foxtail pines (*Pinus balfouriana ssp. austrina*), an endemic species to the southern Sierra Nevada. Foxtail pines live more than 1,000 years and their tree rings contain valuable information about past climate fluctuations. In the Rocky Mountain National Park, vegetation

map and inventory data aid in the study of elk damage to aspen and willow trees within elk wintering grounds.

NPS vegetation mapping follows well-established procedures that are compatible with other agencies and organizations. The inventory uses the National 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 a park includes the following products:

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

Maps are produced in Universal Transverse Mercator (UTM) coordinates (NAD 83) with a 1:24,000 scale and a minimum mapping unit of 0.5 hectares. 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.

Hagerman Fossil Beds National Monument

Hagerman Fossil Beds National Monument (HAFO) encompasses approximately 4,351 acres in the Snake River canyon in south central Idaho. The area has a complex hydrologic system and is prone to landslides that often leave fossils exposed. HAFO is one of the most important locations for Pliocene fossils in the world. The fossils are distributed vertically through 500 feet of the stratigraphic section of the Glenns Ferry Soil Formation.

HAFO is located approximately 35 miles west of Twin Falls, Idaho and 100 miles east of Boise. This unique terrain supports about 380 species of vascular plants and includes examples of native plant communities indigenous to this area. The park consists of two areas located on opposite sides of the Snake River. Approximately 60 acres is located on a relatively flat area east of the river; this area currently contains the research labs for the monument and will house the future site of the monument's museum. The current Visitor Center is located in Hagerman, Idaho. The area west of the Snake River comprises the majority of the monument totaling just over 4,250 acres.

HAFO was authorized in 1988. The main mission of the Monument is to preserve and maintain the history of the area and the rich fossilbeds found along the banks of the Snake River. Since the 1930's, scientists have found fossils in the cliff areas rising 152 m (500 feet) above the river and in areas unearthed by erosion. HAFO is home to the largest known deposits of "Hagerman Horse" fossils found in North America. The Hagerman Horse fossils (a zebra like horse) and others including cats, fish, turtles, beavers, camels, peccaries and mastodon are found at HAFO. These fossils are from the late Pliocene epoch period dating back nearly 3.5 million years. The

layers of sediment were deposited 2.5 to 3.5 million years ago and have preserved the fossils in the silty clay.

The Oregon Trail crosses the southern portion of HAFO. The Monument is one of only 3 units in the National Park system that contains parts of the Oregon National Historic Trail.

Natural Setting

Both areas of the monument are located along the banks of the Snake River approximately 3 miles west of Hagerman, Idaho. The Snake River is a major tributary of the Columbia River system that travels through the physiographic region of Idaho known as the Snake River Plain. The Snake River Plain is a topographic depression that cuts across Basin and Mountain structures paralleling the North American plate. The Snake River Plain is underlain entirely by basalt erupted from the large shield volcanoes found in the area. Beneath the basalts are rhyolite lavas and ignimbrites that erupted as the lithosphere passed over the hotspot. Thick sections of interbedded lacustrine (lake) and fluvial (stream) sediments are found in the area of Hagerman Valley.

HAFO is in a unique region of Idaho that is bounded on the south and west by sagebrush plateaus and on the east by the Hagerman Valley. Some areas on both sides of the river are currently utilized for cultivation of corn, potatoes and other crops. This monument is located primarily along the steep canyon walls adjacent to the river.

The Snake River canyon near HAFO is known as “Thousand Springs” due to the abundance of natural springs that flow from the steep canyon walls and cascade into the Snake River. The source for these springs is the Snake River Plains Aquifer, which is one of the largest underground aquifers in the world. Water seeps through an area of several thousand square miles under volcanic rock before emerging from the basalt cliffs near HAFO.

HAFO ranges in elevation from 2,800 to 3,500 feet above sea level. Many slopes within the monument area are in excess of 100% and range from nearly flat to well over 120%. This places many important areas of HAFO at risk from landslides caused by erosion primarily associated with water movement. Fossil Gulch, Yahoo Creek and Peters Gulch are the major streams located within the boundaries of HAFO.

HAFO typically experiences hot, dry summers with temperatures often exceeding 100 degrees F and precipitation less then ¼ inch during July. August temperatures remain nearly as hot but precipitation is slightly higher at 1/3 inch. This creates a need for water sources for irrigation and livestock grazing in the area. The Snake River has numerous dams. The dams are primarily used for irrigation and energy production. There is an extensive irrigation district in this area. In addition to the diversion of the water from the Snake River, farmers and ranchers utilize additional water by pumping from springs, wells and creeks.

There are a total of 14 soil types found within the monument (Soil Map is found in the appendix). Of this, the Badland-Kudlac association (30 to 90% slopes) is the dominant soil association found. This soil is found on the steeper slopes of the monument, it is well drained silty clay derived from lacustine deposits. Runoff is rapid and the potential for water erosion is severe. This association comprises nearly 72% of the area. Three additional soil types, Kudlac

Silty Clay (4 to 30% slope), Purdam Silt Clay (4 to 8% slope) and Scoon Fine Sandy Loam ,(1 to 4 % slope) comprise 17.9% of the area. The balance of the area consists of the remaining 10 soil types.

Generally, the soils above the park on the terraces are utilized for agricultural purpose. These soils are well drained silt loams. The soils are moderately deep to a hardpan, runoff tends to be slow and the erosion potential is low.

Soils on the alluvial fans and terraces in the lower areas of the monument tend to be well drained loams to clay loams. These soils are characterized as being deep to very deep soils with rapid runoff and severe potential for water erosion.

Vegetation

The vegetation at HAFO contains a mix of common native plants and non-native species. The native elements mainly include shrub species found throughout the monument. The non-native species tended toward invasive trees, primarily *Elaeagnus angustifolia* and invasive grasses including *Bromus tectorum*. Natural plant communities in the area are not well represented and appear to be located in isolated patches found on benches and some steeper slopes.

Atriplex confertifolia and Artemisia tridentata wyomingensis shrublands dominate the uplands and footslopes in most areas within the monument. The uplands are typically loosely associated with east-facing slopes supporting *Artemisia tridentata wyomingensis*. The footslopes are commonly associated with the *Atriplex confertifolia* although both species can be found in the other areas.

Much of the vegetation on the flatter areas along the rim is associated with semi-natural vegetation. These areas were grazed and in some cases utilized for agricultural purposes prior to the establishment of the monument in 1984. All areas were open to grazing until 1984 and many of the flatter areas appear to have had prior agricultural.

The wetter sites are primarily located near the banks of the Snake River and near the seasonal streams found in gulches. In the wetter sites, woodland vegetation is present at the lower elevations on the west side of the river. Several seeps and springs provide the water source in these areas. The area east of the river also supports woodland vegetation near irrigation ditches. The common woodland tree species found along the river include *Elaeagnus angustifolia, Populus angustifolia* and *Populus balsamifera. Ulmus americana* was present primarily outside of the monument’s boundaries.

Relatively recent human disturbance to the natural landscape has introduced many non-native species to the area, which are replacing the native grasses and riparian vegetation. This includes *Agropyron cristatum* and *Borumus tectorum* both common grasses found in the monument and other non-natives observed in and around HAFO including *Elaeagnus angustifolia.*

HAFO Vegetation Mapping Project

The specific decision to classify and map the vegetation at HAFO 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. The UCBN consists of nine National Park units spread across 4 states in the Inland Northwest (Figure 1). This network of parks was formed to create and centralize necessary information about the nature and status of selected biological resources occurring within park boundaries. The information is used for making management decisions, for scientific research, and for educating the public. One of the goals of this network is to provide baseline inventory information for resource management and to help monitor the health of park ecosystems. Stemming from this goal, development of a vegetation classification to the plant community level and associated GIS map and database for each park was viewed as a high priority.

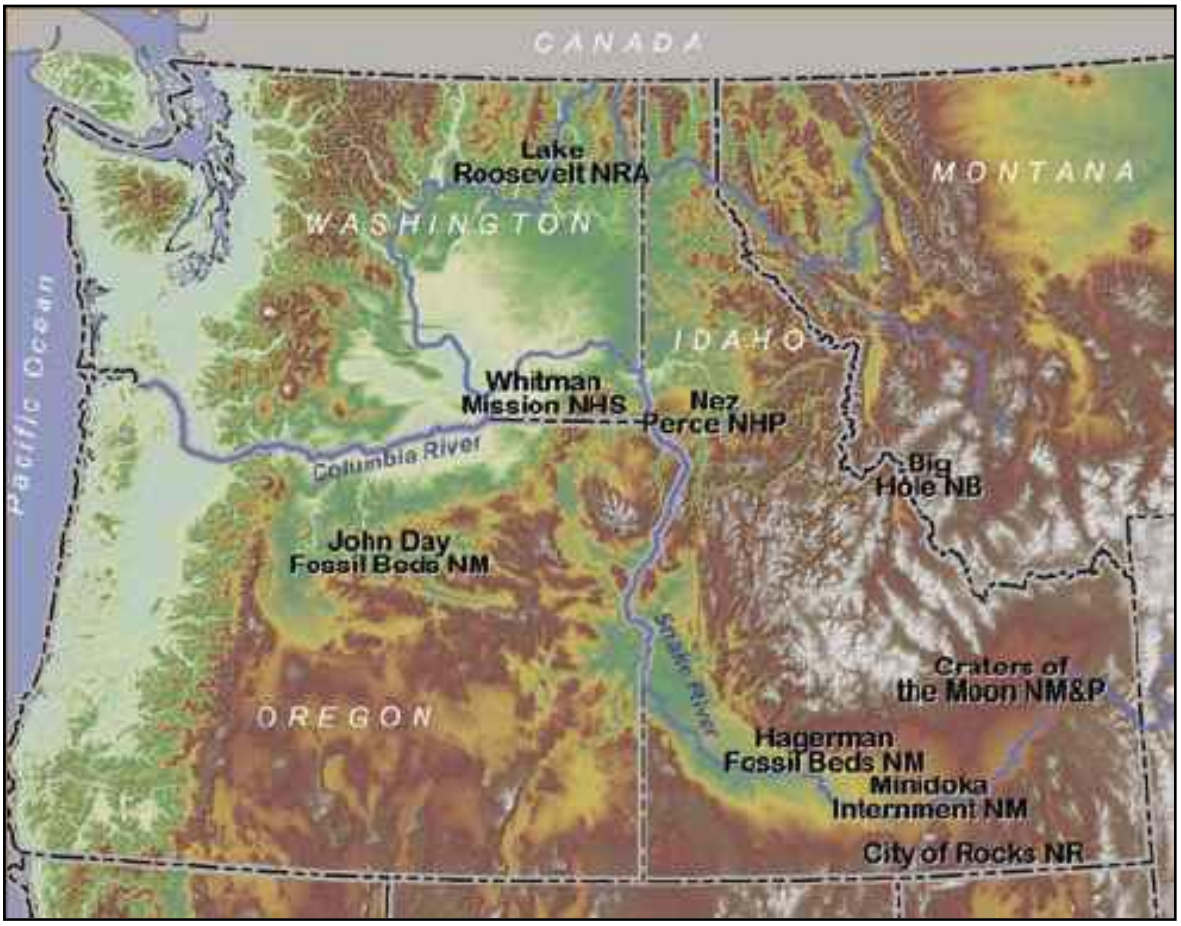


Figure 1. Map of UCBN showing the location of the park units in the network.

Hagerman Fossil Beds National Monument Vegetation Mapping Project

Hagerman Fossil Beds National Monument (HAFO) is one of nine parks served by the UCBN Inventory & Monitoring Program. The UCBN initiated a vegetation mapping inventory for HAFO in the spring of 2006 as part of a larger effort to complete vegetation inventory maps for each of the 8 parks in the Network that contain significant natural resources (Minidoka National Historic Site was excluded due to the small size of the monument).

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 8 UCBN parks. The work plan received approval from the Washington Area Service Office (WASO) Inventory Coordinator in May 2006.

An initial scoping meeting was held at Craters of the Moon National Monument & Preserve (CRMO) May 3-4, 2006 to discuss the preliminary vegetation classification for both CRMO and HAFO. NMI was contracted to complete vegetation plot field data collection during May-July 2006. The Idaho Conservation Data Center (IDCDC) provided the preliminary and final vegetation classification as part of a cooperative agreement with the UCBN. CTI, as part of an interagency agreement with the BOR, provided photo interpretation services. In September 2007, the UCBN entered into a contract with NMI to provide all the vegetation mapping services designated by the work plan and to administer and coordinate the UCBN vegetation mapping projects for all 8 park units.

As a team, the objectives were to produce data consistent with the national program's mandates. These include the following:

Spatial Data

- Aerial photography (NAIP imagery)
- Map classification based on HAFO-specific requirements
- Map classification description and key
- Spatial database of vegetation communities of HAFO's vegetation
- 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

Vegetation mapping for HAFO occurred within an approximate 21,600 acre project boundary, encompassing the boundary of HAFO (as provided by UCBN) and a general 2-km environ radius. The final project area determination was based on management needs, financial constraints, and time limitations (Figure 2). The 2-km environs were used in this project for inventory and monitoring purposes and to capture various management considerations such as exotic 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.

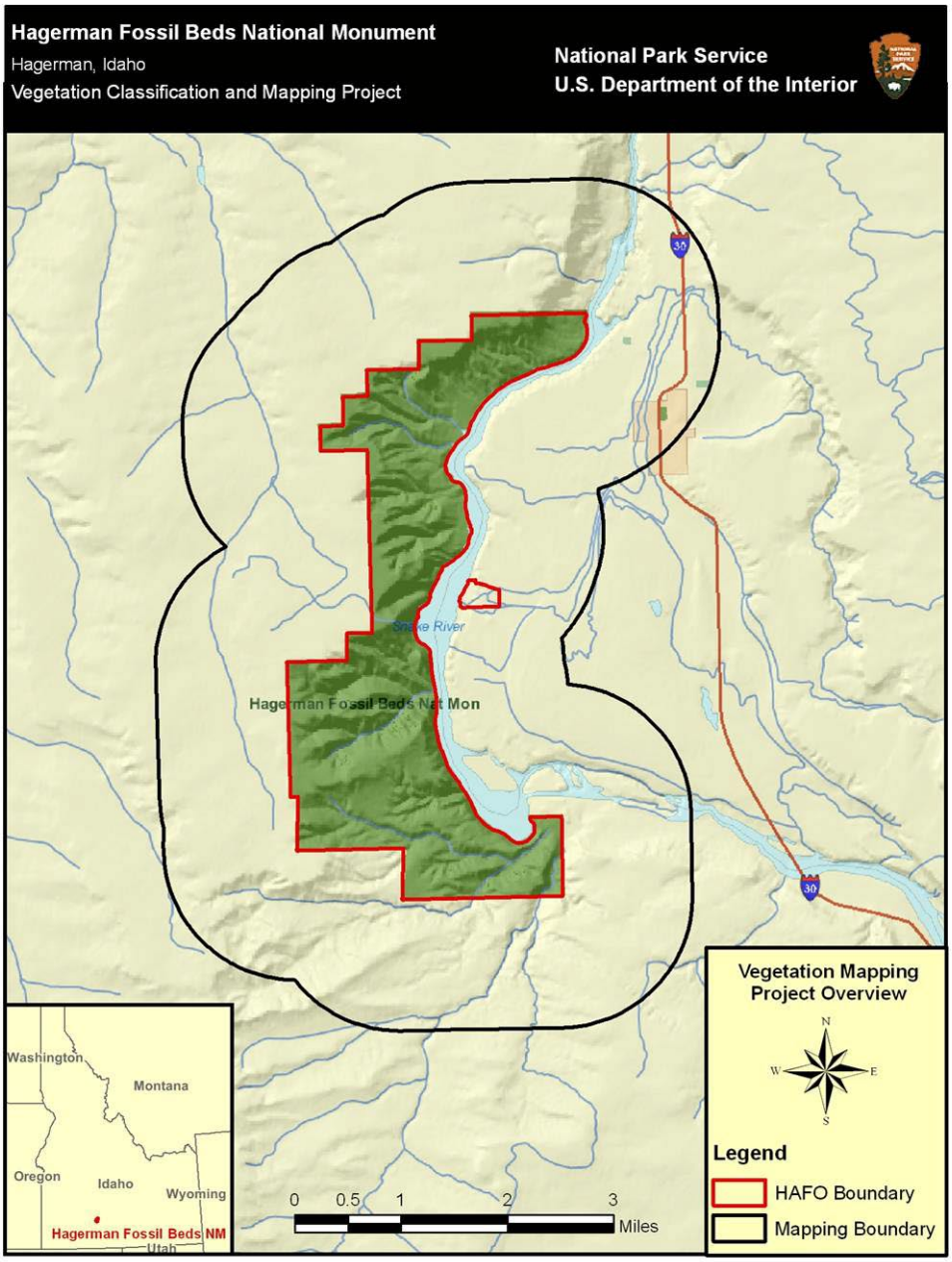


Figure 2. Map of the vegetation project boundary and park boundaries.

Methods

The vegetation mapping project at HAFO 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. Based on this approach the assignment of responsibilities was divided into five major steps following the flowchart of major steps produced for the national program by the USGS (Appendix A). These responsibilities included the following:

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

All protocols for this project as outlined in the following sections can be found in documents produced by The Nature Conservancy (1994a, 1994b, and 1994c) for the USGS-NPS Vegetation Mapping Program and are found at this website: http://biology.usgs.gov/npsveg.

Planning, Data Gathering and Coordination

A series of planning conference calls were held throughout 2006 and attended by representative NMI, CTI, UCBN and CRMO staff which assisted in the development of the HAFO project. The goals of these calls were to (1) discuss the National Vegetation Mapping Program with the UCBN/CRMO staff , (2) learn about the 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) define a project scope.

Once the boundary was finalized all of the latest NAIP imagery for this area was ordered from the USDA Geospatial Gateway website (http://datagateway.nrcs.usda.gov). These included both the county mosaics and the corresponding individual quarter quadrangles.

The remaining work responsibilities were assigned to the following participants:

HAFO-UCBN-NPS Responsibilities

- Provide oversight and project funding;
- Provide HAFO plant list;
- Supply digital boundary files and ancillary data files;
- Assist with fieldwork and logistical considerations;
- Work with Idaho Conservation Data Center 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 HAFO;
- Collect representative plot data;
- Collect less detailed observations about the draft vegetation map;
- Write descriptions of the vegetation types found at HAFO;
- Write a field key to the vegetation types found at HAFO;
- 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.

Idaho Conservation Data Center (ICDC)

- 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;
- Provide guidance regarding the crosswalk of vegetation types to map units;
- Review the local vegetation descriptions and field key;
- 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;
- Assist in creating the project DVD.

Field Survey

Overall, the field methods used for developing the classification and conducting the accuracy assessment at HAFO followed the methodology outlined by the USGS-BRD/NPS Vegetation Mapping Program (TNC 1994b) for medium sized parks. First, ICDC provided a preliminary list of vegetation associations and alliances from the NVCS based on previous studies and local knowledge. The resulting list was initially used to set targets for data collection with each association assigned 3-5 plots. The list was then taken into the field during the summer of 2006 by NMI botanists and ecologists who surveyed the entire site for stands of vegetation represented on the list as well as for any previously unidentified associations and alliances.

Once a stand of vegetation was located that appeared to be representative of the plant communities in the area, a Relevé macroplot was laid out to capture its characteristics. In this manner, transitional areas such as ecotones were avoided. Once a plot was laid out, all data were recorded on a modified plot form (Appendix B). Environmental information collected included: 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: 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 structure and species composition were sampled using plots that varied in size depending on the dominant physiognomy of the vegetation. Woodland plots and shrubland, dwarf-shrubland, and herbaceous vegetation plots were 400 m^2. Plot dimensions were recorded on the forms and the plot shape usually was square, but was modified to best represent the vegetation (e.g. narrow, linear rectangles were used for riparian vegetation).

Field staff collected the information for each of the vegetation plots in two ways. First, a species list was developed and recorded on field forms by the team botanist. GPS coordinates, field notes header information (Identifiers/Locators), environmental descriptions and a plot map were recorded on this form. All other field data was collected with Archer Field PCs utilizing Microsoft Windows Mobile 5.0 operating systems and using DataPlus software 2.5.

Within each plot, NMI visually divided the vegetation into strata, with the height and canopy cover of vegetation estimated for each stratum. Physiognomic class, leaf phenology, and type of dominant stratum were recorded. The species of each stratum were then 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 epithet familiar to researchers. Finally, a provisional vegetation type was assigned to the plot.

After all the physiognomic and environmental information was collected, researchers used a Garmin GPS 76CSX receiver to record the southeast corner of the plot. UTM NAD83 X-Y coordinates and elevation were recorded both manually on the plot forms and stored as waypoints in the GPS unit. Finally, four representative photos were taken facing the four cardinal directions (N, E, S, and W).

During the summer of 2006, a total of 85 vegetation plots were sampled across the monument on both sides of the Snake River (Figure 3).

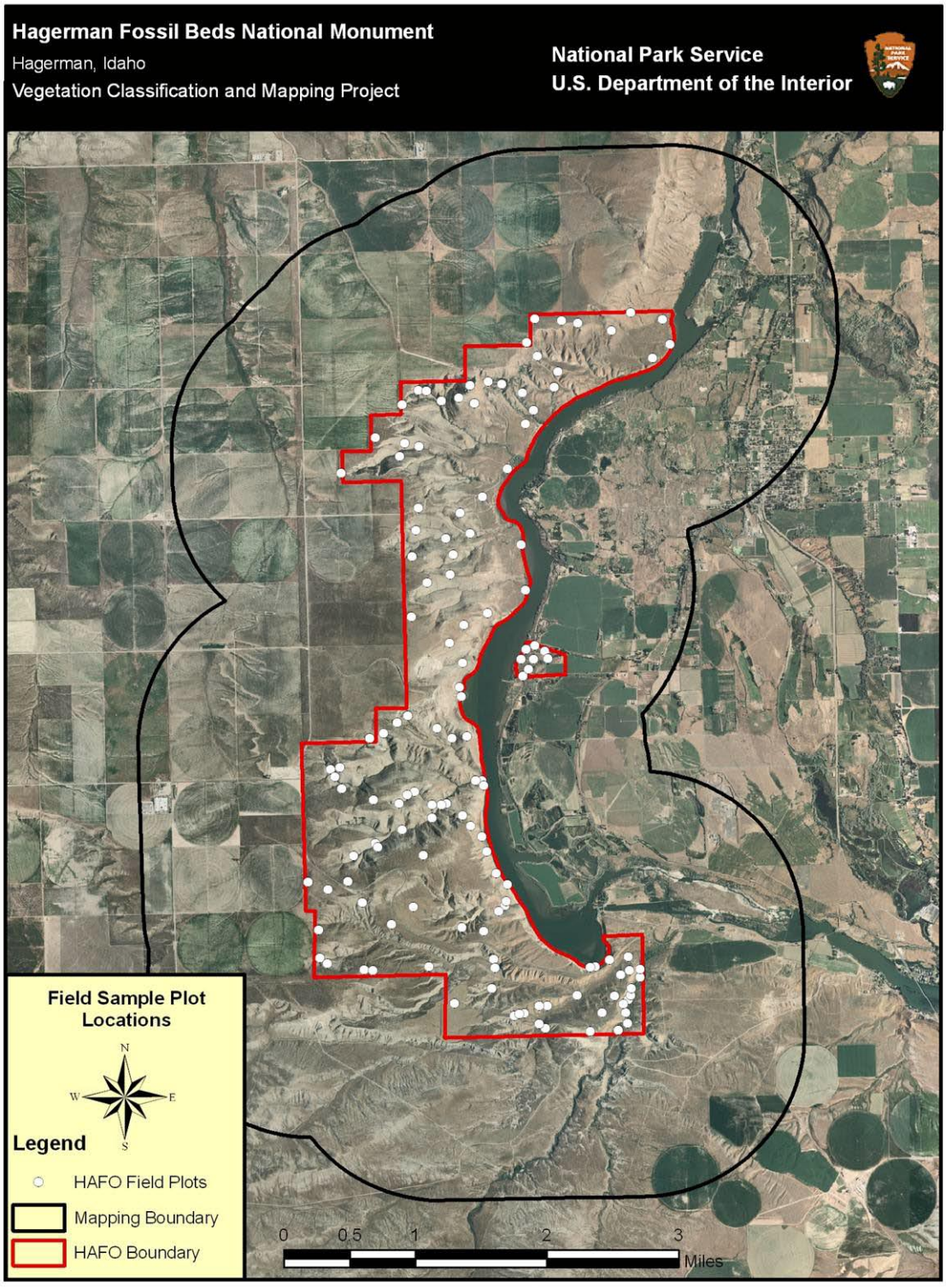


Figure 3. Location of all vegetation plots collected at HAFO in 2006.

Vegetation Classification

Field data for this project was collected digitally. Electronic data was transferred directly from the data recorders (NMI created data dictionaries as needed) into Database Files (DBF). DBF files 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) was entered manually into the database for this project. Separate databases were established as necessary. Field data was collected on Archer Field PC's with Windows Mobile 5.0 operating systems using DataPlus software. All data from these units was transferred and managed in a Microsoft Access database.

Upon completion of field surveys, all recorded data were entered into the NMI's database, a MS Access-derived program. The database is a modified PLOTS2 database initially developed specifically for the NPS vegetation and mapping program, so that the electronic data entry fields mirrored the standard field form. Data entry was facilitated by utilizing drop down menus for each plant scientific name. Scientific names were updated according to the vascular plant list provided to the crews on the date of sampling found on the UCBN website, http://science.nature.nps.gov/im/units/ucbn/inventory/index.cfm#table. After data entry, checking was performed to minimize errors associated with duplicate entries or erroneously selected plant names. Problems regarding unknown species, especially those with high cover, were resolved, as were other taxonomic issues such as grouping subspecies and varieties judged to be ecologically similar.

Prior to quantitative analysis, the database was prepared for use in the analytical programs. Data preparation followed these steps:

1). Standardize strata for certain taxa. Some taxa are listed in different strata in different plots even though they should all be the same, especially if there are multiple field crews. For example, cacti may sometimes be listed as shrubs and sometimes listed as herbaceous;

2). Create "pseudospecies" for each taxon by appending the stratum in which it was found in each plot to a code for the taxon.

3) The species lists were updated to include changes in the scientific names.

4). Remove plots with grossly incomplete or missing data.

At the onset of the vegetation mapping project, a search for existing data was completed (sensu The Nature Conservancy 1996). No existing relevant data were located. Cole (1995); however, may be a potential source for future analyses. Classification analyses were conducted using the 137 vegetation samples collected in 2006. Field methods employed in the collection of these data are described by Northwest Management Inc. (2006) in subsequent sections of this document.

Analytical methods were employed in a manner consistent with the objective of identifying natural associations of existing vegetation (The Nature Conservancy and Environmental Systems Research Institute 1994b; Tart *et al*. 2005; Jennings *et al*. 2006). Multivariate statistical analyses

were conducted using PC-ORD (McCune and Mefford 1999). Initial plant community groups were identified using hierarchical cluster analysis. Plant community groups were successively partitioned to optimize within-group homogeneity, between-group difference, and the number of groups. These three factors were evaluated using statistics generated by indicator species analysis (the mean p-value and number of significant [$p<0.05$] indicator species) and multi-response permutation procedures (T, a measure of separation between groups; the chance-corrected within-group agreement [A], a measure of within-group homogeneity; and the compositional similarity of samples within a group [as measured by average relative Sorensen distance]). Environmental relations, within-group homogeneity, and between-group difference were evaluated graphically using indirect gradient analysis through detrended correspondence analysis (McCune and Grace 2002). Final decisions regarding the naming of plant associations were informed by cross-walking candidate community groupings to the National Vegetation Classification Standard (NatureServe 2007). Classification and regression tree analysis (recursive partitioning) was employed in the development of dichotomous keys and the evaluation of classification results using the rpart package in R Development Core Team (2007).

The plant species nomenclature standard identified by the monument was maintained for the analysis to reflect local and regional taxonomic distinctions. Plant nomenclature of the Integrated Taxonomic Information System (ITIS) as reflected by the PLANTS Database (USDA, NRCS 2007) is employed in the naming of plant associations. This is the National Vegetation Classification Standard and is necessary to discriminate differences among associations currently reported within the National Vegetation Classification (Idaho Data Conservation Center 2008).

Digital Imagery and Interpretation

Since HAFO represented a fairly small and accessible site, no new imagery or aerial photography was deemed necessary for this project. Instead, existing sources of imagery were evaluated and 2 NAIP products were selected to be used as base maps. These included the 2004 and 2006 NAIP products (Figure 4). The 2004 products had 1-meter resolution and were acquired at 1:12,000-scale, which is adequate for vegetation mapping purposes. The 2006 product had 2-meter resolution and was acquired in true-color infrared format. The 2006 imagery was more recent than the 2004 and although it had a coarser resolution, it did highlight all of the recent changes to the landscape such as fires, new roads, tree removals, etc.

After obtaining both sets, the 2006 imagery was color balanced in Imagine Software to remove some of the edge-matching issues and sharpen the image. The 2004 imagery was also color balanced, but edge-matching was not necessary. The resulting image from the 2006 imagery was mosaiced and clipped to just beyond the extent of the project boundary.

Interpretation of the vegetation at HAFO involved a three step process: (1) image segmentation, (2) cleaning and smoothing, and (3) ground-truthing of the data. First, the 2006 imagery was re-sampled to a 3-meter pixel resolution to reduce noise and to generalize the vegetation signatures. Next, this imagery was segmented using eCognition software to delineate obvious landforms (e.g. open water and fields) and physiognomic features (e.g. grasslands versus woodlands). The initial segments were created using a series of trial and error multi-resolution segmentation routines in the software. The settings for scale and shape were manipulated until a desired network of images resulted. The objective of the segmentation was to create a system of lines

with as coarse a scale as possible without omitting most of the small, important and obvious land cover patches. By incrementally increasing segmentation size within the program, small image objects (i.e. preliminary polygons) were continuously merged into larger ones.

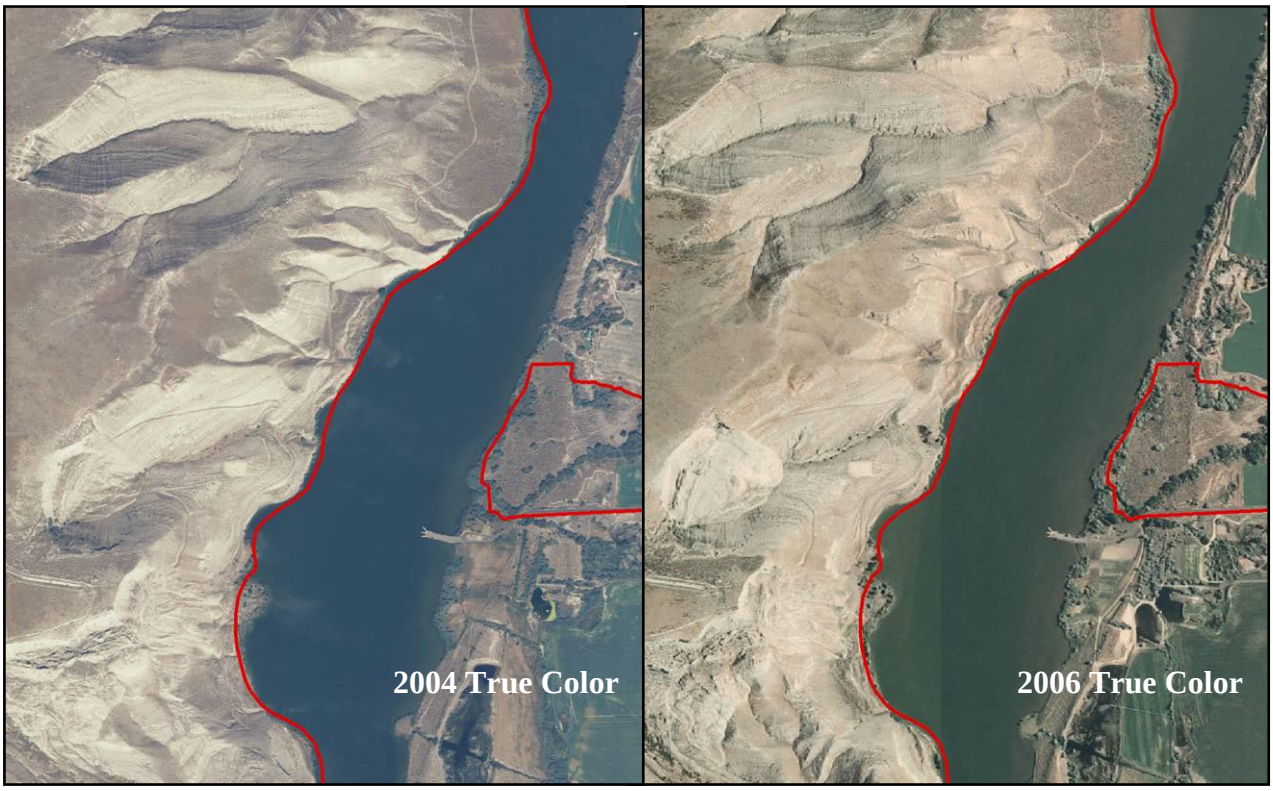


Figure 4. Examples of the NAIP 2004 and 2006 imagery for HAFO.

Completion of the segmentation was based on visual judgment of the analyst when obvious, distinct features were lost. At this point in the process, the previous segmentation was adopted as the final treatment.

Following segmentation, the lines were exported as ArcInfo shapefiles and converted to ArcInfo coverages. The resulting coverages were run through a series of smoothing routines provided in the ArcGIS software. Smoothing was conducted to reduce the stair-stepping pattern of the lines resulting from the large pixels. Smoothing ended when no obvious artificial or relict breaks in the lines were visible. Following smoothing, the line-work was manually cleaned to remove extraneous lines, small polygons, and polygons that obviously split a homogenous stand of vegetation. The cleaning stage was considered complete when all resulting polygons matched homogenous stands of vegetation apparent on the 2006 imagery

The lines resulting from the 2004 imagery segmentation were visually inspected in ArcInfo comparing them to the more detailed 2006 imagery. Any obvious problems in the mapping (such as shifting) between the two years were edited and resolved. Review of the merged polygon layer revealed that the roads and the facilities were not adequately separated from the surrounding

vegetation. To resolve this, all developed areas, roads, streams and other linear or rectangular features were manually digitized directly off the 2006 imagery and incorporated into the final segmentation. After merging the digitized lines with the segmented linework the resulting preliminary GIS layer was considered complete and ready to be ground-truthed in the field.

Ground-truthing the preliminary vegetation layer for HAFO involved printing 1:6,000-scale hardcopy maps. These contained the 2006 basemaps and the linework as an overlay. During three days in 2007, researchers from CTI visited representative polygons at HAFO. Ground-truthing consisted of verifying the maps against the actual vegetation on the ground to ensure that the polygons were labeled properly and to locate any extra or missing vegetation polygons. More general observations were also taken during this trip to help write map unit descriptions and ultimately create the mapping scheme. All the information from this trip was subsequently added to the final GIS layer to correct any errors.

Upon return from the field, CTI researchers used the final classification supplied by NMI to create the mapping scheme. In most cases, the map units were derived on a 1 association or alliance to 1 map unit basis. Due to the limitations of the imagery, some of the associations could not be recognized consistently. This issue was addressed by either scaling up the NVCS to the alliance level or combining similar associations/alliances into complexes. All of the resulting map units were then correlated or "crosswalked" by noting when plant associations were used as a map unit or when they were grouped. To round-out the mapping scheme, map units were created for land use types based on a mapping system developed by Anderson et al. (1976). This included unvegetated lands not in the NVCS, such as roads, facilities, and agricultural fields. A separate class of map modifiers or "Park Specials" was defined especially for HAFO to cover types that occurred either outside of the park boundary or where too small to sample. These included the emergent wetland, western wheatgrass, skunkbush and salt cedar stands. In some cases, NVCS alliances were later matched to the Park Specials. All of the resulting map unit names, map unit codes, NVCS information, and other relevant attributes were added to each polygon in the GIS layer (Table 1).

Table 1. Polygon attribute items and descriptions used in the HAFO GIS coverage.

ATTRIBUTE	**DESCRIPTION**
AREA*	Surface area of the polygon in meters squared
PERIMETER*	Perimeter of the polygon in meters
HAFO_VEG#*	Unique code for each polygon
HAFO_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: 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

Once the vegetation layer was completed and finalized the accuracy assessment (AA) was conducted. Typically, in mapping exercises both thematic or attribute map accuracy as well as the positional or polygon line accuracy are considered. In the case of the USGS NPS National Vegetation Mapping Program however, the positional accuracy is usually omitted since rarely does vegetation split on discrete edges that can be positively located in the field. The subjectivity involved in this effort plus the high resolution and accuracy of the NAIP basemaps usually allows for the assumption that all products derived from them are well within National Map Accuracy Standards for 1:12,000-scale maps (±30 feet). Further, since no additional funding was budgeted or available, the positional accuracy was not assessed.

The thematic accuracy of the vegetation map was assessed using the methodology following the standards provided by the USGS NPS National Vegetation Mapping Program's Accuracy Assessment Procedures manual (TNC 1994c). This 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 field manual with stratified random targets placed in each map class based on their respective frequency and abundance (Table 2).

Table 2. Target number of AA samples per map class based on number of polygons and area.

Scenario	Description	Polygons in class	Area occupied by class	Recommended number of samples in class
Scenario A:	The class is abundant. It covers more than 50 hectares of the total area and consists of at least 30 polygons. In this case, the recommended sample size is 30.	> 30	> 50 ha	30
Scenario B:	The class is relatively abundant. It covers more than 50 hectares 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	> 50 ha	20
Scenario C:	The class is relatively rare. It covers less than 50 hectares 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	< 50 ha	20
Scenario D:	The class is rare. It has more than 5, but fewer than 30 polygons and covers less than 50 hectares 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	<50 ha	5
Scenario E:	The class is very rare. It has fewer than 5 polygons and occupies less than 50 hectares 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	< 50 ha	Visit all and confirm

These parameters were loaded into a custom GIS program along with the vegetation layer. This program picked the random target locations and also buffered them 10 meters away from any polygon boundary and 50 meters away from any other point. 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). The resulting target locations were restricted to those within the boundaries of HAFO due to private land access constraints.

Once the target locations were selected, botanists were provided with draft field maps, overview maps, map unit definitions, the key to the associations (Appendix C), and digital GPS files containing the location of the target AA sites. During the summer of 2008, the botanists traveled to the AA target sites and determined the vegetation association using the field key. At each target they recorded the primary and secondary associations that occurred within a roughly 50-meter radius. They also recorded height and cover of vegetative strata, environmental data, and percent canopy cover of the major species (see AA point form in Appendix B). Other nearby vegetation types outside the 50-meter radius and any recent disturbance were also recorded. To better assist the analysis a minimum of 4 photographs were taken at each AA point in the sequence of cardinal directions, N-E-S-W. If the point was too close to dense, especially shrubby vegetation, one or more optional photographs were taken at a distance to show the character of the vegetation. In such cases, the site of the optional photograph was given a GPS waypoint, which was recorded along with the aspect of the photograph at that point.

During 2008, a total of 267 points were sampled (Figure 5). The data recorded on the field forms were subsequently entered into the PLOTS2 database and reviewed for data entry errors by NPS and NatureServe staff. Incomplete data on the field sheets were corrected if possible. The results were imported from the database into a GIS layer where they were visually compared in two stages to the vegetation map coverage. The first step was to compare the AA points to the original target locations to check for erroneous points and to remove thesepoints 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 bad GPS satellite positioning or the point occurred to close to a polygon boundary. Through this process, UTM coordinates for four points were corrected and three points were removed due to either poor GPS receiver accuracy or location in the wrong target polygon.

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 has involved fuzzy logic which assigns different levels of accuracy based on the primary, secondary and sometimes even the tertiary calls. However, due to the small size of this project and the confusion that fuzzy logic can cause for the end user, a simple binary assessment was conducted. To accomplish this, CTI had to assign a final map unit for every point by choosing between the primary and secondary calls. This was done by first adding a new attribute to the point layer labeled “Final_Code” and then 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 their secondary field call based on one of the

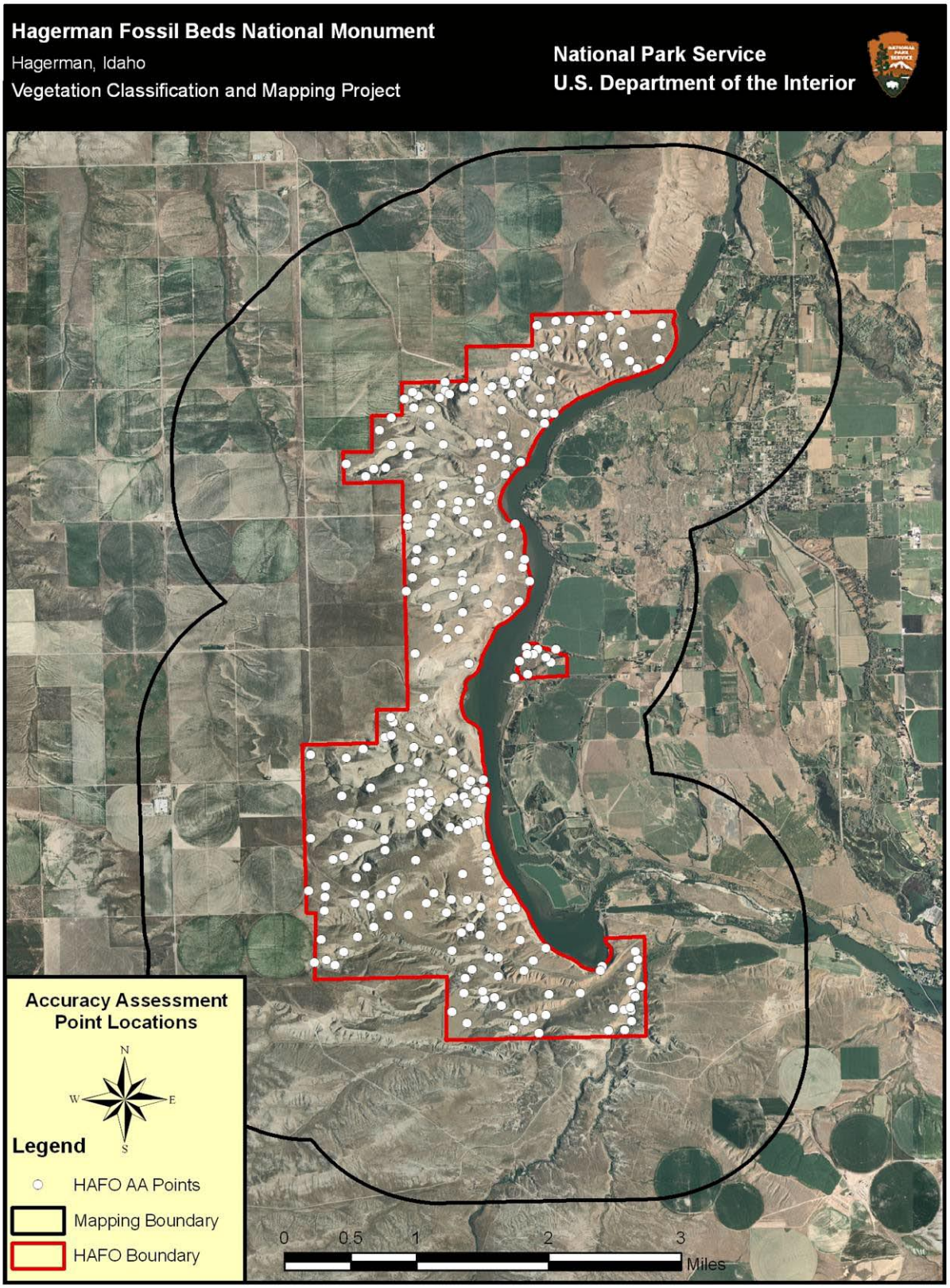


Figure 5. Location of all accuracy assessment points collected at HAFO in 2008.

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. called 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 more appropriately matched the ecological context (e.g. riparian woodland located next to a stream vs. upland woodland located next to a stream). Overall, roughly 20-30 points were reassigned to their secondary field call instead of their primary identification.

Once the data were reviewed, the accuracy analysis was conducted. In the case of HAFO, 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 of the statistics and calculations used to analyze these data are described at length in the program manuals (TNC 1994c) and are summarized in Table 3. Final assessments for each point were recorded using an error matrix.

Table 3. Summary of the AA Statistics used at HAFO.

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 $z_{\alpha =}$ 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

Thirty-four plant associations are identified as occurring within the study area. Table 4 provides a summary of the associations described for the monument.

Plant communities are named for the indicator (dominant or diagnostic) species of the vegetative strata present. The indicator species of the uppermost strata is listed first, followed by successively lower strata. Species that occur in the same strata (or are the same lifeform) are separated by a hyphen (-). Indicator species that occur in different strata (or are a different lifeform) are separated by a slash (/). Plant association names incorporate the physiognomic class in which the association is classified (e.g., Forest, Woodland, or Herbaceous) (FGDC 1997, 2006).

Thirty percent of the associations identified within the monument are currently listed in the National Vegetation Classification as indicated by an assigned element code (Table 1) (NatureServe 2007). Many of these plant associations are known from other sites within the region and are well-documented. This study together with Idaho Conservation Data Center and Wolken (2007), however, provides the first documentation of *Artemisia tridentata* ssp. *wyomingensis / Achnatherum hymenoides* Shrubland and *Atriplex confertifolia / Achnatherum hymenoides* Shrubland within Idaho. A summary of previous classification work regarding vegetation that occurs within the study area is provided in Appendix A.

The *Atriplex confertifolia - Picrothamnus desertorum /Achnatherum hymenoides - Bromus tectorum* Semi-natural Shrubland association identified for Hagerman Fossil Beds National Monument is similar to *Atriplex confertifolia - Picrothamnus desertorum / Achnatherum hymenoides* Shrubland, an association recognized within the NVCS (NatureServe 2007). The diagnostic species, *Achnatherum hymenoides*, is only present in one out of three observations considered here.

Approximately two-thirds of the associations described in this classification are not recognized by the National Vegetation Classification or have not been described previously. These associations include: (1) semi-natural vegetation (19 associations, Table 1) that, due to the priority of conserving natural vegetation, has not been systematically reviewed nor incorporated into the National Vegetation Classification and (2) plant communities (5 associations) that have not been described previously at the association level. Distinctive plant associations that warrant further consideration for inclusion in the National Vegetation Classification include: *Chrysothamnus viscidiflorus / Achnatherum hymenoides* Shrubland, *Eriogonum microthecum / Achnatherum hymenoides* Dwarf-shrubland, and *Populus angustifolia / Typha latifolia* Woodland (Idaho Data Conservation Center 2008).

Digital Imagery and Interpretation

For HAFO, 27 map units were developed and directly cross-walked or matched to corresponding plant associations and land use classes (Table 5). These included a mix of 1 map unit to 1 NVCS association/alliance relationship or 1 map unit to many groupings. In the case of the grouped map units, these represented types that were difficult to distinguish from one another or accurately determine the understory species. When associations or alliances had to be grouped, an effort was made to use the alliance name when appropriate. If the grouped associations belonged to different alliances, then an ecological complex name was created. This did not affect the map

unit's accuracy. Since the park special map units were not classified to the NVCS, these do not have a corresponding NVCS association or alliance. Please reference Appendix F for detailed descriptions and representative photos for all vegetation map units.

Relationship between Map Units and Plant Associations/Alliances

The HAFO map units represent a compromise between the detail of the NVCS, the needs of the park, and the limitations of the imagery. As a result, the mapping scheme does not exactly match the NVCS. Rather, the vegetation map units were linked (i.e. "crosswalked") to the NVCS plant associations or alliances when possible. When the NVCS link was not feasible, other map units were created.

The following were the possible map scenarios that were encountered at HAFO:

1. When a plant association or alliance had a unique photo signature and could be readily delineated on the photos, the map unit adopted the plant association/alliance name. This was considered a one-to-one relationship.
2. When plant associations occurred in stands too small to map or when related plant associations shared the same signature and could not be distinguished on the photos, several plant associations were collapsed into a single alliance. This was considered a one-to-many relationship.
3. When unique stands of vegetation did not have a corresponding NVCS association or alliance these were considered "park specials".
4. Finally, non-vegetated areas and vegetation types not recognized by the NVCS received Anderson et al. (1976) Land Use – Land Cover map unit designations.

Table 4. List of NVCS Plant Associations and Alliances found at HAFO.

NVCS Name	NVCS Common Name	NVCS Level	NVCS Code
Forest and Woodlands			
***Ulmus americana* Semi-natural Woodland Alliance**	**American Elm Semi-natural Woodland Alliance**	**Alliance**	**Provisional**
Ulmus americana / Bromus tectorum Semi-natural Woodland	American Elm / Cheatgrass Semi-natural Woodland	Association	Provisional
***Elaeagnus angustifolia* Semi-natural Woodland Alliance**	**Russian-olive Semi-natural Woodland Alliance**	**Alliance**	**A.3566**
Elaeagnus angustifolia / Bromus tectorum Semi-natural Woodland	Russian-olive / Cheatgrass Semi-natural Woodland	Association	Provisional
Elaeagnus angustifolia / Equisetum laevigatum Semi-natural Woodland	Russian-olive / Smooth Horsetail Semi-natural Woodland	Association	Provisional
Elaeagnus angustifolia / Leymus cinereus Semi-natural Woodland	Russian-olive / Basin Wildrye Semi-natural Woodland	Association	Provisional
Elaeagnus angustifolia / Poa secunda Semi-natural Woodland	Russian-olive / Sandberg Bluegrass Semi-natural Woodland	Association	Provisional
Elaeagnus angustifolia / Purshia tridentata / Leymus cinereus Semi-natural Woodland	Russian-olive / Bitterbrush / Basin Wildrye Semi-natural Woodland	Association	Provisional
Elaeagnus angustifolia / Rhus trilobata var. trilobata - Rosa woodsii Semi-natural Woodland	Russian-olive / Skunkbush – Wood's Rose Semi-natural Woodland	Association	Provisional
Elaeagnus angustifolia / Sarcobatus vermiculatus / Mesic Graminoids Semi-natural Woodland	Russian-olive / Black Greasewood / Mesic Graminoids Semi-natural Woodland	Association	Provisional
***Populus angustifolia* Temporarily Flooded Woodland Alliance**	**Narrowleaf Cottonwood Temporarily Flooded Woodland Alliance**	**Alliance**	**A.641**
Populus angustifolia / Typha latifolia Woodland	Narrowleaf Cottonwood / Broadleaf Cattail Woodland	Association	Provisional
***Populus balsamifera ssp. trichocarpa* Temporarily Flooded Forest Alliance**	**Black Cottonwood Temporarily Flooded Forest Alliance**	Alliance	**A.311**
Populus balsamifera ssp. trichocarpa - Elaeagnus angustifolia / Bromus tectorum Woodland	Black Cottonwood – Russian-olive / Cheatgrass Woodland	Association	Provisional

Shrublands			
***Artemisia tridentata ssp. wyomingensis* Shrubland Alliance**	**Wyoming Big Sagebrush Shrubland Alliance**	**Alliance**	**A.832**
Artemisia tridentata ssp. wyomingensis / Achnatherum hymenoides Shrubland	Wyoming Big Sagebrush / Ricegrass Shrubland	Association	CEGL001046
Artemisia tridentata ssp. wyomingensis / Hesperostipa comata Shrubland	Wyoming Big Sagebrush / Needle-and Thread Grass Shrubland	Association	CEGL001051
Artemisia tridentata ssp. wyomingensis / Poa secunda Shrubland	Wyoming Big Sagebrush / Sandberg Bluegrass Shrubland	Association	CEGL001049
Artemisia tridentata ssp. wyomingensis - Atriplex confertifolia Shrubland	Wyoming Big Sagebrush - Fourwing Saltbush Shrubland	Association	CEGL001040
Artemisia tridentata spp. wyomingensis - Chrysothamnus viscidiflorus / Achnatherum hymenoides Shrubland	Wyoming Big Sagebrush - Green Rabbitbrush / Ricegrass Shrubland	Association	Provisional
Artemisia tridentata ssp. wyomingensis / Bromus tectorum Semi-natural Shrubland	Wyoming Big Sagebrush / Cheatgrass Semi-natural Shrubland	Association	Provisional
***Artemisia tridentata ssp. wyomingensis* Shrub Herbaceous Alliance**	**Wyoming Big Sagebrush Shrub Herbaceous Alliance**	**Alliance**	**A.1527**
Artemisia tridentata ssp. wyomingensis / Bromus tectorum Semi-natural Shrub Herbaceous Vegetation	Wyoming Big Sagebrush / Cheatgrass Semi-natural Shrub Herbaceous Vegetation	Association	Provisional
***Artemisia tridentata ssp. tridentata / Bromus tectorum* Shrubland Alliance**	**Basin Big Sagebrush / Cheatgrass Shrubland Alliance**	**Alliance**	**A.830**
Artemisia tridentata ssp. tridentata / Bromus tectorum Semi-natural Shrubland	Basin Big Sagebrush / Cheatgrass Semi-natural Shrubland	Association	Provisional
***Atriplex canescens* Shrubland Alliance**	**Fourwing Saltbush Shrubland Alliance**	**Alliance**	**A.869**
Atriplex canescens / Achnatherum hymenoides Shrubland	Fourwing / Ricegrass Shrubland	Association	CEGL001289
Atriplex canescens / Leymus cinereus Shrubland	Fourwing / Basin Wildrye Shrubland	Association	Provisional
Atriplex canescens / Poa secunda - Bromus tectorum Shrubland	Fourwing / Sandberg Bluegrass - Cheatgrass Shrubland	Association	Provisional

***Atriplex confertifolia* Shrubland Alliance**	**Shadscale Shrubland Alliance**	**Alliance**	**A.870**
Atriplex confertifolia / Achnatherum hymenoides Shrubland	Shadscale / Ricegrass Shrubland	Association	CEGL001311
Atriplex confertifolia - Picrothamnus desertorum / (Achnatherum hymenoides) - Bromus tectorum Semi-natural Shrubland	Shadscale - Bud Sagebrush / (Ricegrass) - Cheatgrass Semi-natural Shrubland	Association	Provisional
***Eriogonum microthecum* Dwarf-shrubland Alliance**	**Slender Buckwheat Dwarf-shrubland Alliance**	**Alliance**	**A.1107**
Eriogonum microthecum / Achnatherum hymenoides Dwarf-shrubland	Slender Buckwheat / Ricegrass Dwarf-shrubland	Association	Provisional
***Eriogonum ovalifolium* Dwarf-shrubland Alliance**	**Cushion Buckwheat Dwarf-shrubland Alliance**	**Alliance**	**Provisional**
Eriogonum ovalifolium / Achnatherum hymenoides Dwarf-shrubland	Cushion Buckwheat / Ricegrass Dwarf-shrubland	Association	Provisional
***Krascheninnikovia lanata* Dwarf-shrub Herbaceous Alliance**	**Winter-fat Dwarf-shrub Herbaceous Alliance**	**Alliance**	**A.1565**
Krascheninnikovia lanata / Poa secunda Dwarf-shrubland Dwarf-shrubland	Winter-fat / Sandberg Bluegrass Dwarf-shrubland Dwarf-shrubland	Association	CEGL001326
***Tamarisk ramosissima* Semi-natural Temporarily Flooded Shrubland Alliance**	**Salt-cedar species Semi-natural Temporarily Flooded Shrubland Alliance**	Alliance	**A.842**
***Ericameria nauseosa* Shrubland Alliance**	**Rubber Rabbitbrush Shrubland Alliance**	**Alliance**	**A.835**
Ericameria nauseosa - Chrysothamnus viscidiflorus / (Achnatherum hymenoides) - Bromus tectorum Semi-natural Shrubland	Rubber Rabbitbrush – Green Rabbitbrush / (Ricegrass) – Cheatgrass Semi-natural Shrubland	Association	Provisional
***Chrysothamnus viscidiflorus* Shrubland Alliance**	**Green Rabbitbrush Shrubland Alliance**	**Alliance**	**A.2651**
Chrysothamnus viscidiflorus / Hesperostipa comata Shrubland	Green Rabbitbrush / Needle-and-thread Grass Shrubland	Association	CEGL002799
***Purshia tridentata* Shrubland Alliance**	**Bitterbrush Shrubland Alliance**	**Alliance**	**A.825**
Purshia tridentata / Achnatherum hymenoides Shrubland	Bitterbrush / Ricegrass Shrubland	Association	CEGL001058
Purshia tridentata / Elymus elymoides Shrubland	Bitterbrush / Squirreltail Shrubland	Association	Provisional

***Salix exigua* Temporarily Flooded Woodland Alliance**	**Coyote Willow Temporarily Flooded Woodland Alliance**	**Alliance**	**A.639**
Salix exigua / Barren Shrubland	Coyote Willow / Barren Shrubland	Association	CEGL001200
Salix exigua / Mesic Forbs Shrubland	Coyote Willow / Mesic Forbs Shrubland	Association	CEGL001202
***Salix lucida* Temporarily Flooded Shrubland Alliance**	**Whiplash Willow Temporarily Flooded Shrubland Alliance**	**Alliance**	**A.979**
Salix lucida ssp. caudata / Thinopyrum intermedium Semi-natural Shrubland	Whiplash Willow / Intermediate Wheatgrass Semi-natural Shrubland	Association	Provisional
***Sarcobatus vermiculatus* Shrubland Alliance**	**Black Greasewood Shrubland Alliance**	**Alliance**	**A.1041**
Sarcobatus vermiculatus / Bromus tectorum Semi-natural Shrubland	Black Greasewood Cheatgrass Semi-natural Shrubland	Association	Provisional
Sarcobatus vermiculatus / Leymus cinereus Shrubland	Black Greasewood / Basin Wildrye Semi-natural Shrubland	Association	CEGL001366
***Rhus trilobata* Intermittently Flooded Shrubland Alliance**	**Skunkbush Intermittently Flooded Shrubland Alliance**	**Alliance**	**A.938**
Herbaceous Vegetation			
***Agropyron cristatum* Semi-natural Herbaceous Alliance**	**Crested Wheatgrass Semi-natural Herbaceous Alliance**	**Alliance**	**Provisional**
Agropyron cristatum - *Sisymbrium altissimum* Semi-Natural Vegetation	Crested Wheatgrass / Tumble Mustard Semi-natural Vegetation	Association	Provisional
***Bromus tectorum* Semi-natural Herbaceous Alliance**	**Cheatgrass Semi-natural Herbaceous Alliance**	**Alliance**	**A.1814**
Bromus tectorum - *Sisymbrium altissimum* Semi-Natural Vegetation	Cheatgrass / Tumble Mustard Semi-natural Vegetation	Association	Provisional
***Eleocharis palustris* Seasonally Flooded Herbaceous Alliance**	**Marsh Spikerush Seasonally Flooded Herbaceous Alliance**	**Alliance**	**A.1422**
Eleocharis palustris Herbaceous Vegetation	Marsh Spikerush Herbaceous Vegetation	Association	CEGL001833

***Typha (angustifolia, latifolia) - (Schoenoplectus* spp.) Semipermanently Flooded Herbaceous Alliance**	**Narrowleaf Cattail, Broadleaf Cattail - (Clubrush species) Semipermanently Flooded Herbaceous Alliance**	**Alliance**	**A.1436**
***Equisetum laevigatum* Semipermanently Flooded Herbaceous Alliance**	**Smooth Horsetail Semipermanently Flooded Herbaceous Alliance**	**Alliance**	**A.2648**
***Lactuca tatarica var. pulchella* Herbaceous Alliance**	**Blue Lettuce Herbaceous Alliance**	**Alliance**	**Provisional**
Lactuca tatarica var. pulchella Herbaceous Vegetation	Blue Lettuce Herbaceous Vegetation	Association	Provisional
***Pascopyrum smithii* Herbaceous Alliance**	**Western Wheatgrass Herbaceous Alliance**	**Alliance**	**A.1232**
Pascopyrum smithii - Achnatherum hymenoides Herbaceous Vegetation	Western Wheatgrass - Ricegrass Herbaceous Vegetation	Association	Provisional

Table 5. HAFO Map Units.
The units are organized into ecological groups. “Level” refers to whether the map unit represents a NVCS plant association/alliance (NVCS unless otherwise noted) or a local plant community/plant population (Park Special), or a land use class. Anderson Land Use Classes are identified by Roman numerals.

Map Code	Map Unit Name	Map Unit Common Name	Level
Forest and Woodlands			
1	*Ulmus americana / Bromus tectorum* Woodland	American Elm / Cheatgrass Woodland	Association
2	*Elaeagnus angustifolia* Woodland Alliance	Russian-olive Woodland	Alliance
3	*Populus angustifolia / Typha latifolia* Woodland	Narrowleaf Cottonwood / Broadleaf Cattail Woodland	Association
4	*Populus balsamifera* ssp. *trichocarpa - Elaeagnus angustifolia / Bromus tectorum* Woodland	Black Cottonwood – Russian-olive / Cheatgrass Woodland	Association
Shrublands			
5	*Artemisia tridentata* ssp. *wyomingensis* Shrubland Alliance	Wyoming Big Sagebrush Shrubland Alliance	Alliance
6	*Artemisia tridentata* ssp. *wyomingensis / Bromus tectorum* Shrubland Alliance	Wyoming Big Sagebrush / Cheatgrass Shrubland Alliance	Alliance
8	*Artemisia tridentata* ssp. *tridentata / Bromus tectorum* Shrubland Alliance	Basin Big Sagebrush / Cheatgrass Shrubland Alliance	Alliance
9	Sparsely Vegetated Badlands Complex	Sparsely Vegetated Badlands Complex	Complex
10	*Tamarisk ramosissima* Shrubland Stand	Salt Cedar Shrubland Stand	Park Special*
11	*Ericameria (Chrysothamnus)* spp. Shrubland Complex	Rabbitbrush Shrubland Complex	Complex
12	*Purshia tridentata* Shrubland Alliance	Bitterbrush Shrubland Alliance	Alliance
13	*Salix exigua - Salix lucida* ssp. *caudata* Shrubland Complex	Coyote Willow – Whiplash Willow Shrubland Complex	Complex
14	*Sacobatus vermiculatus* Intermittently Flooded Shrubland Alliance	Black Greasewood Intermittently Flooded Shrubland Alliance	Alliance
15	*Rhus trilobata / Ribes aureum* Shrubland Stand	Skunkbush – Golden Currant Shrubland Stand	Park Special*
Herbaceous Vegetation			
18	*Agropyron cristatum / Sisymbrium altissimum* Herbaceous Vegetation	Crested Wheatgrass / Tumble Mustard Herbaceous Vegetation	Association
19	*Bromus tectorum / Sisymbrium altissimum* Herbaceous Vegetation	Cheatgrass / Tumble Mustard Herbaceous Vegetation	Association

20	*Eleocharis palustris* - *Typha latifolia* Wetland Vegetation Complex	Marsh Spikerush – Broadleaf Cattail Wetland Vegetation Complex	Complex
21	Annual Weedy Herbaceous Vegetation Complex	Annual Weedy Herbaceous Vegetation Complex	Complex
22	*Pascopyrum smithii* - *Achnatherum hymenoides* Herbaceous Vegetation	Western Wheatgrass - Ricegrass Herbaceous Vegetation	Association
23	Emergent and Floating Aquatic Herbaceous Vegetation Complex	Emergent and Floating Aquatic Herbaceous Vegetation Complex Vegetation	Complex
24	Badlands (Barren)	Badlands (Barren)	Park Special
Land Use – Land Cover			
25	Stream / River	Stream / River	Level II
26	Canal / Ditch	Canal / Ditch	Level II
27	Lake / Pond	Lake / Pond	Level II
28	Reservoir	Reservoir	Level II
29	Residential	Residential	Level II
30	Commercial / Light Industry	Commercial / Light Industry	Level II
31	Communications and Utilities	Communications and Utilities	Level II
32	Agricultural Business	Agricultural Business	Level II
33	Transportation	Transportation	Level II
34	Entertainment and Recreational	Entertainment and Recreational	Level II
35	Quarries / Strip mines / Gravel pits	Quarries / Strip mines / Gravel pits	Level II
36	Bare Rock / Sand	Bare Rock / Sand	Level II
37	Irrigated Orchard / Vineyards / Groves	Irrigated Orchard / Vineyards / Groves	Level II
38	Planted / Cultivated	Planted / Cultivated	Level II
39	Transistional	Transistional	Level II
40	Flats	Flats	Level II
41	NPS Facilities	NPS Facilities	Park Special

*Park Special: Represents either unvegetated areas or discrete stands of vegetation that were too small and/or occurred too infrequently to classify.

Map Units

Below is a comprehensive breakdown of the crosswalking of the NVCS associations to the map units for HAFO:

Map Units Representing Single NVCS Units (either existing or new)
(One Alliance/Association-to-One Map Class)

The following map units were created from the NVCS and represent established or provisional plant associations/alliances that could be discerned and delineated on the imagery.

Map Code	NVCS Plant Alliance / Association(s)
1	***Ulmus americana / Bromus tectorum* Woodland** *Ulmus americana / Bromus tectorum* Woodland
3	***Populus angustifolia / Typha latifolia* Woodland** *Populus angustifolia / Typha latifolia* Woodland
4	***P. balsamifera* ssp. *trichocarpa - Elaeagnus angustifolia / Bromus tectorum* Woodland** *P. balsamifera* ssp. *trichocarpa - Elaeagnus angustifolia / Bromus tectorum* Woodland
10	***Tamarisk ramosissima* Shrubland Stand** *Tamarisk ramosissima* Semi-natural Temporarily Flooded Shrubland Alliance
15	***Rhus trilobata / Ribes aureum* Shrubland Stand** *Rhus trilobata* Intermittently Flooded Shrubland Alliance
18	***Agropyron cristatum / Sisymbrium altissimum* Herbaceous Vegetation**
19	***Bromus tectorum / Sisymbrium altissimum* Herbaceous Vegetation**
21	**Annual Weedy Herbaceous Vegetation Complex** *Lactuca tatarica* var. *pulchella* Herbaceous Vegetation
22	***Pascopyrum smithii - Achnatherum hymenoides* Herbaceous Vegetation**

Map Units Representing Aggregations of Plant Associations/Alliances
(Many Alliances /Associations-to-One Map Class)

In cases where closely related plant associations could not be distinguished on the photos, they were combined into a single map unit. Often these occurred from the inability to recognize the understory species or to distinguish between very similar species.

Map Code	NVCS Plant Alliance / Association(s)
2	***Elaeagnus angustifolia* Woodland Alliance**
	Elaeagnus angustifolia / Bromus tectorum Semi-natural Woodland
	Elaeagnus angustifolia / Equisetum laevigatum Semi-natural Woodland
	Elaeagnus angustifolia / Leymus cinereus Semi-natural Woodland
	Elaeagnus angustifolia / Poa secunda Semi-natural Woodland
	Elaeagnus angustifolia / Rhus trilobata var. trilobata - Rosa woodsii Semi-natural Woodland
	Elaeagnus angustifolia / Sarcobatus vermiculatus / Mesic Graminoids Semi-natural Woodland
5	***Artemisia tridentata* ssp. *wyomingensis* Shrubland Alliance**
	Artemisia tridentata ssp. *wyomingensis / Achnatherum hymenoides* Shrubland
	Artemisia tridentata ssp. *wyomingensis / Hesperostipa comata* Shrubland
	Artemisia tridentata ssp. *wyomingensis / Poa secunda* Shrubland
	Artemisia tridentata ssp. *wyomingensis - Atriplex confertifolia*
	Artemisia tridentata spp. *wyomingensis - Chrysothamnus viscidiflorus / Achnatherum hymenoides* Shrubland
6	***Artemisia tridentata* ssp. *wyomingensis / Bromus tectorum* Shrubland Alliance**
	Artemisia tridentata ssp. *wyomingensis / Bromus tectorum* Semi-natural Shrubland
	Artemisia tridentata ssp. *wyomingensis / Bromus tectorum* Semi-natural Shrub Herbaceous Vegetation
8	***Artemisia tridentata* ssp. *tridentata / Bromus tectorum* Shrubland Alliance**
	Artemisia tridentata ssp. *tridentata / Bromus tectorum* Semi-natural Shrubland
	(Also likely includes other understory species that were not sampled)
9	**Sparsely Vegetated Badlands Complex**
	Atriplex canescens / *Achnatherum hymenoides* Shrubland
	Atriplex canescens / *Bromus tectorum* Semi-natural Shrubland
	Atriplex confertifolia – Picrothamnus desertorum / (*Achnatherum hymenoides) - Bromus tectorum* Semi-natural Shrubland
	Atriplex confertifolia - Achnatherum hymenoides Shrubland
	Atriplex confertifolia - Bromus tectorum Semi-natural Shrubland
	Eriogonum microthecum / Achnatherum hymenoides Dwarf-shrubland

Eriogonum ovalifolium / Achnatherum hymenoides Dwarf-shrubland
Krascheninnikovia lanata / Poa secunda Dwarf-shrubland

11 *Ericameria (Chrysothamnus)* spp. Shrubland Complex
Chrysothamnus viscidiflorus / Hesperostipa comata Shrubland
Ericameria nauseosa - Chrysothamnus viscidiflorus / (Achnatherum hymenoids) - Bromus tectorum Semi-natural Shrubland

12 *Purshia tridentata* Shrubland Alliance
Purshia tridentata / Achnatherum hymenoides Shrubland
Purshia tridentata / Elymus elymoides Shrubland

13 *Salix exigua - Salix lucida* ssp. *caudata* Shrubland Complex
Salix exigua / Barren Shrubland
Salix exigua / Mesic Forbs Shrubland
Salix lucida ssp. *caudata / Thinopyrum intermedium* Semi-natural Shrubland

14 *Sacobatus vermiculatus* Intermittently Flooded Shrubland Alliance
Sarcobatus vermiculatus / Bromus tectorum Semi-natural Shrubland
Sarcobatus vermiculatus / Leymus cinereus Shrubland

20 *Eleocharis palustris - Typha latifolia* Wetland Vegetation Complex
Eleocharis palustris Herbaceous Vegetation
Typha (angustifolia, latifolia) - (Schoenoplectus spp.) Semipermanently Flooded Herbaceous Alliance

Map Units Representing No Association/Alliance

These map units were created for HAFO to describe vegetation that had no corresponding NVCS association for the following reason:

Local Stands - Represents infrequent or rare types that were observed primarily in the environs during the photo interpretation and could not be classified to an association/alliance since no plots or points were collected;

Map Code	NVCS Plant Alliance / Association(s)

23 Emergent and Floating Aquatic Herbaceous Vegetation Complex
(Did not occur in the park)

24 Badlands (Barren)
(Park Special – mostly barren land)

Vegetation Map

Just over 4,300 acres in the current boundary of HAFO and an additional 17,199 acres in the environs were mapped using 38 map classes (Appendix G). This included 17 land cover classes and 21 vegetation classes. Of all the map units, the most frequent were *Elaeagnus angustifolia* Woodland Alliance and *Bromus tectorum / Sisymbrium altissimum* Herbaceous Vegetation with each having about 350 polygons. The most abundant map unit in terms of area was Planted / Cultivated (7,095 acres) representing agricultural fields in the environs and *Artemisia tridentata* ssp. *wyomingensis / Bromus tectorum* Shrubland Alliance (2,860 acres). All of the frequencies for each map unit (i.e., number of polygons) along with their acreages are listed in Table 6.

Table 6. Total acreage and frequency of map units for HAFO.

Map Code	Map Unit Description	HAFO Boundary			Total Project Area		
		Freq.	Acres	HA	Freq.	Acres	HA
1	*Ulmus americana / Bromus tectorum* Woodland	4	1.1	0.5	5	3.4	1.4
2	*Elaeagnus angustifolia* Woodland Alliance	91	66.3	26.9	351	426.3	172.6
3	*Populus angustifolia / Typha latifolia* Woodland	4	2.8	1.1	8	9.4	3.8
4	*Populus balsamifera* ssp. *trichocarpa - Elaeagnus angustifolia / Bromus tectorum* Woodland	3	4.6	1.9	64	116.6	47.2
5	*Artemisia tridentata* ssp. *wyomingensis* Shrubland Alliance	60	667.0	270.1	76	880.8	356.6
6	*Artemisia tridentata* ssp. *wyomingensis / Bromus tectorum* Shrubland Alliance	111	1119.9	453.4	216	2860.3	1158.0
8	*Artemisia tridentata* ssp. *tridentata / Bromus tectorum* Shrubland Alliance	31	225.1	91.1	69	529.1	214.2
9	Sparsely Vegetated Badlands Complex	116	607.1	245.8	195	973.8	394.3
10	*Tamarisk ramosissima* Shrubland Stand	4	6.7	2.7	4	6.7	2.7
11	*Ericameria (Chrysothamnus)* spp. Shrubland Complex	67	253.8	102.7	137	709.0	287.1
12	*Purshia tridentata* Shrubland Alliance	27	59.4	24.0	39	105.6	42.8
13	*Salix exigua - Salix lucida* ssp. *caudata* Shrubland Complex	9	7.4	3.0	13	21.8	8.8
14	*Sacobatus vermiculatus* Intermittently Flooded Shrubland Alliance	20	99.3	40.2	88	264.0	106.9
15	*Rhus trilobata / Ribes aureum* Shrubland Stand	2	0.9	0.4	2	0.9	0.4
18	*Agropyron cristatum / Sisymbrium altissimum* Herbaceous Vegetation	10	45.6	18.5	10	800.5	324.1
19	*Bromus tectorum / Sisymbrium altissimum* Herbaceous Vegetation	170	578.2	234.1	350	2594.8	1050.5
20	*Eleocharis palustris - Typha latifolia* Wetland Vegetation Complex	30	24.1	9.7	37	39.0	15.8

21	Annual Weedy Herbaceous Vegetation Complex	15	8.3	3.4	82	239.6	97.0
22	*Pascopyrum smithii - Achnatherum hymenoides* Herbaceous Vegetation	0	0.0	0.0	32	623.4	252.4
23	Emergent and Floating Aquatic Herbaceous Vegetation Complex	0	0.0	0.0	79	123.8	50.1
24	Badlands (Barren)	97	408.0	165.2	104	436.4	176.7
25	Stream / River	30	25.3	10.3	8	857.5	347.2
26	Canal / Ditch	1	1.7	0.7	39	51.3	20.8
27	Lake / Pond	0	0.0	0.0	68	114.0	46.1
28	Reservoir	0	0.0	0.0	2	5.1	2.1
29	Residential	1	1.1	0.5	97	224.2	90.7
30	Commercial / Light Industry	0	0.0	0.0	37	81.5	33.0
31	Communications and Utilities	0	0.0	0.0	9	10.1	4.1
32	Agricultural Business	1	0.3	0.1	31	121.9	49.3
33	Transportation	17	43.0	17.4	10	408.9	165.6
34	Entertainment and Recreational	0	0.0	0.0	2	12.0	4.8
35	Quarries / Strip mines / Gravel pits	0	0.0	0.0	7	86.1	34.9
36	Bare Rock / Sand	2	1.7	0.7	4	3.1	1.3
37	Irrigated Orchard / Vineyards / Groves	0	0.0	0.0	45	44.2	17.9
38	Planted / Cultivated	8	39.8	16.1	161	7094.9	2872.4
39	Park Facilities	10	12.5	5.1	128	597.0	241.7
40	Flats	0	0.0	0.0	7	33.5	13.5
41	NPS Facilities	3	2.8	1.1	3	2.8	1.1
Total Natural Vegetation		871	4,186	1,695	1,961	11,765	4,763
Total Land use / Land Cover		73	128	52	658	9,748	3,947
Totals		**944**	**4,351**	**1,747**	**2,619**	**21.513**	**8,710**

Normally the standard minimum mapping unit for NPS vegetation mapping projects is defined as 0.5 hectare. However, this is a nominal unit and due to the small size of HAFO and the resolution of the imagery, it was reduced to ¼ acre for most classes. This size allowed for more detail in the mapping and allowed for better delineation of important stands of vegetation such as wetlands, weedy patches and riparian vegetation. This ability to recognize small patches of vegetation is reflected in the high number of polygons created (2,619) and the average size of the polygons for this project, (~8 acres or 3 hectares).

Accuracy Assessment

The 2008 accuracy assessment effort yielded 270 points that were distributed throughout HAFO, with none sampled in the environs due to access constraints. In addition to using the AA points in the AA analysis, many of the points were also used to update the classification and to revise the local descriptions. These data helped strengthen the classification for HAFO and added to the global perspective of the individual types.

Actual analysis of the AA points involved a point-by-point review in two stages. During stage one, an AA GIS point file was created from the AA point coordinates recorded in the field. These were then overlaid on the vegetation map and a comparison of the final AA field call versus the vegetation polygon label was conducted by CTI staff. This resulted in a preliminary error matrix that was reviewed by NMI and CTI. Adjustments were made to the field calls at this time based on the actual cover values recorded taking into account some errors in the field key. After these changes were made, results were presented to UCBN and HAFO staff during a conference call and recommendations were made on how to improve the accuracy of the map.

Stage two involved incorporating the NPS recommendations by combining similar classes and re-running the accuracy assessment. Specifically, the *Atriplex canescens* Shrubland Alliance, *Atriplex confertifolia* Shrubland Alliance, *Eriogonum microthecum* Dwarf-shrubland Alliance, *Eriogonum microthecum* Dwarf-shrubland Alliance, *Eriogonum ovalifolium* Dwarf-shrubland Alliance and *Krascheninnikovia lanata* Dwarf-shrub Herbaceous Alliance were grouped into a single unit called the Sparsely Vegetated Badlands Complex. Also the *Artemisia tridentata* ssp. *wyomingensis / Bromus tectorum* Shrubland Alliance was expanded to include a few polygons that were preliminarily called *Artemisia tridentata* ssp. *tridentata* (no cheatgrass).

After the vegetation map was updated, two final error matrices were calculated. The first was the binary assessment level (Table 7) that only factored the primary field call and the second (level 2) (Table 8) included any correct alternate second or third field calls. In most cases, the correct second and third calls were very closely related to the incorrect primary call. For example, mixed stands containing equal levels of both sub-species of big sagebrush often had both listed as first and second calls. The final binary assessment revealed an overall accuracy of 78% for level 1 and 87% for level 2. Concentrations of error were found primarily between the mapping of the three big sagebrush map units (map units 5, 6, 8) and between the big sagebrush units and the Sparsely Vegetated Badlands Complex (map unit 9). These trends likely reflect the difficulty in accurately separating similar shrub species from an overhead perspective. Also compounding this problem was the high reflectivity of the sparsely vegetated badland portions of HAFO. These eroding slopes had minimal vegetation and the brightly colored bare soil effectively masked any reliable signatures.

Another general trend of the accuracy reveals the difficulty in getting sufficient numbers of AA points for very rare or small stands. Having only a handful of AA points to draw from decreases the confidence levels and makes it difficult to conclude the accuracy of these classes with any certainty. Finally, some of the out-laying errors in the map can likely be explained by the difficulty in resolving the difference in scale and perspective between viewing the vegetation on the imagery and assessing it on the ground. For example, sampling could have occurred in inclusions or canopy openings that were a part of a larger mapped polygon.

Table 7. Level 1 (Binary) contingency table (error matrix) for vegetation mapping at HAFO.

	Reference Data (Accuracy Assessment Field Data)																					User's Error		
Sample Data (Polygon Map Data) / Producer' Error	Map Class	1	2	3	4	5	6	8	9	10	11	12	13	14	15	18	19	20	21	22	23	Total	Users Accuracy	90% Conf. Interval +	90% Conf. Interval -
	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	100%	50%	100%
	2	0	17	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	20	85%	69%	100%
	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	100%	50%	100%
	4	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	100%	75%	100%
	5	0	0	0	0	43	4	0	1	0	1	0	0	0	0	0	0	0	0	0	0	49	88%	79%	96%
	6	0	0	0	0	5	58	3	0	0	0	0	0	0	0	0	0	0	0	0	0	66	88%	80%	95%
	8	0	0	0	0	0	3	11	0	0	0	0	0	0	0	0	0	0	0	0	0	14	79%	57%	100%
	9	0	0	0	0	7	9	1	20	0	3	0	0	0	0	0	1	0	0	0	0	41	49%	38%	68%
	10	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	100%	75%	100%
	11	0	1	0	0	0	2	0	0	0	11	0	0	1	0	0	0	0	0	0	0	15	73%	51%	95%
	12	0	0	0	0	2	0	0	1	0	0	4	0	0	0	0	0	0	0	0	0	7	57%	19%	95%
	13	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	9	100%	94%	100%
	14	0	0	0	0	0	0	2	0	0	0	0	0	5	0	0	0	0	0	0	0	7	71%	36%	100%
	15	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	100%	50%	100%
	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	4	100%	88%	100%
	19	0	0	0	0	0	1	1	0	0	3	0	0	0	0	0	15	0	0	0	0	20	75%	57%	93%
	20	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	5	0	0	0	7	71%	36%	107%
	21	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	50%
	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	1	19	2	2	58	78	18	23	2	18	4	9	6	2	4	16	5	0	0	0				
	Producer's Accuracy	100%	89%	50%	100%	74%	74%	61%	87%	100%	61%	100%	100%	83%	50%	100%	94%	100%	0	0	0	209 Total Correct Points			
	90% Conf.-	50%	75%	0	75%	64%	64%	39%	72%	75%	39%	88%	94%	50%	0	88%	81%	90%	0	0	0	267 Total Points			
	Level +	100%	100%	100%	100%	84%	82%	83%	100%	100%	83%	100%	100%	100%	100%	100%	100%	100%	0	0	0				
	Overall Total Accuracy = 78% Overall Kappa Index = 74% Overall 90% Upper and Lower Confidence Interval = 74% and 82%																								

Table 8. Level 2 contingency table (error matrix) for vegetation mapping at HAFO.

		Reference Data (Accuracy Assessment Field Data)																				User's Error		
Sample Data (Polygon Map Data)	Map Class	1	2	3	4	5	6	8	9	10	11	12	13	14	15	18	19	20	21	22	23	Total	Users Accuracy	90% Conf. Interval +	90% Conf. Interval -
	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	100%	50%	100%
	2	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	100%	98%	100%
	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	100%	50%	100%
	4	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	100%	75%	100%
	5	0	0	0	0	46	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	49	94%	87%	100%
	6	0	0	0	0	4	59	3	0	0	0	0	0	0	0	0	0	0	0	0	0	66	89%	82%	96%
	8	0	0	0	0	0	2	12	0	0	0	0	0	0	0	0	0	0	0	0	0	14	86%	67%	100%
	9	0	0	0	0	5	3	1	29	0	2	0	0	0	0	0	1	0	0	0	0	41	71%	62%	88%
	10	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	100%	75%	100%
	11	0	0	0	0	0	2	0	0	0	12	0	0	1	0	0	0	0	0	0	0	15	80%	60%	100%
	12	0	0	0	0	1	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	7	86%	57%	100%
	13	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	9	100%	94%	100%
	14	0	0	0	0	0	0	1	0	0	0	0	0	6	0	0	0	0	0	0	0	7	86%	57%	100%
	15	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	100%	50%	100%
	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	4	100%	88%	100%
	19	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	18	0	0	0	0	20	90%	76%	100%
	20	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	7	71%	36%	100%
	21	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0%	50%
	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0
	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0
Producer' Error	Total	1	19	2	2	58	78	18	23	2	18	4	9	6	2	4	16	5	0	0	0				
	Producer's Accuracy	1	20	2	2	58	68	17	30	2	16	6	9	7	1	4	19	5	0	0	0	233 Total Correct Points			
	90% Conf.-	100%	100%	50%	100%	79%	87%	71%	97%	100%	75%	100%	100%	86%	100%	100%	95%	100%	0	0	0	267 Total Points			
	Level +	50%	98%	0	75%	70%	77%	49%	84%	75%	54%	92%	94%	57%	50%	88%	84%	90%	0	0	0				
	Overall Total Accuracy = 87% Overall Kappa Index = 84% Overall 90% Upper and Lower Confidence Interval = 83% and 91%																								

Instructions on Using the Accuracy Assessment Contingency Table:

The contingency table or error matrix found above 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 or 2) under-mapped - omission errors on the bottom

Discussion

HAFO is truly a special place combining an ancient ecosystem with the relatively geologically-recent Fossil Beds. The Monument documents many kinds of change. HAFO was once a much wetter environment and was formerly a floodplain.

HAFO vegetation was historically a mix of the sagebrush-bunch grass steppe on the uplands, which wasa composed of *Artemisia* sp. with a bunch grass understory usually *Agropyron, Poa, Stipa* or *Oryzopsis* species. Juxtaposed upon this dry landscape are the narrow bands of riparian vegetation found along the perennial streams and rivers. In these areas *Salix* sp. replaces the *Artemisia* sp. This vegetation varies along the moisture gradient from emergent wetland vegetation to transitional communities between the wetland and the uplands.

Today, many species have been introduced into the monument. Many of the bunch grasses are being replaced by introduced and invader species. Introduced species are dominant in the plant communites; however, remnant populations of the native plant communities remain across this landscape. Wide arrays of native and exotic plants thrive in habitats typical of the Snake River Plain. The multiple land uses on this landscape made it challenging to both classify and map the vegetation into meaningful context for all levels of interest (local, regional, and national). However, due to the small size of the park and the accessibility afforded to the sampling and verifying efforts, a highly accurate classification and map was completed. Even though the accuracy is high, there are still some areas where improvements can be made. These areas are summarized below.

Field Survey

The vegetation data presented in this project should be used as a "baseline" to build upon. Using the accuracy assessment as a guide, map classes with lower accuracy could be further surveyed in the field to create more accurate delineations. While it may appear that there are a large number of associations and alliances described for this small study area, some of the associations/alliances were either only minimally sampled or not sampled at all due to access constraints. It is recommended these types should receive additional survey work to further define their classification. For example, some of the herbaceous types should be examined throughout the growing year to document some of the forb species in order to refine their composition. Also, accessing neighboring private lands would allow new plot samples to be obtained increasing the confidence in these types, thereby strengthening the classification.

NVCS Classification

Along with access onto private lands, the other main classification challenge at HAFO is keeping up with rapid changes to plant life caused by anthropogenic disturbance. The main threats are from wild fire and flooding. Landslides introduce another potential change that should be monitored. After these events occur, new data should be collected to reflect the changes.

Digital Imagery and Interpretation

The vegetation map for HAFO was based mainly on the 2006 NAIP imagery. Therefore, all of the resulting mapping products correspond to when that imagery was acquired (i.e. snapshot in time). The decision to use existing NAIP imagery as the basemap for this project was based on cost savings. Although the imagery proved adequate, it was not acquired by the USDA for this purpose. In the future, it may be beneficial to purchase new orthophotos or aerial photos exclusively for mapping the vegetation at HAFO. This would allow the timing to better match the phenology of the vegetation and a finer scale (such as 1:6,000) could be acquired allowing for more precise delineations.

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 on complex 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, reflections and the timing of the imagery acquisition can all impact the vegetation signatures. At HAFO, these issues can be offset not only by acquiring new imagery, but also by conducting more map verification or ground-truthing. Increasing the amount of time and money budgeted for verification of the map would greatly improve the accuracy and level of detail. Similarly, this work should only be viewed as an initial mapping effort that needs to be refined and periodically updated. To perform field checking, the existing map could be examined in the field by qualified park or contract staff, changes could be made to the map, and these could be incorporated into updated versions.

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. Having these divisions in work created some challenges related to communication among all the teams including: (1) adequately conveying changes to the vegetation classification based on finding potentially new types during the field portion of the AA, (2) thoroughly testing and adjusting the field key to remove confusing splits among similar types, (3) ensuring 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 the limitations of 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 getting an overhead perspective to exactly match what's viewed on the ground. Although the accuracy for HAFO appears quite high, improvements can be made and users should fully explore and understand the sources of error as presented in the error matrices (Tables 7 and 8).

It is also important for users to remember that since the mapping portion of this project is primarily a remotely sensed exercise and the field work was conducted on site, all resulting products are scale dependent. In general, the mapping portions should be viewed as a more

general overview and the field data as more site-specific. Although one can zoom in further than 1:12,000 using GIS software, the actual mapping was conducted at this scale. As such, any work done with this product at a finer scale could lead to some confusion. In contrast, the field work was conducted at individual locations on a specific date and any extrapolation from these locations to out-lying areas or using them to determine what is there at different times of the year is less reliable. This is why, even by using second and third field calls, the AA for HAFO was not 100%. Future users should fully appreciate these scale limitations and balance their efforts accordingly.

Future Recommendations

In summary, this project represents the best efforts put forth by a multi-disciplined team over a relatively short period in time. In order to create the best possible "long-term" vegetation classification for HAFO and the most accurate and detailed GIS layer, this project should be viewed as a place to start 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. By keeping in mind that this project was only a snapshot in time, future efforts can help complete our understanding of the vegetation in and around HAFO and how it changes. It is the hope of the producers that the products presented here will help focus and direct future efforts. Recommendations for future projects are summarized below.

1. The diversity of plant species and dynamic nature of the park with respect to erosion, outside influences and fire warrants periodic **field surveys** by experienced ecologists. Furthermore the inaccessibility of the private lands in the environs should be addressed by seeking permission to sample and verify the vegetation. In this way, new plant associations could be discovered and existing types could be updated.

2. Remote sensing does not replace on-the-ground knowledge provided by GPS-linked plots, observations and ground verification. Time and funding limitations curtailed the amount of map **ground-truthing** performed. As opportunities arise, maps should be examined in the field by experienced crews. Also, GPS receiver data and other GIS layers should be used to improve and update the spatial data. This map product should not be viewed as static but should be periodically updated with more current and accurate information.

3. To better understand the limitations of the map, the **accuracy assessment** data presented in Tables 7 and 8 should be thoroughly reviewed by the park staff. Map classes with low accuracy should be examined to see 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 tease out the location of specific types based on specific habitat information. Finally, 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 aerial photos or NAIP imagery acquired every year could be used in regular intervals to capture change. Specifically, this new imagery could be used to create up-to-date vegetation layers that could be used to compare changes in both individual vegetation stands and across the entire park.

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 then be used to help locate potential sites of endangered or threatened species in the field or identify areas for non-native plant removal or treatment.

Research Opportunities

Having an accurate and current vegetation classification and map presents many new and exciting research opportunities. Research could include expanding or linking the GIS layer to derive other information such as fire models, habitat monitoring locations, guides for rare plant surveys, and inventorying areas that likely contain exotic or invasive species. The map could also be enhanced by overlaying other existing GIS layers such as 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. Finally, through innovative analyses, the vegetation layer could possibly be used as a springboard for other ecological studies such as examining how the vegetation interacts with soil chemistry, pollution, archeological sites, weather patterns, etc.

Literature Cited

Ames, Dal. 1998. Soil Survey of Jerome County and Part of Twin Falls County Idaho. U.S. Department of Agriculture – Natural Resource Conservation Service. 254 pp.

Anderson, J.R., E.E. Hardy, J.T. Roach, R.E. Witmer. 1976. A land use and land cover classification system for use with remote sensor data. *Geological Survey Professional Paper 964*. Washington, DC: U.S. Government Printing Office.

Cole, N.K. 1995. Cover type map and vegetation classification of the Hagerman study area, southwestern Idaho. Technical appendix E3.3-A for new license application: Upeer Salmon Falls (FERC no. 2777), Lower Salmon Falls (FERC no. 2061), Bliss (FREC no. 1975). Volume 4. Idaho Power Company, Boise, ID.

Covington, S. 2004. Hagerman Fossil Beds National Monument geologic resources evaluation scoping meeting summary. Geologic Resources Division.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service, Biological Service Program. FWS/OBS-79/31. Washington, DC. 103 pp.

Dallas, K. 2005. Hydrologic study of the Deer Gulch Basalt in Hagerman Fossil Beds National Monument, Idaho. Thesis. University of Idaho, Moscow, ID.

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

Dufrêne M. and P. Legendre. 1997. Species Assemblages and indicator species: the need for a flexible asymmetrical approach. Ecological Monographs 61:345-366

Federal Geographic Data Committee Vegetation Subcomittee. 1997. Vegetation Classification Standard. June 1997. FGDC-STD-005. Available: http://biology.usgs.gov/fgdc.veg/standards/vegstd.

Grossman, D.H., D. Faber-Langendoen, A.W. 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 Standard.* (Draft June 1997.) The Nature Conservancy, Arlington, VA. Available: http://www.natureserve.org/publications/library.jsp#nspubs.

Hansen, Monica, J. Coles, K. Thomas, D. Cogan, M. Ried, J. VonLoh, 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.

Idaho Data Conservation Center. 2008. Classification of the plant communities of Hagerman

Fossil Beds National Monument, Idaho. Natural Resource Technical Report NPS/UCBN/NRTR-2008/097. National Park Service, Fort Collins, Colorado.

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.

McCune, B. and M.J. Mefford. 1997. PC-ORD. *Multivariate Analysis of Ecological Data, Version 3.0*. Gleneden Beach, OR: MJM Software Design, Gleneden Beach, OR.

McCune, B. and J.B. Grace. 2002. Analysis of Ecological Communities. With contribution from Dean L. Urban. Software Design, Gleneden Beach, OR. 300 pp.

National Park Service. 1997. Baseline Water Quality Data Inventory and Analysis Hagerman Fossil Beds National Monument. National Park Service, Water Resource Division, Fort Collins CO and WA.

National Park Service. 1999. Natural Resource Challenge: The National Park Service's Action Plan for Preserving Natural Resources. National Park Service, Natural Resource Stewardship and Science Division, Washington D.C.

NatureServe. 2005. NPS PLOTS Database Version 2.0. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: May 24, 2006).

NatureServe. 2006. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. U.S.A

Northwest Managmentment, Inc. 2006. Report of the NPS Vegetation Mapping Project at Hagerman Fossil Beds National Monument. Unpublished report prepared for the U.S. Department of Interior, Inventory and Monitoring Program, Upper Columbia Basin Network, Moscow, ID.

Oelrich, K., T. Rodhouse, and L. Garrett. 2003. Report for Subagreement No. 20 to Cooperative Agreement No. CA9000-95-018 2003 vertebrate inventory Hagerman Fossil Beds National Monument University of Idaho and National Park Service Columbia Cascades Support Office. University of Idaho Department of Fish and Wildlife Resource, Moscow, Idaho.

Salas, D., J. Stevens, 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, Colorado.

Svancara, J. 2005. Inventory of Upper Columbia Basin Network Fire Information. University of Idaho, Moscow, Idaho.

Tart, D., C. Williams, J. DiBenedettto, E. Crowe, M. Girard, H. Gordon, K. Sleavin, M. Manning, J. Haglund, B. Short and D. Wheeler. 2005. Section 2: Existing vegetation classification protocol. In: R. Broham and L Bryant, eds. Existing Vegetation Classification and Mapping Technical Guide. USDA Forest Service, Ecosystem Management Coordination Staff Gen. Tech. Rep. WO-67. Washington D.C.

The Nature Conservancy and Environmental Research Systems Institute. 1994a. NBS/NPS Vegetation Mapping Program: Standardized National Vegetation Classification System. Arlington, VA.

The Nature Conservancy and Environmental Research Systems Institute. 1994b. NBS/NPS Vegetation Mapping Program: Field Methods for Vegetation Mapping. Arlington,

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

The Nature Conservancy. 1996. Methodogy for assessing the utility of esisting data for vegetation mapping. Unpublished report prepared for the U.S. Department of Inteior, Biological Survey and National Partk Service by The Nature Conserency and Environmental Systems Research Institute, Arlington, VA.

United States Department of Agriculture, Natural Resource Conservation Service. 2008. Custom Soil Resource Report for Jerome County and Part of Twin Falls County Idaho – Hagerman. USDA , NRCS. 26 pp.

Young, H.W. 1984. Evaluation of hydrologic processes affecting soil movement in the Hagerman fauna area, Hagerman, Idaho. 17 pp.

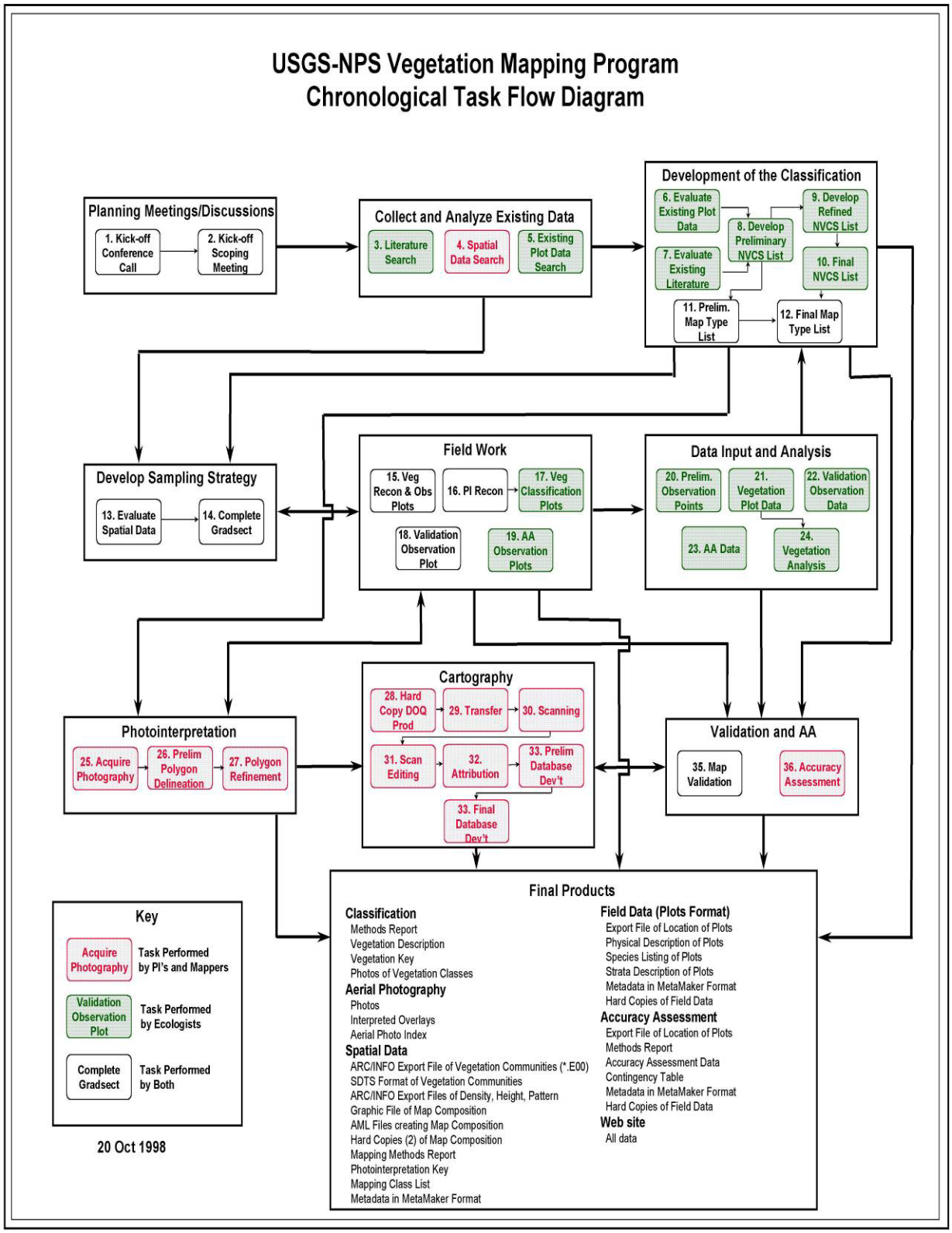
List of Abbreviation and Acronyms

AA	Accuracy Assessment
AML	Arc Macro Language
AOI	Area of Interest
BRD	Biological Resource Division (of the USGS)
CBI	Center for Biological Informatics (of the USGS/BRD)
CRMO	Craters of the Moon National Monument and Preserve
CTI	Cogan Technology Inc.
FGDC	Federal Geographic Data Committee
FSA	Farm Service Agency
GIS	Geographic Information System(s)
GPS	Global Positioning System
HAFO	Hagerman Fossil Beds National Monument
I&M	NPS Inventory and Monitoring Network
MMU	Minimum Mapping Unit
NAD	North American Datum
NAIP	National Agriculture Imagery Program
NBII	National Biological Information Infrastructure
NMI	Northwest Management, Inc.
NPS	U.S. National Park Service
NRCS	Natural Resources Conservation Service
NVC	National Vegetation Classification
NVCS	National Vegetation Classification System
RSGIG	Remote Sensing and Geographic Information Group
TNC	The Nature Conservancy
USDA	United States Department of Agriculture
UCBN	Upper Columbia Basin Inventory and Monitoring Network
USGS	United States Geological Survey
UTM	Universal Transverse Mercator

Links

http://science.nature.nps.gov/im/units/ucbn	Upper Columbia Basin Inventory and Monitoring Network
http://biology.usgs.gov/npsveg/index.html	USGS-NPS Vegetation Mapping Program
http://www.nps.gov	The National Park Service
http://usgs.gov	United States Geologic Survey
http://biology.usgs.gov/cbi	USGS Center for Biological Informatics
http://biology.usgs.gov/cbi/nbii	National Biological Information Infrastructure
http://www.nps.gov/hafo	Hagerman Fossil Beds National Monument
http://www.consulting-foresters.com	Northwest Management, Inc.
http://www.natureserve.org/explorer	NatureServe Explorer® online database server
http://plants.usda.gov	NRCS PLANTS Database

APPENDIX A: Components and Flow Diagram of the Vegetation Classification and Mapping Program



APPENDIX B: Field Data Forms and Instructions

General instructions for filling out fields
in the PLOT SURVEY FORM (adapted from Salas et al. 2004)

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 andday.

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).

<u>Cover Scale for Species Percent Cover</u>

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	
Trees and Shrubs		___Forest				
___Evergreen	___Broad-leaved	___Woodland	01	5%	01	<0.5 m
___Cold-deciduous	___Needle-leaved	___Shrubland	02	10%	02	0.5-1m
___Drought-deciduous	___Microphyllous	___Dwarf Shrubland	03	20%	03	1-2 m
___Mixed evergreen - cold-deciduous	___Graminoid	___Herbaceous	04	30%	04	2-5 m
___Mixed evergreen - drought-deciduous	___Forb	___Nonvascular	05	40%	05	5-10 m
	___Pteridophyte	___Sparsely Vegetated	06	50%	06	10-15 m
Herbs			07	60%	07	15-20 m
___Annual			08	70%	08	20-35 m
___Perennial			09	80%	09	35 - 50 m
			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%

NATIONAL PARK VEGETATION MAPPING PROGRAM: OBSERVATION POINT FORM (1997)

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

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_____

ENVIRONMENTAL DESCRIPTION

Elevation _____ Slope _____ Aspect_____

Topographic Position

Landform

Cowardian System	Hydrologic Regime		Salinity Modifiers
___Upland	Non-Tidal		___Saltwater
___Riverine	___Permanently Flooded	___Saturated	___Brackish
___Palustrine	___Semipermanetly Flooded	___Temporarily Flooded/Saturated	___Freshwater
___Lacustrine	___Seasonally Flooded	___Intermittently Flooded	

Environmental Comments:	Unvegetated Surface: (please use the cover scale below)
	___ 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:_____

VEGETATION DESCRIPTION

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

Strata	Height	Cover Class	Dominant species (mark any known diagnostic species with a *)	Cover Class
T1 Emergent	_____	_____		
T2 Canopy	_____	_____		
T3 Sub-canopy	_____	_____		
S1 Tall shrub	_____	_____		
S2 Short Shrub	_____	_____		
S3 Dwarf-shrub H Herbaceous	_____	_____		
N Non-vascular	_____	_____		
V Vine/liana	_____	_____		
E Epiphyte	_____	_____		

please see the table on the previous page for height and cover scales for strata

Other Comments

Cover Scale for Species

01 <1%
02 1-5%
03 5-25%
04 25-50%
05 50-75%
06 75-100%

Tree D.B.H Form

Plot Code:_____Units in cm or inches (circle one)

Record tree diameter over 5 cm at 4.5 feet (1.37 m) height for species that contribute to tree canopy.

Separate measurements of multi-stemmed trees with commas. Can estimate by 5 cm dia. classes

Species	D.B.H.(s) for multi-stems trees

Species	D.B.H.(s) for multi-stems trees

ACCURACY ASSESSMENT POINT FORM

IDENTIFIERS/LOCATORS

Field Point Code _____ Database Point Code _____

State __ Park Name _____ Park Site Name _____

Quad Name_____ QuadCode_____

Primary Name Veg Assoc: _____

Secondary Name Veg Assoc:_____

Other Veg Assoc within 50 m _____

Classification Comments:

GPS file name_____ Field UTM X___ ___ ___ ___ ___ ___ m E Field UTM Y___ ___ ___ ___ ___ ___ ___ m N

GPS 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_____

ENVIRONMENTAL DESCRIPTION

Elevation _____ Slope _____Aspect_____

Topographic Position

Landform

Environmental Comments (including hydrology):

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

___ 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:_____

VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	Leaf Type (of dominant stratum)	Physiognomic class	HEIGHT (M) COVER SCALE
Trees and Shrubs ___Evergreen ___Cold-deciduous ___Drought-deciduous ___Mixed evergreen - cold-deciduous ___Mixed everg. - drought-deciduous Herbs ___Annual ___Perennial	___Broad-leaved ___Needle-leaved ___Mixed broad-lvd/Needle-lvd ___Microphyllous ___Graminoid ___Forb ___Pteridophyte	___Forest ___Woodland ___Shrubland ___Dwarf-shrubland ___Herbaceous ___Nonvascular ___Sparsely Vegetated	01 -<0.5 T - <1% 02 - 0.5-1 01 - 1-5% 03 - 1-2 02 - 6-15% 04 - 2-5 03 - 16-25% 05 - 5-10 04 - 26-35% 06 - 10-15 05 - 36-45% 07 - 15-20 06 - 46-55% 08 - 20-35 07 - 56-65% 09 - 35-50 08 - 65-75% 10 ->50 09 - 76-85% 10 - 86-95% 11- 96-100%

Strata	Height Class	Cover Class	Dominant species (mark any known diagnostic species with a *)	Cover Class
T1 Emergent	____	____		
T2 Canopy	____	____		
T3 Sub-canopy	____	____		
S1 Tall shrub	____	____		
S2 Short Shrub	____	____		
S3 Dwarf-shrub	____	____		
H Herbaceous	____	____		
N Non-vascular	____	____		
V Vine/liana	____	____		
E Epiphyte	____	____		

APPENDIX C: Dichotomous Key to HAFO Plant Associations

Key to Vegetation types at HAFO (Developed By Steven Rust, Idaho Data Comservation Center)

The field key to plant communities of the monument 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, several 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 and 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 lifeform. The value is calculated by dividing the percent cover of the species (or group of species) under consideration by the total cover of the respective lifeform. For example, the relative cover of native grass species is calculated as follows: (sum of native grass species cover within the sample) / (total cover of all graminoids within the sample) = (relative native grass composition).

Key to Lifeform Groups

la) Tree canopy cover (*Elaeagnus angustifolia, Fraxinus pennsylvanica, Populus angustifolia, Populus balsamifera* ssp. *trichocarpa, Salix amygdaloides,* or *Ulmus americana*) ≥10%, Part A: Forest, Woodland, and Savannah, lead 4a.

lb) Tree canopy cover <10%, lead 2a.

- 2a) Shrub canopy cover ≥10%, Part B: Shrublands and Shrub-Steppe, lead 12a.
- 2b) Shrub canopy cover <10%, lead 3a.
  - 3a) Vascular plant cover ≥10%, Part C: Herbaceous Vegetation, lead 31a.
  - 3b) Vascular plant cover <10%, PASM-ACHY (Sparse Vegetation).

Part A: Forest, Woodland, and Savannah

4a) *Populus balsamifera* spp. *trichocarpa* ≥5% cover, POBAT-ELAN/BRTE.

4b) *Populus balsamifera* spp. *trichocarpa* <5% cover, lead 5a.

- 5a) *Populus angustifolia* ≥5% cover, POAN3/TYLA.
- 5b) *Populus angustifolia* <5% cover, lead 6a.
  - 6a) *Elaeagnus angustifolia* ≥4% cover, lead 7a.
    - 7a) *Sarcobatus vermiculatus* ≥1% cover, ELAN/SAVE4/Mesic Graminoids.
    - 7b) *Sarcobatus vermiculatus* <1% cover, lead 8a.
    - 8a) *Rhus trilobata* var. *trilobata* ≥4% cover, ELAN/RHTRT-ROWO.

8b) *Rhus trilobata* var. *trilobata* <4% cover, lead 9a.
9a) *Purshia tridentata* ≥4% cover, ELAN/PUTR2/LECI4.
9b) *Purshia tridentata* <4% cover, 10a.
10a) Native grass composition ≥30% relative cover, lead 11a.
11a) *Leymus cinereus* ≥1% cover, ELAN/LECI4.
11b) *Leymus cinereus* <1% cover, ELAN/POSE.
10b) Native grass composition <30% relative cover, ELAN/BRTE.
6b) *Elaeagnus angustifolia* <4% cover, ULAM/BRTE.

Part B: Shrublands and Shrub-Steppe
12a) *Elaeagnus angustifolia* ≥5% cover, lead 6a (above).
12b) *Elaeagnus angustifolia* <5% cover, lead 13a.
13a) *Salix exigua* ≥4% cover, SAEX/Mesic Forbs.
13b) *Salix exigua* <4% cover, lead 14a.
14a) *Salix lucida* ssp. *caudata* ≥5% cover, SALUC/THIN6.
14b) *Salix lucida* ssp. *caudata* <5% cover, lead 7a (above).
15a) *Artemisia tridentata* ssp. *wyomingensis* ≥4% cover, lead 16a.
16a) Native grass composition ≥30% relative cover, lead 17a.
17a) *Hesperostipa comata* ssp. *comata* is present, ARTRW8/HECO26.
17b) *Hesperostipa comata* ssp. *comata* is absent, lead 18a.
18a) *Achnatherum hymenoides* is present, ARTRW8/ACHY.
18b) *Achnatherum hymenoides* is absent, ARTRW8/POSE.
16b) Native grass composition <30% relative cover, ARTRW8/BRTE.
15b) *Artemisia tridentata* ssp. *wyomingensis* <4% cover, lead 19a.
19a) *Atriplex canescens* var. *canescens* ≥2% cover, lead 20a.
20a) *Achnatherum hymenoides* ≥2% cover, ATCA2/ACHY.
20b) *Achnatherum hymenoides* <2% cover, ATCA2/BRTE.
19b) *Atriplex canescens* var. *canescens* <2% cover, lead 21a.
21a) *Eriogonum microthecum* var. *laxiflorum* ≥2% cover, ERMI4/ACHY.
21b) *Eriogonum microthecum* var. *laxiflorum* <2% cover, lead 22a.
22a) *Artemisia tridentata* ssp. *tridentata* ≥2% cover, ARTRT/BRTE.
22b) *Artemisia tridentata* ssp. *tridentata* <2% cover, lead 23a.
23a) *Sarcobatus vermiculatus* ≥1% cover, lead 24a.
24a) *Leymus cinereus* ≥5% cover, SAVE4/LECI4.
24b) *Leymus cinereus* <5% cover, SAVE4/BRTE.
23b) *Sarcobatus vermiculatus* <1% cover, lead 25a.
25a) *Purshia tridentata* ≥2% cover, PUTR2/ACHY.
25b) *Purshia tridentata* <2% cover, lead 25a.
26a) *Krascheninnikovia lanata* ≥2% cover, KRLA2/POSE.
26b) *Krascheninnikovia lanata* >2% cover, lead 27a.
27a) *Atriplex confertifolia* ≥1% cover, lead 28a.
28a) *Picrothamnus desertorum* is present, ATCO-PIDE4/(ACHY)-BRTE.
28b) *Picrothamnus desertorum* is absent, lead 29a.
29a) *Achnatherum hymenoides* is present, ATCO/ACHY.

29b) *Achnatherum hymenoides* is absent, ATCO/BRTE.

27b) *Atriplex confertifolia* <1% cover, lead 30a.

30a) *Ericameria nauseosa* ≥2% cover, ERNA10-CHVI8/(ACHY)-BRTE.

30b) *Ericameria nauseosa* <2% cover, CHVI8/ACHY.

Part C: Herbaceous Vegetation

31a) Total shrub cover ≥3% cover, lead 13a (Part B, above).

31a) Total shrub cover <3% cover, lead 32a.

32a) Native grass composition ≥50% cover, lead 33a.

33a) *Achnatherum hymenoides* ≥2% cover, EROV/ACHY.

33b) *Achnatherum hymenoides* <2% cover, lead 34a.

34a) *Eleocharis palustris* ≥5% cover, ELPA3.

34b) *Eleocharis palustris* <5% cover, POAN3/TYLA.

32b) Native grass composition <50% cover, lead 35a.

35a) *Lactuca tatarica* var. *pulchella* ≥5% cover, LATAP.

35b) *Lactuca tatarica* var. *pulchella* <5% cover, lead 36a.

36a) *Agropyron cristatum* ≥4% cover, AGCR/SIAL2.

36b) *Agropyron cristatum* <4% cover, BRTE/SIAL2.

APPENDIX D: Vegetation Association Descriptions for HAFO

U.S. NATIONAL VEGETATION CLASSIFICATION

Hagerman Fossil Beds National Monument

February 19, 2009

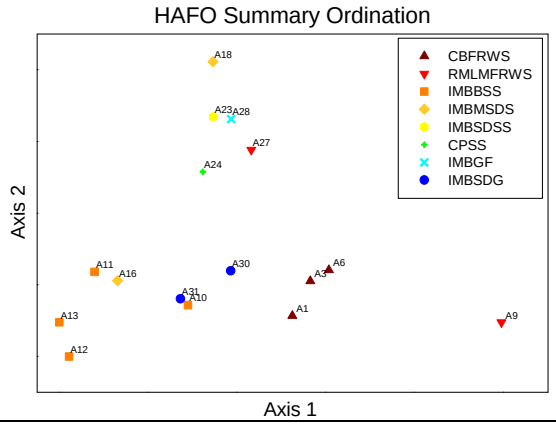
By
Northwest Management, Inc.
PO Box 9748
Moscow, Idaho 83843

And
NPS – Upper Columbia Basin Network
University of Idaho
College of Natural Resources
Moscow, Idaho 83843

This subset of the U.S. National Classification covers vegetation associations and alliances attributed to Hagerman Fossil Beds National Monument**.** This classification has been developed in consultation with many individuals and agencies and incorporates information from a variety of publications and other classifications.

Russian Olive / Cheatgrass Semi-natural Woodland

Elaeagnus angustifolia / Bromus tectorum Semi-natural Woodland



Description

The vegetation of this semi-natural association is characterized by the dominance of the introduced tree species *Elaeagnus angustifolia.* The tree canopy may range from open to nearly closed. The understory is sparse to moderate in terms of cover, and is generally dominated by introduced species. The introduced annual grass, *Bromus tectorum* is the most common species in the understory and comprises the majority of the herbaceous cover. *Agropyron cristatum*, an introduced perennial grass species may also be sparse and variable in the herbaceous layer. A variety of native shrub species may also occur sporadically in the understory with relatively low cover values. Associated shrub species may include *Artemisia* spp., *Ribes aureum, Salix exigua, Salix melanopsis,* and *Atriplex confertifolia*.

Elaeagnus angustifolia tends to dominate more mesic habitats of semi-arid environments, often adjacent to streams and rivers. *Bromus tectorum* can occur across a wide range of environmental conditions and is not tightly constrained by slope, aspect, soil texture, or soil depth. Thus, an association characterized by the dominance of these two species is likely only restricted by the availability of enough soil moisture to sustain *Elaeagnus angustifolia*.

CONSERVATION RANK N/A	DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 3, AA)

Tree

Elaeagnus angustifolia (Russian olive) V.46, *Populus angustifolia* (narrowleaf cottonwood) III.2

Shrub

None

Dwarf-shrub

None

Graminoid

Bromus tectorum (cheatgrass) IV.10

Forb

None

RANGE

Hagerman Fossil Beds National Monument

This association is found along the river and creek corridors as well as adjacent to spring-fed drainages and seeps.

Global

The widespread Russian Olive Semi-natural Woodland Alliance is found in the northern Great Plains, Utah, and probably throughout much of the western United States and adjacent Canada. The Cheatgrass Semi-natural Herbaceous Alliance is also found throughout much of western North America from the western Great Plains to intermountain and southwestern U.S. Therefore, an association characterized by both of these species is likely distributed sporadically throughout the western U.S where conditions are appropriate and where both species have had the opportunity to invade native plant communities.

COMMENTS

Elaeagnus angustifolia is considered a naturalized species and has been widely planted in hedgerows for windbreaks. It has since spread to a variety of native habitats, especially mesic areas associated with streams and rivers. Consequently, stands tend to be small and linear. *Bromus tectorum* often becomes established after disturbance of a natural shrub- or grass-dominated community resulting in the replacement of the natural vegetation by non-native, annual grass species. At Hagerman Fossil Beds National Monument, it is likely that a combination of disturbed soil and the spread of ornamental tree plantings have led to the establishment and co-dominance of these two species.

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on limited data from Hagerman Fossil Beds and 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.

MAP UNITS

This map code *Elaeagnus angustifolia* Woodland Alliance contains *Elaeagnus angustifolia* / *Bromus tectorum* Semi-natural Woodland (A1) and also contains the following associations; *Elaeagnus angustifolia* / *Leymus cinereus* Semi-natural Woodland (A2), *Elaeagnus angustifolila* / *Poa secunda* Semi-natural Woodland (A3), *Elaeagnus angustifolia* / *Purshia tridentat*a / *Leymus cinereus* Semi-natural Woodland (A4), *Elaeagnus angustifolia / Rhus trilobata* var. trilobata – *Rosa woodsii* Semi-natural Woodland (A5), *Elaeagnus angustifolia* / *Sarcobatus vermiculatus* / Mesic Graminoids Semi-natural Woodland (A6). This map code occupies approximately (91) polygons containing a combination of the associations listed above. These polygons average about (3.38) ha in size and comprise nearly (26.9) ha of total area within the Monument.

Russian Olive / Basin Wildrye Semi-natural Woodland

Elaeagnus angustifolia / Leymus cinereus Semi-natural Woodland

Description

This semi-natural association is characterized by the dominance of the introduced tree species *Elaeagnus angustifolia* with a variety of native and introduced species occurring in the understory. The tree canopy may range from open to nearly closed. *Leymus cinereus* is typically the dominant native grass species in the herbaceous understory; however, non-native grass species, primarily *Bromus tectorum*, may also occur frequently with moderate cover levels in this vegetation type.

Elaeagnus angustifolia tends to occur in more mesic habitats of semi-arid environments, such as near streams and rivers. The presence of *Leymus cinereus* also suggests an environment with seasonal flooding and more mesic soils, possibly with substantial clay content.

CONSERVATION RANK N/A	DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 1, AA)

Tree

Elaeagnus angustifolia (Russian olive)

Shrub

N/A

Dwarf-shrub

N/A

Graminoid

Leymus cinereus (basin wildrye)

Forb

N/A

RANGE

Hagerman Fossil Beds National Monument

This association is found along the river and creek corridors as well as adjacent to spring-fed drainages and seeps.

Global

The widespread Russian Olive Semi-natural Woodland Alliance is found in the northern Great Plains, Utah, and probably throughout much of the western United States and adjacent Canada. The Russian Olive / Basin Wildrye Semi-natural Woodland Association likely occurs within the range of the greater alliance where environmental conditions are appropriate for the persistence of *Leymus cinereus*.

COMMENTS

Elaeagnus angustifolia is considered a naturalized species and has been widely planted in hedgerows for windbreaks. It has since spread to a variety of native habitats, especially mesic areas associated with streams and rivers. Consequently, stands tend to be small and linear.

This association is uncommon at Hagerman Fossil Beds National Monument. Due to the limited spatial extent of occurence and associated low sample size, the classification of this plant community is considered provisional. Only one plot was sampled at Hagerman Fossil Beds; therefore a thorough characteristic species list could not be compiled.

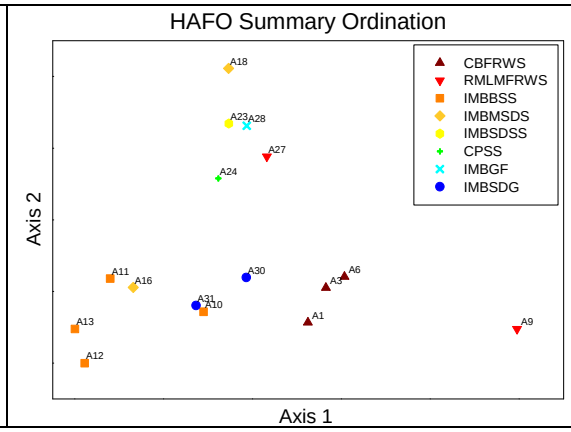
This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on limited data from Hagerman Fossil Beds and related plant communities 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.

MAP UNITS

This map code *Elaeagnus angustifolia* Woodland Alliance contains *Elaeagnus angustifolia* / *Leymus cinereus* Semi-natural Woodland (A2) and also contains the following associations; *Elaeagnus angustifolia* / *Bromus tectorum* Semi-natural Woodland (A1), *Elaeagnus angustifolila* / *Poa secunda* Semi-natural Woodland (A3), *Elaeagnus angustifolia* / *Purshia tridentat*a / *Leymus cinereus* Semi-natural Woodland (A4), *Elaeagnus angustifolia / Rhus trilobata* var. trilobata – *Rosa woodsii* Semi-natural Woodland (A5), *Elaeagnus angustifolia* / *Sarcobatus vermiculatus* / Mesic Graminoids Semi-natural Woodland (A6). This map code occupies approximately (91) polygons containing a combination of the associations listed above. These polygons average about (3.38) ha in size and comprise nearly (26.9) ha of total area within the Monument.

A3 Russian Olive / Sandberg Bluegrass Semi-natural Woodland

Elaeagnus angustifolia / Poa secunda Semi-natural Woodland



Description

This semi-natural association is characterized by the dominance of the introduced tree species *Elaeagnus angustifolia.* The native perennial grass *Poa secunda* generally dominates the herbaceous understory. The tree canopy may range from open to nearly closed. Herbaceous cover can approach moderate cover levels. Shrubs may occur sporadically at very low cover. The shrub species that occur with the greatest regularity in this plant community include *Artemisia* spp. and *Ericameria nauseosa.* In addition to *Poa secunda*, grass species present in the herbaceous understory often include *Hordeum jubatum* and *Bromus tectorum.* Forb cover is generally low and species composition is variable. Only one forb species, *Chenopodium fremontii,* a native annual, occurs with high constancy, albeit at low cover values, in this vegetation type.

Elaeagnus angustifolia tends to dominate more mesic habitats of semi-arid environments, often adjacent to streams and rivers. *Poa secunda* can be found across a wide range of elevations and slopes. This species occurs on all aspects, but is most common on southern exposures. Soils are typically shallow, moderately to well-drained, non-calcareous with a high percentage of rock fragments and exposed rock (lithic), and texture varies from sandy loam to clay loam.

CONSERVATION RANK N/A	DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 4, AA)

Tree

Elaeagnus angustifolia (Russian olive) V.42

Shrub

None

Dwarf-shrub

None

Graminoid

Poa secunda (Sandberg bluegrass) V.10, *Bromus tectorum* (cheatgrass) V.3, *Hordeum jubatum* (foxtail barley) IV.1

Forb

Chenopodium fremontii (Fremont's goosefoot) IV.1

RANGE

Hagerman Fossil Beds National Monument

This association is found along the river and creek corridors as well as adjacent to spring fed-drainages and seeps.

Global

The widespread Russian Olive Semi-naural Woodland Alliance is found in the northern Great Plains, Utah, and probably throughout much of the western United States and adjacent Canada. The *Poa secunda* Grassland Alliance is restricted to the Columbia Basin of eastern Washington, eastern Oregon, Idaho and northeastern California. Therefore, the range of the Russian Olive / Sandberg Bluegrass Semi-natural Woodland Association is likely restricted to locations where environmental conditions permit the persistence of *Elaeagnus angustifolia*, within the greater range of *Poa secunda*-dominated community types.

COMMENTS

Elaeagnus angustifolia is considered a naturalized species and has been widely planted in hedgerows for windbreaks. It has since spread to a variety of native habitats, especially mesic areas associated with streams and rivers. Consequently, stands tend to be small and linear.

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on limited data from Hagerman Fossil Beds and 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.

MAP UNITS

This map code *Elaeagnus angustifolia* Woodland Alliance contains *Elaeagnus angustifolia* / *Poa secunda* Semi-natural Woodland (A3) and also contains the following associations; *Elaeagnus angustifolia* / *Bromus tectorum* Semi-natural Woodland (A1), *Elaeagnus angustifolila* / *Leymus cinereus* Semi-natural Woodland (A2), *Elaeagnus angustifolia* / *Purshia tridentat*a / *Leymus cinereus* Semi-natural Woodland (A4), *Elaeagnus angustifolia / Rhus trilobata* var. trilobata – *Rosa woodsii* Semi-natural Woodland (A5), *Elaeagnus angustifolia* / *Sarcobatus vermiculatus* / Mesic Graminoids Semi-natural Woodland (A6). This map code occupies approximately (91) polygons containing a combination of the associations listed above. These polygons average about (3.38) ha in size and comprise nearly (26.9) ha of total area within the Monument.

A4 Russian Olive / Antelope Bitterbrush / Basin Wildrye Semi-natural Woodland

Elaeagnus angustifolia / Purshia tridentata / Leymus cinereus Semi-natural Woodland

Description

This woodland community type is dominated by the introduced tree species, *Elaeagnus angustifolia.* The tree canopy may range from open to crowns nearly touching. *Purshia tridentata* is typically present in the shrub layer, and *Leymus cinereus* is generally the dominant native grass in the herbaceous understory. Additional native shrub, grass, and forb species may occur, but species composition can be variable and cover of these species is generally low. Non-native grass species, primarily *Bromus* spp., are often present in the herbaceous layer and cover can range from low to moderate.

Elaeagnus angustifolia tends to occur in more mesic habitats of semi-arid environments, such as near streams and rivers. The presence of *Leymus cinereus* also suggests an environment with seasonal flooding and more mesic soils, possibly with substantial clay content.

CONSERVATION RANK N/A	DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 2, AA)

Tree

Elaeagnus angustifolia (Russian olive)

Shrub

Purshia tridentata (antelope bitterbrush)

Dwarf-shrub

N/A

Graminoid

Leymus cinereus (basin wildrye)

Forb

N/A

RANGE

Hagerman Fossil Beds National Monument

This association is found along the river and creek corridors as well as adjacent to spring-fed drainages and seeps.

Global

The widespread Russian Olive Semi-natural Woodland Alliance is found in the northern Great Plains, Utah, and probably throughout much of the western United States and adjacent Canada. The Russian Olive / Antelope Bitterbrush / Basin Wildrye Semi-natural Woodland Association likely occurs as small patches within the range of the greater alliance where environmental conditions are appropriate for the persistence of *Purshia tridentata* and *Leymus cinereus*.

COMMENTS

Elaeagnus angustifolia is considered a naturalized species and has been widely planted in hedgerows for windbreaks. It has since spread to a variety of native habitats, especially mesic areas associated with streams and rivers. Consequently, stands tend to be small and linear.

This association is uncommon at Hagerman Fossil Beds National Monument. Due to the limited spatial extent of occurence and associated low sample size, the classification of this plant community is considered provisional. Only two plots were sampled at Hagerman Fossil Beds; therefore, a thorough characteristic species list could not be compiled.

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on limited data from Hagerman Fossil Beds and 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.

MAP UNITS

This map code Elaeagnus angustifolia Woodland Alliance contains *Elaeagnus angustifolia* / *Purshia tridentata / Leymus cinereus* Semi-natural Woodland (A4) and also contains the following associations; *Elaeagnus angustifolia* / *Bromus tectorum* Semi-natural Woodland (A1), *Elaeagnus angustifolila* / *Leymus cinereus* Semi-natural Woodland (A2), *Elaeagnus angustifolila* / *Poa secunda* Semi-natural Woodland (A3), *Elaeagnus angustifolia / Rhus trilobata* var. trilobata – *Rosa woodsii* Semi-natural Woodland (A5), *Elaeagnus angustifolia* / *Sarcobatus vermiculatus* / Mesic Graminoids Semi-natural Woodland (A6). This map code occupies approximately (91) polygons containing a combination of the associations listed above. These polygons average about (3.38) ha in size and comprise nearly (26.9) ha of total area within the Monument.

A5 Russian Olive / Skunkbush Sumac – Woods' Rose Semi-natural Woodland

Elaeagnus angustifolia / Rhus trilobata - Rosa woodsii Semi-natural Woodland

Description

This woodland is dominated by the introduced tree species, *Elaeagnus angustifolia* with canopy cover ranging from open to nearly closed. The shrub layer is typically dense and is dominated by *Rhus trilobata*; however, *Rosa woodsii* is often present and may also be locally abundant. Other shrubs species that occasionally occur in this plant community include *Ribes aureum* and *Salix* spp. The herbaceous layer is typically sparse due to shading but *Bromus* spp. are often present.

Elaeagnus angustifolia tends to occur in more mesic habitats of semi-arid environments, such as near streams and rivers. *Rhus trilobata* favors intermittently flooded areas, including rocky, well-drained benches and toeslopes in rocky river reaches having little floodplain development due to bedrock confinement. The association resulting from the co-dominance of these species likely occurs as a narrow band on rocky, well-drained benches located between the high-water line and the upland slopes in moderately wide valleys and along narrow reaches of larger rivers. Soil textures are shallow sandy loams or loamy sands over coarse alluvium or bedrock.

CONSERVATION RANK N/A	DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 1, AA)

Tree

Elaeagnus angustifolia (Russian olive)

Shrub

Rhus trilobata (skunkbush sumac), *Rosa woodsii* (Woods' rose)

Dwarf-shrub

N/A

Graminoid

N/A Forb

N/A

RANGE

Hagerman Fossil Beds National Monument

This association is found along the river and creek corridors as well as adjacent to spring-fed drainages and seeps.

Global

The widespread Russian Olive Semi-natural Woodland Alliance is found in the northern Great Plains, Utah, and probably throughout much of the western United States and adjacent Canada. The Skunkbush Sumac Intermittently Flooded Shrubland Alliance has been described from western Colorado, southwestern New Mexico, and central Idaho. It likely also occurs throughout the southwestern U.S. and Colorado Plateau regions. Hence, the Russian Olive / Skunkbush Sumac – Woods' Rose Semi-natural Woodland Alliance is probably constrained to small patches adjacent to rivers and streams within the ranges of the greater alliances where environmental conditions are appropriate and *Elaeagnus angustifolia* has had the opportunity to invade the otherwise native plant community.

COMMENTS

Elaeagnus angustifolia is considered a naturalized species and has been widely planted in hedgerows for windbreaks. It has since spread to a variety of native habitats, especially mesic areas associated with streams and rivers. Consequently, stands tend to be small and linear.

This association is uncommon at Hagerman Fossil Beds National Monument. Due to the limited spatial extent of occurence and associated low sample size, the classification of this plant community is considered provisional. Only one plot was sampled at Hagerman Fossil Beds; therefore a thorough characteristic species list could not be compiled.

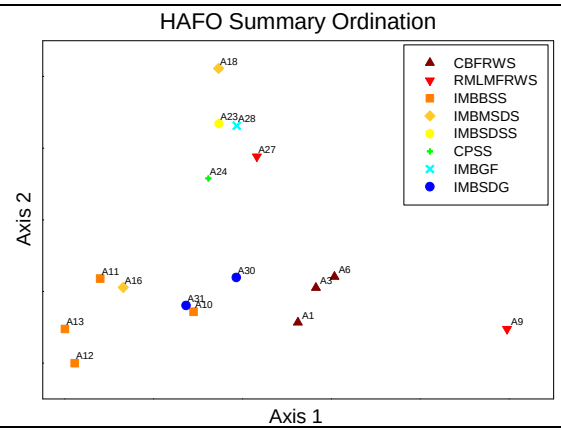
This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on limited data from Hagerman Fossil Beds and related plant communities 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.

MAP UNITS

This map code Elaeagnus angustifolia Woodland Alliance contains *Elaeagnus angustifolia / Rhus trilobata* var. trilobata – *Rosa woodsii* Semi-natural Woodland (A5), and also contains the following associations; *Elaeagnus angustifolia* / *Bromus tectorum* Semi-natural Woodland (A1), *Elaeagnus angustifolila* / *Leymus cinereus* Semi-natural Woodland (A2), *Elaeagnus angustifolila* / *Poa secunda* Semi-natural Woodland (A3), *Elaeagnus angustifolia* / *Purshia tridentata / Leymus cinereus* Semi-natural Woodland (A4), *Elaeagnus angustifolia* / *Sarcobatus vermiculatus* / Mesic Graminoids Semi-natural Woodland (A6). This map code occupies approximately (91) polygons containing a combination of the associations listed above. These polygons average about (3.38) ha in size and comprise nearly (26.9) ha of total area within the Monument.

A6 Russian Olive / Greasewood / Mesic Graminoids Semi-natural Woodland

Elaeagnus angustifolia / *Sarcobatus vermiculatus* / Mesic Graminoids Semi-natural Woodland



Description

Elaeagnus angustifolia dominates the canopy of this semi-natural woodland association. The tree canopy can range from open to nearly closed. Shrubs cover is generally low, but *Sarcobatus vermiculatus* is always present and *Ribes aureum* and *Ericameria nauseosa* may also occur in the shrub layer on occasion. Graminoids, including *Poa secunda, Eleocharis palustris,* and *Bromus tectorum* and the forb *Dipsacus fullonum,* comprise the majority of the herbaceous understory.

Elaeagnus angustifolia tends to dominate more mesic habitats of semi-arid environments, often adjacent to streams and rivers, while *Sarcobatus vermiculatus* is typically found on saline and alkaline soils that are prone to seasonal flooding. The combination of environmental factors required for the co-dominance of these species likely occurs adjacent to streams and rivers where soil texture is fine and drainage is poor.

CONSERVATION RANK N/A

DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 1, AA)

Tree

Elaeagnus angustifolia (Russian olive)

Shrub

Sarcobatus vermiculatus (greasewood)

Dwarf-shrub

N/A

Graminoid

N/A

Forb

N/A

RANGE

Hagerman Fossil Beds National Monument

This association is found along the river and creek corridors as well as adjacent to spring-fed drainages and seeps.

Global

The widespread Russian Olive Semi-natural Woodland Alliance is found in the northern Great Plains, Utah, and probably throughout much of the western United States and adjacent Canada. Greasewood is native and common throughout the West on saline, alkaline flood plains. The distribution of the Russian Olive / Greasewood / Mesic Graminoids Semi-natural Woodland Association is probably limited in patch size and distribution, occurring only where environmental conditions are conducive to *Sarcobatus vermiculatus* persistence and where *Elaeagnus angustifolia* has had the opportunity to invade the local plant community.

COMMENTS

Elaeagnus angustifolia is considered a naturalized species and has been widely planted in hedgerows for windbreaks. It has since spread to a variety of native habitats, especially mesic areas associated with streams and rivers. Consequently, stands tend to be small and linear.

This association is uncommon at Hagerman Fossil Beds National Monument. Due to the limited spatial extent of occurence and associated low sample size, the classification of this plant community is considered provisional. Only one plot was sampled at Hagerman Fossil Beds; therefore a thorough characteristic species list could not be compiled.

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on limited data from Hagerman Fossil Beds and 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.

MAP UNITS

This map code Elaeagnus angustifolia Woodland Alliance contains *Elaeagnus angustifolia* / *Sarcobatus vermiculatus* / Mesic Graminoids Semi-natural Woodland (A6), and also contains the following associations; *Elaeagnus angustifolia* / *Bromus tectorum* Semi-natural Woodland (A1), *Elaeagnus angustifolila* / *Leymus cinereus* Semi-natural Woodland (A2), *Elaeagnus angustifolila* / *Poa secunda* Semi-natural Woodland (A3), *Elaeagnus angustifolia* / *Purshia tridentata / Leymus cinereus* Semi-natural Woodland (A4), *Elaeagnus angustifolia / Rhus trilobata* var. trilobata – *Rosa woodsii* Semi-natural Woodland (A5). This map code occupies approximately (91) polygons containing a combination of the associations listed above. These polygons average about (3.38) ha in size and comprise nearly (26.9) ha of total area within the Monument.

A7 Black Cottonwood - Russian Olive / Cheatgrass Semi-natural Woodland

Populus balsamifera - Elaeagnus angustifolia / Bromus tectorum Semi-natural Woodland

Description

Populus balsamifera and *Elaeagnus angustifolia* dominate the tree canopy of this vegetation type. The canopy can range from open to nearly closed. *Bromus tectorum*, a non-native annual grass, is characteristic of the understory of this plant community and cover of this species can reach moderate levels. Additional tree, shrub, and/or herbaceous species may occur in this plant community, but cover is generally low and species composition can be quite variable from one stand to another.

Vegetation types in the Black Cottonwood Temporarily Flooded Woodland Alliance occur on alluvial terraces along major streams and rivers. Stands can occupy broad floodplains or form narrow stringers adjacent to streams with a much steeper slope. Soils are typically Entisols, with up to 1 m of mineral soil overlying river gravel and/or cobbles. Soil texture varies from loam to coarse sand. The water table underlying these plant communities usually drops below 1 m of the soil surface in summer, but can remain moist due to capillary action. *Elaeagnus angustifolia* also tends to dominate more mesic habitats of semi-arid environments, often adjacent to streams and rivers. *Bromus tectorum* can occur across a wide range of environmental conditions and is not tightly constrained by slope, aspect, soil texture, or soil depth. Thus, an association characterized by an abundance of these three species is likely constrained by the hydrologic regime and soils necessary for the persistence of *Populus balsamifera*.

CONSERVATION RANK N/A	DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 1, AA)

Tree

Populus balsamifera (black cottonwood), *Elaeagnus angustifolia* (Russian olive)

Shrub

N/A

Dwarf-shrub

N/A

Graminoid

Bromus tectorum (cheatgrass)

Forb

N/A

RANGE

Hagerman Fossil Beds National Monument

This association is found along the river and creek corridors as well as adjacent to spring-fed drainages and seeps.

Global

The widespread Russian Olive Semi-natural Woodland Alliance is found in the northern Great Plains, Utah, and probably throughout much of the western United States and adjacent Canada. The Cheatgrass Semi-natural Herbaceous Alliance is also found throughout much of western North America from the western Great Plains to intermountain and southwestern U.S. The Black Cottonwood Temporarily Flooded Woodland Alliance is found in Alaska, Idaho, Oregon, and British Columbia, Canada, and possibly Washington. The range of the Black Cottonwood - Russian Olive / Cheatgrass Semi-natural Woodland Alliance is probably limited to small patches along rivers and streams in the western U.S. where environmental conditions are appropriate for *Populus balsamifera* to dominate and where *Elaeagnus angustifolia* and *Bromus tectorum* have had the opportunity to invade the plant community.

COMMENTS

Elaeagnus angustifolia is considered a naturalized species and has been widely planted in hedgerows for windbreaks. It has since spread to a variety of native habitats, especially mesic areas associated with streams and rivers. Consequently, stands tend to be small and linear. *Bromus tectorum* often occurs after disturbance of natural shrub- or grass-dominated communities resulting in the replacement of the natural vegetation by non-native, annual grass species.

This association is uncommon at Hagerman Fossil Beds National Monument. Due to the limited spatial extent of occurence and associated low sample size, the classification of this plant community is considered provisional. Only one plot was sampled at Hagerman Fossil Beds; therefore a thorough characteristic species list could not be compiled.

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on limited data from Hagerman Fossil Beds and 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.

MAP UNITS

This map code Populus balsamifera Woodland alliance contains *Populus balsamifera spp. Trichocarpa--Elaeagnus angustifolia / Bromus tectorum* Semi-natural woodland (A7). This map code occupies approximately (3) polygons containing a combination of the associations listed above. These polygons average about (1.58) ha in size and comprise nearly (1.9) ha of total area within the Monument.

A8 American Elm / Cheatgrass Semi-natural Woodland

Ulmus americana / Bromus tectorum Semi-natural Woodland

Description

The vegetation in this semi-natural alliance is dominated by the introduced tree species *Ulmus americana. Bromus tectorum* comprises the majority of the herbaceous cover in this vegetation type. However, a variety of native and introduced species may also occur sporadically in the understory.

Ulmus americana is not known to occur in Idaho except as an ornamental shade tree. Appropriate habitats within its traditional range include bottomlands and flood plains but, it will often survive and thrive in well-drained soils. *Ulmus americana* likely occurs in abandoned farmsteads and as an ornamental planting outside of its historic range. *Bromus tectorum* can occur across a wide range of environmental conditions and is not tightly constrained by slope, aspect, soil texture, or soil depth. It often occurs after disturbance of a natural shrub- or grass-dominated community. The distribution of a plant community dominated by a combination of these species is probably not constrained by environmental factors; rather it results from historic land use patterns.

CONSERVATION RANK N/A	DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 0, AA)

Tree

Ulmus americana (American elm)

Shrub

N/A

Dwarf-shrub

N/A

Graminoid

Bromus tectorum (cheatgrass)

Forb

N/A

RANGE

Hagerman Fossil Beds National Monument

This association is found along drainage ditches or upland from the river's edge.

Global

This association is likely uncommon, with a few small patches across the western U.S., occurring only where *Ulmus americana* has been planted or has spread from a planting and disturbance has facilitated the dominance of *Bromus tectorum* in the understory.

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 in large parts of the western U.S. Consequently, this species tends to co-dominate primarily on sites that have been impacted by disturbance.

This association is uncommon at Hagerman Fossil Beds National Monument. Due to the limited spatial extent of occurence and associated low sample size, the classification of this plant community is considered provisional. No plots were sampled at Hagerman Fossil Beds and only three observations point were noted; therefore a thorough characteristic species list could not be compiled.

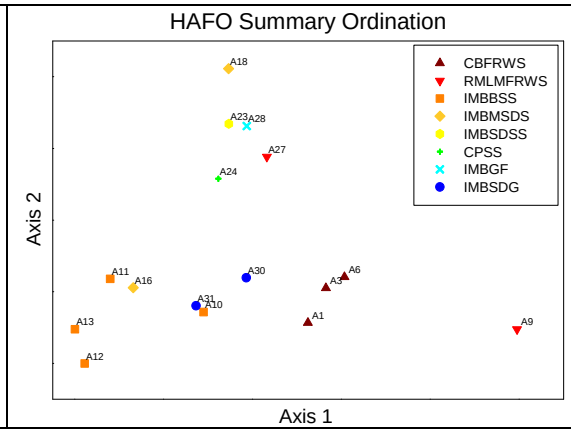
This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on limited data from Hagerman Fossil Beds and related plant communities 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.

MAP UNITS

This map code Ulmus americana Woodland alliance contains *Ulmus Americana / Bromus tectorum* Semi-natural woodland (A8). This map code occupies approximately (4) polygons containing a combination of the associations listed above. These polygons average about (0.0125) ha in size and comprise nearly (0.5) ha of total area within the Monument.

A9 Narrowleaf Cottonwood / Broadleaf Cattail Woodland

Populus angustifolia / Typha latifolia Woodland



Description

This woodland community is visually dominated by *Populus angustifolia* comprising an open canopy. *Elaeagnus angustifolia* may also be found in the canopy of some stands. The wetland forb, *Typha latifolia,* is characteristic of the understory, and cover can reach moderate levels. A sparse tall-shrub layer is often present and *Salix exigua* is the most constant species in that layer. *Populus angustifolia* saplings are also often common beneath the canopy. Depending on hydrologic conditions and the degree of canopy closure, the herbaceous layer may be sparse to dense and can be quite diverse. Aside from *Typha latifolia, Solanum dulcamara* is the most constant herbaceous species in understory.

Communities dominated by *Populus angustifolia* are typically found in wide valleys to narrow canyons at mid to upper elevations, occurring on streamside alluvial bars that border perennial rivers and intermittent streams of low to moderate gradients. Soils tend to be young and weakly developed with wet (aquic) conditions in the top 50 cm. *Typha latifolia* requires regular inundation and slow moving water on fine, poorly drained soils. The persistence and co-dominance of both species likely results from a complex collection of environmental conditions.

CONSERVATION RANK N/A	DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 4, AA)

Tree

Populus angustifolia (narrowleaf cottonwood) V.13, *Elaeagnus angustifolia* (Russian olive) III.9

Shrub

Salix exigua (narrowleaf willow) III.4

Dwarf-shrub

None

Graminoid

None

Forb

Unknown species V.6, *Typha latifolia* (broadleaf cattail) IV.22, *Solanum dulcamara* (climbing nightshade) IV.5

RANGE

Hagerman Fossil Beds National Monument

This association is found along the river and creek corridors as well as adjacent to spring-fed drainages and seeps.

Global

Associations in the Narrowleaf Cottonwood Temporarily Flooded Woodland Alliance are widespread in mountainous regions of the San Juan, Pecos, and Rio Grande river basins in northern and central New Mexico and are widely distributed throughout the Rocky Mountain region and Intermountain West. The distribution of the Narrowleaf Cottonwood / Broadleaf Cattail Woodland Association is probably patchy and very limited within the greater alliance

COMMENTS

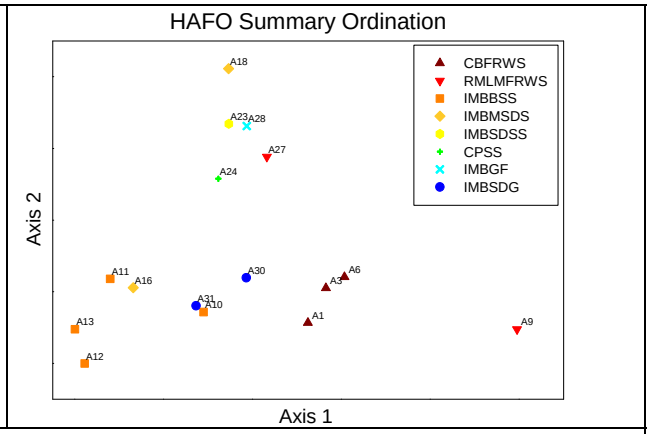
This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on limited data from Hagerman Fossil Beds and related plant communities 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.

MAP UNITS

This map code Populus angustifolia Woodland alliance contain*s Polulus angustifolia / Typha latifolia* Woodland (A9). This map code occupies approximately (4) polygons containing a combination of the associations listed above. These polygons average about (0.275) ha in size and comprise nearly (1.1) ha of total area within the Monument.

A10 Basin Big Sagebrush / Cheatgrass Semi-natural Shrubland

Artemisia tridentata ssp. *tridentata* / *Bromus tectorum* Semi-natural Shrubland



Description

Artemisia tridentata ssp. *tridentata* dominates the canopy of this shrubland association. The canopy structure can range from open to nearly closed. Additional species occurring in the shrub overstory include *Atriplex confertifolia* and *Atriplex canescens,* which are frequently present as scattered individuals. The herbaceous understory is generally sparse to moderate in terms of cover and is dominated by *Bromus tectorum*. Additional native and non-native grass and forb species often occur in this vegetation type, but tend to be sparse in terms of cover and variable in terms of species composition; *Sisymbrium altissimum* is the only forb species consistently present in the understory of this community, albeit at low cover values.

This shrubland association occurs in small to large patches on point bars, stream terraces, valley floors and alluvial fans with slopes that are generally gentle. Stands may be oriented to any aspect. Soils are sandy loams or loamy sands derived from alluvium. Although associated with drainages and floodplains, this community occurs in sites that rarely flood.

CONSERVATION RANK N/A	DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 3, AA)

Tree

None

Shrub

Artemisia tridentata ssp. *tridentata* (basin big sagebrush) V.28, *Atriplex confertifolia* (shadscale) IV.2

Dwarf-shrub

None

Graminoid

Bromus tectorum (cheatgrass) V.23

Forb

Sisymbrium altissimum (tall tumblemustard) V.<1

RANGE

Hagerman Fossil Beds National Monument

This association is found along the terrace above the river, and other alluvial fans below draws. This plant community may also occur on mid slopes where favorable soil and moisture conditions exist.

Global

This shrubland association has the potential to occur throughout the interior western U.S. from Washington to Montana south to Utah and Nevada. It may also occur in Oregon, California, and British Columbia, Canada.

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 in large parts of the western U.S. Consequently, this species tends to co-dominate primarily on sites that have been impacted by disturbance.

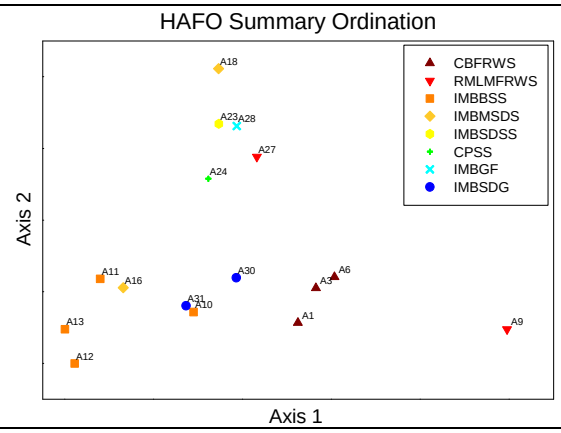
This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on limited data from Hagerman Fossil Beds and related plant communities 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.

MAP UNITS

This map code Artemisia tridentate spp. tridentata Woodland alliance contains *Artemisia tridentate spp. Tridentate / Bromus tectorum* Semi-natural Shrubland alliance (A10). This map code occupies approximately (31) polygons containing a combination of the associations listed above. These polygons average about (2.93) ha in size and comprise nearly (91.1) ha of total area within the Monument.

A11 Wyoming Big Sagebrush / Indian Ricegrass Shrubland

Artemisia tridentata ssp. *wyomingensis* / *Achnatherum hymenoides* Shrubland



Description

This association is characterized by an open to dense shrub canopy dominated by *Artemisia tridentata* ssp. *wyomingensis*, with the bunchgrass *Achnatherum hymenoides* conspicuous in a patchy open herbaceous layer. Other shrub species may include *Artemisia tripartita*, *Chrysothamnus viscidiflorus*, *Purshia tridentata* and *Ericameria nauseosa.* The herbaceous layer is diverse and variable, providing low to moderate cover. Associated graminoids generally include but are not limited to *Elymus elymoides*, *Poa secunda*, and the introduced grass *Bromus tectorum*. *Bromus tectorum* typically occurs at relatively low cover. Forbs are variable, provide sparse cover, and may include *Lactuca serriola, Balsamorhiza sagittata*, *Crepis acuminata*, *Leptodactylon pungens*, *Erigeron* spp., and *Phlox* spp. Mosses and lichens may also provide sparse to low cover.

This shrubland association occurs on slopes and terraces above drainages and ridges. Sites are gentle to steep colluvial slopes and alluvial benches often on warmer southeast to southwest aspects. Substrates are variable but are typically moderately deep, well-drained soils with sandy clay loam, sandy loam and loam textures. The ground surface has high cover of large and small rocks, low to moderate cover of litter, and occasionally high cover of bare ground.

CONSERVATION RANK G5

DATABASE CODE CEGL001046

CHARACTERISTIC SPECIES (n = 5, AA)

Tree

None

Shrub

Artemisia tridentata ssp. *wyomingensis* (Wyoming big sagebrush) V.8, *Chrysothamnus viscidiflorus* (green rabbitbrush) V.3, *Ericameria nauseosa* (rubber rabbitbrush) V.1

Dwarf-shrub

None

Graminoid

Achnatherum hymenoides (Indian ricegrass), *Poa secunda* (Sandberg bluegrass) V4, *Bromus tectorum* (cheatgrass) V.2, *Elymus elymoides* (bottlebrush squirreltail) V.1

Forb

Lactuca serriola (prickly lettuce) V.<1

RANGE

Hagerman Fossil Beds National Monument

This association is scattered throughout the park in open, exposed sites and is more common in sandy soils.

Global

This sagebrush shrubland association is known from the Gunnison River Valley and the Piceance Basin in western Colorado and the Columbia Basin in Oregon and Idaho, and it likely occurs in California. It is also recognized as occuring in the Upper Snake River Plain and Great Rift regions of southeast and south-central Idaho.

COMMENTS

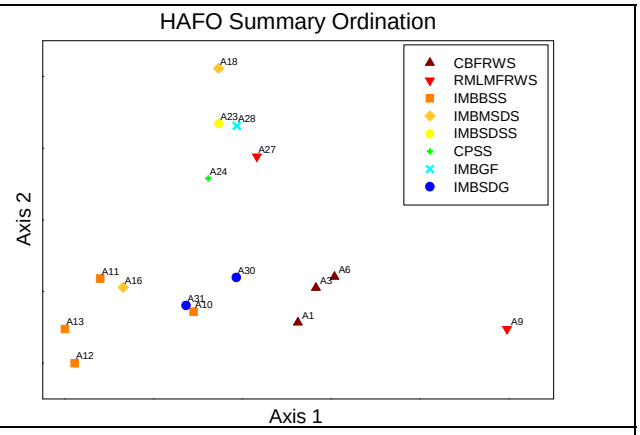
Although *Achnatherum hymenoides* is a characteristic species of this association, other grass species, such as *Poa secunda,* may occasionally be more locally abundant in communities at Hagerman Fossil Beds.

MAP UNITS

This map code Artemisia tridentate spp. wyomingensis Shrubland alliance contains *Artemisia tridentate spp. wyomingensis / Achnatherum hymenoides* Shrubland alliance (A11) and also contains the following associations; *Artemisia tridentate spp*. w*yomingensis / Hesperostipa comata* Shrubland (A13) and *Artemisia tridentate spp*. *wyomingensis* / *Poa secunda* Shrubland (A14). This map code occupies approximately (60) polygons containing a combination of the associations listed above. These polygons average about (4.50) ha in size and comprise nearly (270.1) ha of total area within the Monument.

A12 Wyoming Big Sagebrush / Cheatgrass Semi-natural Shrubland

Artemisia tridentata ssp. *wyomingensis* / *Bromus tectorum* Semi-natural Shrubland



Description

Artemisia tridentata ssp. *wyomingensis* forms a moderate to dense, shrub canopy that generally does not exceed 1 m in height. *Atriplex confertifolia, Chrysothamnus viscidiflorus*, *Ericameria nauseous,* and *Sarcobatus vermiculatus* are also occasionally present in the shrub layer. The herbaceous layer is dominated by graminoids, primarily the introduced annual grass, *Bromus tectorum*. *Agropyron cristatum* and *Poa secunda* may also occur frequently in the understory of this plant community. Cover of the herbaceous layer is generally much lower than that of the shrub layer. Forb cover and species composition can be quite variable from one site to another. Forbs are likely more characteristic of the plant community that was present prior to the invasion of *Bromus tectorum* than they are of the current vegetation type.

This shrubland association often occupies the most disturbed sites within the shrub-steppe mosaic in which it occurs. Slopes range from level to moderate, and many stands are on derived substrates such as loess deposits or alluvial fans and terraces, often modified by a veneer of alluvial cobble or gravel. Soils are generally calcareous, excessively well-drained, fine-textured silts, clays or fine sands; often deep to bedrock but sometimes with a shallow duripan that limits water infiltration.

CONSERVATION RANK N/A	DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 14, AA)

Tree

None

Shrub

Artemisia tridentata ssp. *wyomingensis* (Wyoming big sagebrush) V.28, *Atriplex confertifolia* (shadscale) IV.1

Dwarf-shrub

None

Graminoid

Bromus tectorum (cheatgrass) V.12, *Agropyron cristatum* (crested wheatgrass) IV.3

Forb

None

RANGE

Hagerman Fossil Beds National Monument

This association is fairly common throughout the park in open, exposed sites especially on slopes and terraces adjacent to agricultural fields.

Global

This association occurs within the greater range of *Artemisia tridentata* ssp. *wyomingensis*-dominated shrublands where *Bromus tectorum* has had the opportunity to invade the understory, including northeastern California, eastern Oregon and southeastern Washington, across the northern Great Basin and dry habitats of the Rocky Mountains to the northern Great Plains of Montana, Wyoming and North and South Dakota. Stands are also reported from the intermountain parks of Colorado, and from Alberta, Canada.

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 in large parts of the western U.S. Consequently, it may often be a characteristic species on or around sites that have been impacted by disturbance.

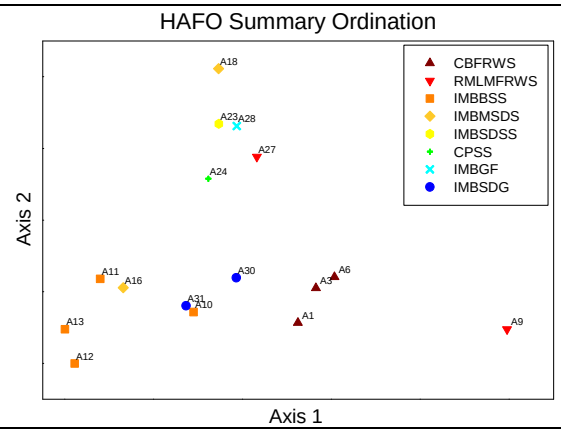
This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on data from Craters of the Moon and on related plant communities 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.

MAP UNITS

This map code Artemisia tridentate spp. wyomingensis Shrubland alliance contains *Artemisia tridentate spp. wyomingensis / Bromus tectorum* Semi-natural Shrubland (A12). This map code occupies approximately (111) polygons containing the association listed above. These polygons average about (4.08) ha in size and comprise nearly (453.4) ha of total area within the Monument

A13 Wyoming Big Sagebrush / Needle and Thread Shrubland

Artemisia tridentata ssp. *wyomingensis* / *Hesperostipa comata* Shrubland



Description

This association is dominated by *Artemisia tridentata* ssp. *wyomingensis*, with *Chrysothamnus viscidiflorus* commonly present in the shrub stratum. Shrub cover typically exceeds herbaceous cover, and *Hesperostipa comata* is the most characteristic understory species. Additional shrubs occasionally occur in this vegetation type and species may include *Purshia tridentata* and *Ericameria nauseosa.* The herbaceous layer is diverse and variable, providing low to moderate cover. Other component graminoids include *Bromus tectorum, Poa secunda,* and *Elymus elymoides*. Forbs are variable, provide low to moderate cover, and may include a variety of different species with *Sisymbrium altissimum* and *Lactuca serriola* being some of the most constant. A cryptogamic crust may be present on undisturbed stands of this association.

This association is restricted to sandy loam or uniformly, highly calcareous silt loam soils. B horizons are weakly to moderately developed, and probably overlie C horizons with carbonate hardpans. Sites where this association occurs are susceptible to wind erosion when plant cover is reduced, due to the low precipitation, warm temperatures and sandy soils.

CONSERVATION RANK G2

DATABASE CODE CEGL001051

CHARACTERISTIC SPECIES (n = 2, AA)

Tree

None

Shrub

Artemisia tridentata ssp. *wyomingensis* (Wyoming big sagebrush) V.14, *Chrysothamnus viscidiflorus* (green rabbitbrush) IV.3

Dwarf-shrub

None

Graminoid

Hesperostipa comata (needle and thread), *Bromus tectorum* (cheatgrass) V.2, *Elymus elymoides* (bottlebrush squirreltail) V.2, *Poa secunda* (Sandberg bluegrass) V.1

Forb

Sisymbrium altissimum (tall tumblemustard) V.<1

RANGE

Hagerman Fossil Beds National Monument

This association is uncommon within the park. However it may be found in open, exposed sites and tends to favor sandy soil.

Global

The plant association occurs within the Columbia River Basin of Oregon and Washington (Columbia Basin and western portion of the Okanogan Highlands ecoregional sections) and the Snake River Plain (Owyhee Uplands and Snake River Basalts ecoregional sections) in Idaho.

COMMENTS

This association is considered to be imperiled. The number, condition, and size of stands of this relatively wide-ranging plant association have declined significantly due to land conversion to cultivation, intensive range management, introduction of exotic species, and alteration of fire disturbance regimes. Few high-quality occurrences are known. Protected occurrences are typically not in good condition and/or are small in size.

MAP UNITS

This map code Artemisia tridentate spp. wyomingensis Shrubland alliance contains *Artemisia tridentate spp. wyomingensis / Hesperostipa comata* Shrubland (A13) and also contains the following associations; *Artemisia tridentate spp*. w*yomingensis / Achnatherum hymenoides* Shrubland (A11) and *Artemisia tridentate spp*. *wyomingensis* / *Poa secunda* Shrubland (A14). This map code occupies approximately (111) polygons containing a combination of the associations listed above. These polygons average about (4.08) ha in size and comprise nearly (453.4) ha of total area within the Monument.

A14 Wyoming Big Sagebrush / Sandberg Bluegrass Shrubland

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

Description

Species richness may be very low in stands of this plant community type. *Artemisia tridentata* ssp. *wyomingensis* dominates the open shrub canopy and generally does not exceed 1 m in height and 25% cover. *Ericameria nauseosa*, *Chrysothamnus viscidiflorus,* and *Purshia tridentata* may also occur sporadically in the shrub canopy. In addition to *Poa secunda, Bromus tectorum* and *Elymus elymoides* are typically common in the graminoid functional group. Other grass species often occur in the herbaceous layer, but are variable in terms of cover and composition. Forbs provide sparse to moderate cover and species composition tends to vary greatly from one stand to another.

This sparse shrubland association occurs as patches within a matrix of other shrubland or shrub-steppe types. Slopes range from level to moderate, and many stands are on derived substrates such as loess deposits or alluvial fans and terraces, often modified by a veneer of alluvial cobble or gravel. Soils are generally calcareous, excessively well-drained, fine-textured silts, clays or fine sands, often deep to bedrock but sometimes with a shallow duripan that limits water infiltration.

CONSERVATION RANK G4	DATABASE CODE CEGL001049

CHARACTERISTIC SPECIES (n = 1, AA)

Tree

N/A

Shrub

Artemisia tridentata ssp. *wyomingensis* (Wyoming big sagebrush)

Dwarf-shrub

N/A

Graminoid

Poa secunda (Sandberg bluegrass)

Forb

N/A

RANGE

Craters of the Moon National Monument

This association is scattered throughout the park in open, exposed sites with low vegetative cover.

Global

This association has been documented from northwestern Colorado, northeastern Nevada, southern Idaho, and the Columbia Basin of eastern Washington, and Oregon. It is likely to occur in Wyoming and possibly also in northeastern California and southern Montana.

COMMENTS

Dominance of shallow-rooted grasses such as *Poa secunda* indicates that sites are too dry for deeper-rooted perennials to persist. The distribution of patches of this association may also be controlled by microhabitat factors, such as snow depth, that are difficult to predict or model.

This association is uncommon at Hagerman Fossil Beds National Monument. Due to the limited spatial extent of occurence and associated low sample size, the classification of this plant community is considered provisional. Only one plot was sampled at Hagerman Fossil Beds; therefore a thorough characteristic species list could not be compiled.

MAP UNITS

This map code Artemisia tridentate spp. wyomingensis Shrubland alliance contains *Artemisia tridentate spp. wyomingensis* / *Poa secunda* Shrubland (A14) and also contains the following associations; *Artemisia tridentate spp. wyomingensis / Achnatherum hymenoides* Shrubland (A11) and *Artemisia tridentate spp. wyomingensis / Hesperostipa comata* Shrubland (A13). This map code occupies approximately (111) polygons containing a combination of the associations listed above. These polygons average about (4.08) ha in size and comprise nearly (453.4) ha of total area within the Monument

A15 Fourwing Saltbush / Indian Ricegrass Shrubland

Atriplex canescens / Achnatherum hymenoides Shrubland

Description

This semi-desert to desert vegetation type is characterized by an open (10 to 25% cover) short-shrub layer that is dominated by *Atriplex canescens*, with a sparse herbaceous layer dominated by the bunchgrass *Achnatherum hymenoides*. Additional shrub species may occur in this plant community, but typically contribute sparse cover; they may include *Grayia spinosa, Chrysothamnus viscidiflorus*, and *Krascheninnikovia lanata*. The herbaceous layer is generally low in species diversity and sparse to low in terms of cover. The introduced annual *Bromus tectorum* may be locally abundant in disturbed stands.

Stands occur on level desert plains, toeslopes, alluvial terraces and steep slopes at the base of foothills. Soils are well-drained, somewhat alkaline and include sandy clay loam.

CONSERVATION RANK G4	DATABASE CODE CEGL001289

CHARACTERISTIC SPECIES (n = 0, AA)

Tree

N/A

Shrub

Atriplex canescens (fourwing saltbush)

Dwarf-shrub

N/A

Graminoid

Achnatherum hymenoides (Indian ricegrass)

Forb

N/A

RANGE

Hagerman Fossil Beds National Monument

This association is scattered throughout the park in open, exposed sites, often in deeper soils such as those at the mouth of draws or within the floodplain of the river.

Global

This shrubland is found on the western slope of the Colorado Rocky Mountains, adjacent northeastern Utah and the Great Salt Lake Desert; it has been observed in the Snake River Plain of eastern Idaho as well. This association may have a wider distribution than is reported here as both diagnostic species are common in the semi-arid western U.S.

COMMENTS

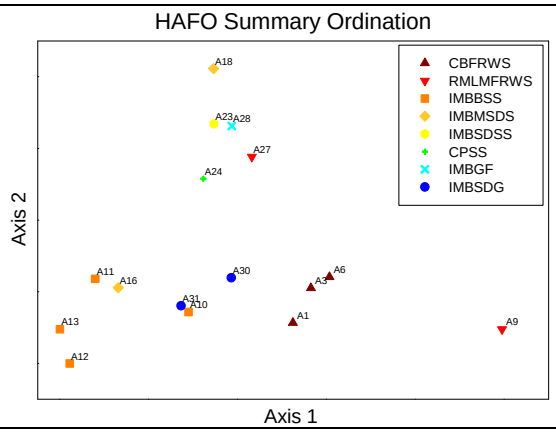
This association is uncommon at Hagerman Fossil Beds National Monument. Due to the limited spatial extent of occurence and associated low sample size, the classification of this plant community is considered provisional. No plots were sampled and only one observation point was recorded at Hagerman Fossil Beds; therefore a thorough characteristic species list could not be compiled.

MAP UNITS

This map code Sparsely Vegetated Badlands Complex contains *Atriplex canescens* / *Achnatherum hymenoides* Shrubland (A15) and also contains the following associations; *Atriplex canescens* / *Bromus tectorum* Semi-natural Shrubland (A16), *Atriplex confertifolia-Picrothamnus desertorum* / (*Achnatherum hymenoides*) – *Bromus tectorum* Semi-natural Shrubland (A17), *Atriplex confertifolia* - *Achnatherum hymenoides* Shrubland (A18), *Atriplex confertifolia – Bromus tectorum* Semi-natural Shrubland (A19), *Krascheninnikovia lanata* / *Poa secunda* Dwarf-shrubland (A22), *Eriogonum microthecum* / *Achnatherum hymenoides* Dwarf-shrubland (A24), and *Eriogonum ovalifolium* / *Achnatherum hymenoides* Dwarf-shrubland (A25). This map code occupies approximately (116) polygons containing a combination of the associations listed above. These polygons average about (2.11) ha in size and comprise nearly (245.8) ha of total area within the monument.

A16 Fourwing Saltbush / Cheatgrass Semi-natural Woodland

Atriplex canescens / Bromus tectorum Semi-natural Woodland



Description

This semi-desert to desert vegetation type is characterized by an open shrub layer that is dominated by *Atriplex canescens*. The sparse herbaceous understory is dominated by the introduced annual, *Bromus tectorum.* Associated shrub species provide sparse cover and may include several species of *Artemisia* and *Atriplex* as well as *Chrysothamnus viscidiflorus.* The herbaceous layer is low in species diversity and *Poa secunda* is the only native grass to occur with high constancy, albeit at low cover values.

This association likely occurs on or around disturbed sites. Stands generally occupy level desert plains, toeslopes, alluvial terraces and steep slopes at the base of foothills. Soils are well-drained, somewhat alkaline and have a sandy clay loam texture.

CONSERVATION RANK N/A

DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 4, AA)

Tree

None

Shrub

Atriplex canescens (fourwing saltbush) V.10, *Artemisia tridentata* ssp. *wyomingensis* (Wyoming big sagebrush) III.5, *Chrysothamnus viscidiflorus* (green rabbitbrush) III.5

Dwarf-shrub

None

Graminoid

Bromus tectorum (cheatgrass) V.4, *Poa secunda* (Sandberg bluegrass) V.1

Forb

None

RANGE

Hagerman Fossil Beds National Monument

This association is scattered throughout the park in open, exposed sites, often in deeper soils such as those at the mouth of draws or within the floodplain of the river.

Global

Although fourwing saltbush shrubland associations have only been described on the western slope of the Colorado Rocky Mountains, adjacent northeastern Utah, the Great Salt Lake Desert, and the Snake River Plain of Idaho, their range is likely much greater due to the widespread range of occurrence of the diagnostic species.

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 in large parts of the western U.S. Consequently, this species tends to co-dominate primarily on sites that have been impacted by disturbance.

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on limited data from Hagerman Fossil Beds and 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.

MAP UNITS

This map code Sparsely Vegetated Badlands Complex contains *Atriplex canescens* / *Bromus tectorum* Semi-natural Shrubland (A16) and also contains the following associations; *Atriplex canescens* / *Achnatherum hymenoides* Shrubland (A15), *Atriplex confertifolia-Picrothamnus desertorum* / (*Achnatherum hymenoides*) – *Bromus tectorum* Semi-natural Shrubland (A17), *Atriplex confertifolia* - *Achnatherum hymenoides* Shrubland (A18), *Atriplex confertifolia – Bromus tectorum* Semi-natural Shrubland (A19), *Krascheninnikovia lanata* / *Poa secunda* Dwarf-shrubland (A22), *Eriogonum microthecum* / *Achnatherum hymenoides* Dwarf-shrubland (A24), and *Eriogonum ovalifolium* / *Achnatherum hymenoides* Dwarf-shrubland (A25). This map code occupies approximately (116) polygons containing a combination of the associations listed above. These polygons average about (2.11) ha in size and comprise nearly (245.8) ha of total area within the monument.

A17 Shadscale - Bud Sagebrush / (Indian Ricegrass) - Cheatgrass Semi-natural Shrubland

Atriplex confertifolia - Picrothamnus desertorum / (Achnatherum hymenoides) - Bromus tectorum Semi-natural Shrubland

Description

Sparse and patchy vegetative cover is characteristic of this shrub-dominated association. Shrubs are low-statured and the canopy is generally open. Dominant shrubs are *Atriplex confertifolia* and *Picrothamnus desertorum.* Other shrub species, such as *Artemisia tridentata* may also occur occasionally in the canopy of this plat community. Herbaceous cover is generally very sparse. The most constant native graminoids include *Achnatherum hymenoides* and *Poa secunda*, although the distribution of *Achnatherum hymenoides* tends to be patchy and variable, which may result in its absence from the understory of some stands at a local scale. The non-native annual grass *Bromus tectorum* can be abundant in some stands, particularly those in close proximity to areas that have been disturbed.

This alkaline desert association occurs on barren toeslopes and playas on sandy or heavy clay soils, and foothill areas where saline hardpans occur at depths of 1-2 feet. Soil moisture tends to be limited through much of the growing season as a result exposure and soil texture.

CONSERVATION RANK N/A	DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 3, AA)

Tree

N/A

Shrub

Atriplex confertifolia (shadscale)

Dwarf-shrub

Picrothamnus desertorum (bud sagebrush)

Graminoid

Achnatherum hymenoides (Indian ricegrass), *Bromus tectorum* (cheatgrass)

Forb

N/A

RANGE

Hagerman Fossil Beds National Monument

This uncommon association is scattered throughout the park in open, exposed, very dry sites mostly with a southwest to southeast aspect.

Global

This association likely occurs occasionally throughout the range of the Shadscale Shrubland Alliance, primarily across the Great Basin, Columbia Basin and Colorado Plateau.

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 in large parts of the western U.S. Consequently, this species tends to co-dominate primarily on sites that have been impacted by disturbance.

This association is uncommon at Hagerman Fossil Beds National Monument. Due to the limited spatial extent of occurence and associated low sample size, the classification of this plant community is considered provisional. Although three plots were sampled at Hagerman Fossil Beds; a thorough characteristic species list could not be compiled for this association as a result of insuccifient data.

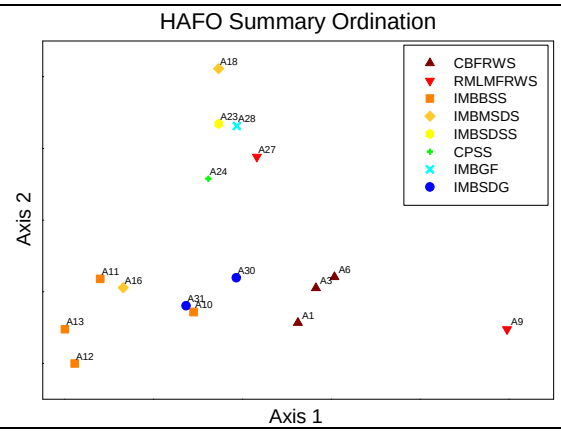
This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on limited data from Hagerman Fossil Beds and related plant communities 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.

MAP UNITS

This map code Sparsely Vegetated Badlands Complex contains *Atriplex confertifolia-Picrothamnus desertorum* / (*Achnatherum hymenoides*) – *Bromus tectorum* Semi-natural Shrubland (A17) and also contains the following associations; *Atriplex canescens* / *Achnatherum hymenoides* Shrubland (A15), *Atriplex canescens* / *Bromus tectorum* Semi-natural Shrubland (A16), *Atriplex confertifolia* - *Achnatherum hymenoides* Shrubland (A18), *Atriplex confertifolia – Bromus tectorum* Semi-natural Shrubland (A19), *Krascheninnikovia lanata* / *Poa secunda* Dwarf-shrubland (A22), *Eriogonum microthecum* / *Achnatherum hymenoides* Dwarf-shrubland (A24), and *Eriogonum ovalifolium* / *Achnatherum hymenoides* Dwarf-shrubland (A25). This map code occupies approximately (116) polygons containing a combination of the associations listed above. These polygons average about (2.11) ha in size and comprise nearly (245.8) ha of total area within the monument.

A18 Shadscale / Indian Ricegrass Shrubland

Atriplex confertifolia / Achnatherum hymenoides Shrubland



Description

Low-growing *Atriplex confertifolia* is the dominant shrub in this shrubland association, which is characterized by low total vegetative cover. The shrub layer tends to have open canopy and other shrub species, including *Artemisia tridentata*, *Chrysothamnus viscidiflorus, Atriplex canescens,* and *Ericameria nauseosa* may also occur as scattered individuals in the canopy. In high-quality stands of this vegetation type, *Achnatherum hymenoides* dominates the otherwise sparse herbaceous understory. Forbs vary greatly across the range of this association and rarely contribute significant cover. Some locally common forb species include *Eriogonum* spp., *Stanleya pinnata, Chaenactis douglasii,* and *Astragalus* spp. Degraded stands tend to have an abundance of *Bromus tectorum* in the understory and higher total herbaceous cover.

This plant association is widely scattered on benches, plateaus, gullies and slopes vary from gentle to steep. The association is typically found on well-drained, alkaline soils derived from volcanic tuff or shale that often have been modified by alluvial deposits. Soil textures include rocky and gravelly sandy loams and may have an argillic horizon. Many sites show evidence of sheet and gully erosion.

CONSERVATION RANK G3

DATABASE CODE CEGL001311

CHARACTERISTIC SPECIES (n = 2, AA)

Tree

None

Shrub

Atriplex confertifolia (shadscale) V.3, *Ericameria nauseosa* (rubber rabbitbrush) V.2, *Artemisia tridentata* ssp. *wyomingensis* (Wyoming big sagebrush) V.<1

Dwarf-shrub

None

Graminoid

Achnatherum hymenoides (Indian ricegrass), *Bromus tectorum* (cheatgrass) V.4

Forb

Stanleya pinnata (desert princesplume) V.1, *Astragalus purshii* (woollypod milkvetch) V.<1, *Chaenactis*

douglasii (Douglas' dustymaiden) V.<1, *Eriogonum watsonii* (Watson's buckwheat) V.<1

RANGE

Hagerman Fossil Beds National Monument

This association is uncommon within the park but does occur sporadically in open, exposed, very dry sites and favors sandy soils.

Global

This plant association ranges from southeastern Oregon, southern Idaho, and Nevada to Utah and western Colorado. It is also purported to occur in California and Wyoming. In Idaho, it is known from the South Fork Owyhee River canyon, the Owyhee Mountains lowland front near the Snake River, and the Salmon River canyon near Challis.

COMMENTS

This plant association is widespread throughout its range, but not abundant. This vegetation type tends to be discontinuously distributed, and large stands are uncommon. Its long-term security throughout its range is questionable. Stands undisturbed by livestock grazing, off-highway vehicles, or other activities have healthy understories of *Achnatherum hymenoides* and minimal *Bromus tectorum*. However, such high-quality stands are probably uncommon. The historic range of this type is unknown; however, widespread *Bromus tectorum* invasion has likely decreased the total number of occurrences.

MAP UNITS

This map code Sparsely Vegetated Badlands Complex contains *Atriplex confertifolia* - *Achnatherum hymenoides* Shrubland (A18) and also contains the following associations; *Atriplex canescens* / *Achnatherum hymenoides* Shrubland (A15), *Atriplex canescens* / *Bromus tectorum* Semi-natural Shrubland (A16), *Atriplex confertifolia*-*Picrothamnus desertorum* / (*Achnatherum hymenoides*) – *Bromus tectorum* Semi-natural Shrubland (A17), *Atriplex confertifolia – Bromus tectorum* Semi-natural Shrubland (A19), *Krascheninnikovia lanata* / *Poa secunda* Dwarf-shrubland (A22), *Eriogonum microthecum* / *Achnatherum hymenoides* Dwarf-shrubland (A24), and *Eriogonum ovalifolium* / *Achnatherum hymenoides* Dwarf-shrubland (A25). This map code occupies approximately (116) polygons containing a combination of the associations listed above. These polygons average about (2.11) ha in size and comprise nearly (245.8) ha of total area within the monument.

A19 Shadscale / Cheatgrass Semi-natural Shrubland

Atriplex confertifolia / Bromus tectorum Semi-natural Shrubland

Description

Low-growing *Atriplex confertifolia* is the dominant shrub in this sparsely-vegetated association. Scattered individuals of other shrub species may also occur in the canopy, but constancy and cover are generally low. The introduced annual grass, *Bromus tectorum* dominates the understory of this plant community with low to moderate cover. Additional native and non-native grasses and forbs often occur in the herbaceous understory, but cover is generally sparse and constancy of a given species from one stand to another is low.

This plant association is widely scattered on benches, plateaus, and gullies and slopes vary from gentle to steep. The association is typically found on well-drained, alkaline soils derived from volcanic tuff or shale that often have been modified by alluvial deposits. Soil textures include rocky and gravelly sandy loams and may have an argillic horizon. Many sites show evidence of sheet and gully erosion.

CONSERVATION RANK N/A	DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 0, AA)

Tree

N/A

Shrub

Atriplex confertifolia (shadscale)

Dwarf-shrub

N/A

Graminoid

Bromus tectorum (cheatgrass)

Forb

N/A

RANGE

Hagerman Fossil Beds National Monument

This association is scattered throughout the park in open, exposed, very dry sites.

Global

This plant association occurs sporadically within the range of the greater Shadscale Shrubland Alliance where cheatgrass has had the opportunity to invade the understory. The Shadscale Shrubland Alliance ranges from southeastern Oregon, southern Idaho, and Nevada to Utah and western Colorado. It is purported to occur in California and Wyoming. In Idaho, it is known from the South Fork Owyhee River canyon, the Owyhee Mountains lowland front near the Snake River, and the Salmon River canyon near Challis.

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 in large parts of the western U.S. Consequently, this species tends to co-dominate primarily on sites that have been impacted by disturbance.

This association is uncommon at Hagerman Fossil Beds National Monument. Due to the limited spatial extent of occurence and associated low sample size, the classification of this plant community is considered provisional. No plots were sampled at Hagerman Fossil Beds and only three observation points were recorded; therefore a thorough characteristic species list could not be compiled.

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on limited data from Hagerman Fossil Beds and 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.

MAP UNITS

This map code Sparsely Vegetated Badlands Complex contains *Atriplex confertifolia – Bromus tectorum* Semi-natural Shrubland (A19) and also contains the following associations; *Atriplex canescens* / *Achnatherum hymenoides* Shrubland (A15), *Atriplex canescens* / *Bromus tectorum* Semi-natural Shrubland (A16), *Atriplex confertifolia-Picrothamnus desertorum* / (*Achnatherum hymenoides*) – *Bromus tectorum* Semi-natural Shrubland (A17), *Atriplex confertifolia* - *Achnatherum hymenoides* Shrubland (A18), *Krascheninnikovia lanata* / *Poa secunda* Dwarf-shrubland (A22), *Eriogonum microthecum* / *Achnatherum hymenoides* Dwarf-shrubland (A24), and *Eriogonum ovalifolium* / *Achnatherum hymenoides* Dwarf-shrubland (A25). This map code occupies approximately (116) polygons containing a combination of the associations listed above. These polygons average about (2.11) ha in size and comprise nearly (245.8) ha of total area within the monument.

A20 Green Rabbitbrush / Indian Ricegrass Shrubland

Chrysothamnus viscidiflorus / Achnatherum hymenoides Shrubland

Description

Stands in the *Chrysothamnus viscidiflorus* Shrubland Alliance, are characterized by an open to moderately dense shrub layer. *Chrysothamnus viscidiflorus* dominates the canopy, and other shrub species may be present but sparse in the shrub stratum of this plant community. *Achnatherum hymenoides* is characteristic of the understory of this association; however, the herbaceous layer can be quite variable ranging from moderately dense and diverse to sparse and depauperate. Total vegetation cover is low to moderate and rarely exceeds 60%. Forbs may be diverse and variable in terms of species composition, but typically contribute very little cover. Disturbance-related species, such as the introduced annual grass *Bromus tectorum*, have become important in some stands.

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 have textures ranging from silt loam to sandy loam to loamy sand, and bare soil covers most of the unvegetated ground surface.

CONSERVATION RANK N/A	DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 4, AA)

Tree

N/A

Shrub

Chrysothamnus viscidiflorus (green rabbitbrush)

Dwarf-shrub

N/A

Graminoid

Achnatherum hymenoides (Indian ricegrass)

Forb

N/A

RANGE

Hagerman Fossil Beds National Monument

This uncommon association in the park favors open, exposed, dry sites and sandy soils.

Global

The Green Rabbitbrush Shrubland Alliance is currently known from Colorado and Utah in the Colorado Plateau extending east into the southern Rocky Mountains. Stands are likely more widespread in the intermountain western U.S since both diagnostic species in the Green Rabbitbrush / Indian Ricegrass Shrubland Association are common and widely distributed throughout the region.

COMMENTS

This association is uncommon at Hagerman Fossil Beds National Monument. Due to the limited spatial extent of occurence and associated low sample size, the classification of this plant community is considered provisional. Although four plots were sampled at Hagerman Fossil Beds; a thorough characteristic species list could not be compiled as a result of insufficient data.

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on limited data from Hagerman Fossil Beds and 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.

MAP UNITS

This map code Ericameria (Chrysothamnus) spp. Shrubland Complex contains *Ericameria nauseosa* – *Chrysothamnus viscidiflorus* / (*Achnatherum humanoids*) – *Bromus tectorum* Semi-natural Shrubland (A21) and also contains *Chrysothamnus viscidiflorus* / *Hesperostipa comata* Shrubland (A20). This map code occupies approximately (67) polygons containing a combination of the associations listed above. These polygons average about (1.52) ha in size and comprise nearly (102.7) ha of total area within the monument.

A21 Rubber Rabbitbrush - Green Rabbitbrush / (Indian Ricegrass) - Cheatgrass Semi-natural Shrubland

Ericameria nauseosa - Chrysothamnus viscidiflorus / (Achnatherum hymenoides) - Bromus tectorum Semi-natural Shrubland

Description

Total vegetation cover of this association is generally low to moderate and the plant community is characterized by an open shrub canopy dominated by either *Ericameria nauseosa, Chrysothamnus viscidiflorus* or a combination of both. Other shrubs may occur sporadically in the overstory, although species composition is variable and cover is sparse. Cover of the herbaceous layer is low to moderate and occasionally approaches cover levels equal to those of the shrub stratum. *Achnatherum hymenoides* generally dominates the patchy understory and *Bromus tectorum* is always present and occasionally co-dominates the herbaceous layer at low to moderate cover values. Forbs tend to be sparse and variable and often include both introduced and native species.

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 have textures ranging from silt loam to sandy loam to loamy sand, and bare soil covers most of the unvegetated ground surface.

CONSERVATION RANK N/A	DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 2, AA)

Tree

N/A

Shrub

Ericameria nauseosa (rubber rabbitbrush), *Chrysothamnus viscidiflorus* (green rabbitbrush)

Dwarf-shrub

N/A

Graminoid

Achnatherum hymenoides (Indian ricegrass), *Bromus tectorum* (cheatgrass)

Forb

N/A

RANGE

Hagerman Fossil Beds National Monument

This association is uncommon within the park. It is located in open, exposed sites and tends to favor sandy soils.

Global

This association likely occurs as isolated patches throughout the western U.S. as all of the diagnostic species are common and widespread. The range of this association is probably restricted to areas that have been impacted by disturbance as indicated by the abundance of cheatgrass and the absence of non-resprouting shrubs.

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 in large parts of the western U.S. Consequently, this species tends to co-dominate primarily on sites that have been impacted by disturbance.

This association is uncommon at Hagerman Fossil Beds National Monument. Due to the limited spatial extent of occurence and associated low sample size, the classification of this plant community is considered provisional. Because only two plots were sampled at Hagerman Fossil Beds; a thorough characteristic species list could not be compiled.

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on limited data from Hagerman Fossil Beds and 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.

MAP UNITS

This map code Ericameria (Chrysothamnus) spp. Shrubland Complex contains *Chrysothamnus viscidiflorus* / *Hesperostipa comata* Shrubland (A20) and also contains *Ericameria nauseosa – Chrysothamnus viscidiflorus* / (*Achnatherum humanoids*) – *Bromus tectorum* Semi-natural Shrubland (A21). This map code occupies approximately (67) polygons containing a combination of the associations listed above. These polygons average about (1.52) ha in size and comprise nearly (102.7) ha of total area within the monument.

A22 Winterfat / Sandberg Bluegrass Dwarf-shrubland

Krascheninnikovia lanata / Poa secunda Dwarf-shrubland

Description

This association has sparse to moderate vegetative cover with most of the total cover resulting form only two lifeforms: dwarf-shrubs and short-grasses. *Krascheninnikovia lanata* dominates the open dwarf-shrub canopy of these communities, contributing 10-50% to the total plant cover. Associated dwarf-shrubs may be present but sporadic at low cover values. *Poa secunda* is often the only conspicuous perennial grass, although *Achnatherum hymenoides* may be a common associate. Forb species tend to be diverse, weedy, low in cover, and inconsistent among sites. Annuals are typically present in all communities; the exotic grass *Bromus tectorum* is the most abundant. Mosses and lichens cover the soil surface in many sites.

This association is a patchily-distributed community type occurring on steep colluvial canyon slopes It is also found locally adjacent to various *Artemisia* spp. association types on more clayey soil types.

CONSERVATION RANK G3	DATABASE CODE CEGL001326

CHARACTERISTIC SPECIES (n = 1, AA)

Tree

N/A

Shrub

Krascheninnikovia lanata (winterfat)

Dwarf-shrub

N/A

Graminoid

Poa secunda (Sandberg bluegrass)

Forb

N/A

RANGE

Hagerman Fossil Beds National Monument

This uncommon association occurs in open, exposed, sparsely vegetated sites within the park.

Global

This association is a minor community type reported in Idaho and is likely to be found in northern Nevada as well as Washington and Oregon.

COMMENTS

Although this community is widespread, locally it never is very common. It occurs in very hot, dry habitats and is susceptible to overgrazing. Many of the remnants in Oregon are included in Research Natural Areas, which provide limited protection from livestock. This association is also threatened by introduced plants, such as *Bromus tectorum*, and agriculture conversion.

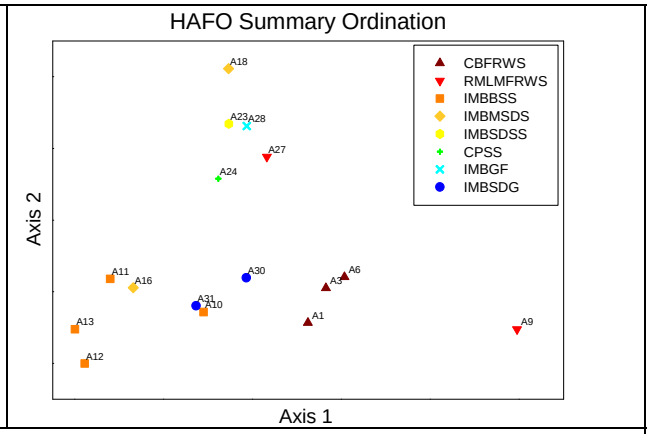
This association is uncommon at Hagerman Fossil Beds National Monument. Due to the limited spatial extent of occurence and associated low sample size, the classification of this plant community is considered provisional. Only one plot was sampled at Hagerman Fossil Beds; therefore a thorough characteristic species list could not be compiled.

MAP UNITS

This map code Sparsely Vegetated Badlands Complex contains *Krascheninnikovia lanata* / *Poa secunda* Dwarf-shrubland (A22) and also contains the following associations; *Atriplex canescens* / *Achnatherum hymenoides* Shrubland (A15), *Atriplex canescens* / *Bromus tectorum* Semi-natural Shrubland (A16), *Atriplex confertifolia-Picrothamnus desertorum* / (*Achnatherum hymenoides*) – *Bromus tectorum* Semi-natural Shrubland.(A17), *Atriplex confertifolia - Achnatherum hymenoides* Shrubland (A18), *Atriplex confertifolia – Bromus tectorum* Semi-natural Shrubland (A19), *Eriogonum microthecum* / *Achnatherum hymenoides* Dwarf-shrubland (A24), and *Eriogonum ovalifolium* / *Achnatherum hymenoides* Dwarf-shrubland (A25). This map code occupies approximately (116) polygons containing a combination of the associations listed above. These polygons average about (2.11) ha in size and comprise nearly (245.8) ha of total area within the monument.

A23 Antelope Bitterbrush / Indian Ricegrass Shrubland

Purshia tridentata / Achnatherum hymenoides Shrubland



Description

This plant community is unique in its patchy vegetation pattern. Total vegetative cover can range from sparse to dense, and two lifeforms predominate; medium-tall shrubs and herbaceous understory species. *Purshia tridentata,* typically 2-3 feet tall, forms a discernable canopy in some stands and is nearly absent others. *Artemisia tridentata, Chrysothamnus viscidiflorus,* are *Ericameria nauseosa* are usually present, but contribute little total canopy cover. *Achnatherum hymenoides,* a bunchgrass, and *Elymus lanceolatus*, a rhizomatous grass, are the most conspicuous perennial grasses in the understory of this plant community. *Hesperostipa comata, Koeleria macrantha*, and *Poa secunda* are often locally abundant in patches throughout the understory. Exotic annuals, such as *Bromus tectorum* and *Salsola kali*, can also be common in the herbaceous layer of this association.

This community type is confined to dry, hot, sand dunes with high exposure and low water holding capacity.

CONSERVATION RANK G1	DATABASE CODE CEGL001058

CHARACTERISTIC SPECIES (n = 3, AA)

Tree

None

Shrub

Purshia tridentata (antelope bitterbrush) V.10, *Ericameria nauseosa* (rubber rabbitbrush) V.3, *Chrysothamnus viscidiflorus* (green rabbitbrush) V.2, *Atriplex confertifolia* (shadscale) V.1, *Artemisia tridentata* ssp. *wyomingensis* (Wyoming big sagebrush) V.1

Dwarf-shrub

None

Graminoid

Achnatherum hymenoides (Indian ricegrass), *Bromus tectorum* (cheatgrass) V.5

Forb

Stanleya pinnata (desert princesplume) V.3, *Balsamorhiza sagittata* (arrowleaf balsamroot) V.1

RANGE

Hagerman Fossil Beds National Monument

This uncommon park association occurs in open, sandy sites.

Global

This association is a narrowly restricted community found in isolated sand dunes in Franklin, Grant, Yakima, Klickitat, and Benton counties, Washington. It is also found as isolated communities in Idaho, Oregon, and Wyoming.

COMMENTS

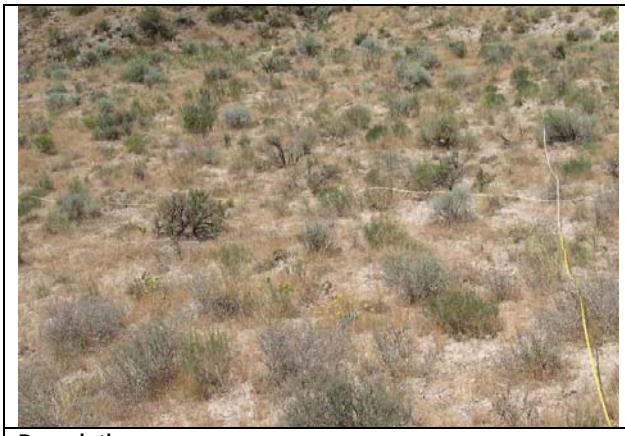
The conservation rank of this association indicates that it is considered to be critically imperiled due to its narrowly restricted geographic range and its susceptibility to disturbance. The condition of occurrences is rapidly declining because of the presence of *Bromus tectorum*. Recreational vehicles and use of large land-moving equipment combined with irrigation have denuded or created non-functional dune systems at an accelerated rate.

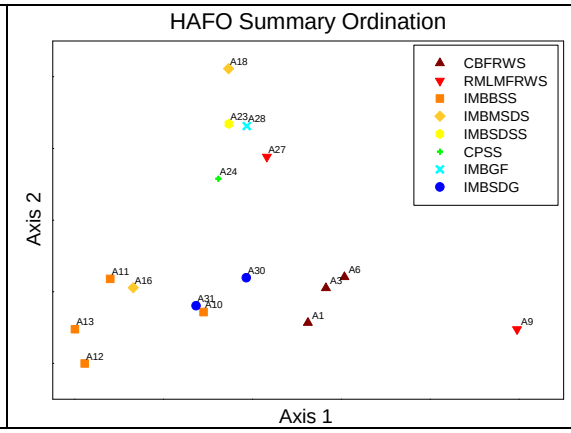
MAP UNITS

This map code *Purshia tridentata* Shrubland Alliance contains *Purshia tridentata* / *Achnatherum hymenoides* Shrubland (A23). This map code occupies approximately (27) polygons containing a combination of the associations listed above. These polygons average about (.88) ha in size and comprise nearly (24) ha of total area within the monument.

A24 Slender Buckwheat / Indian Ricegrass Dwarf-shrubland

Eriogonum microthecum / Achnatherum hymenoides Dwarf-shrubland





Description

This dwarf-shrub association is characterized by a sparse, short woody layer that is dominated by *Eriogonum microthecum*. Individuals of other shrub species may occur sporadically throughout a stand, the most constant of which are *Chrysothamnus viscidiflorus*, *Artemisia tridentata* ssp. *wyomingensis* and *Ericameria nauseosa*. The herbaceous layer also tends to have low cover in this plant community, typically <10%. It is comprised of a relatively even mixture of forbs and grasses, the most characteristic of which is *Achnatherum hymenoides*. Other common grass species include *Poa secunda*, *Elymus elymoides*, and the non-native annual, *Bromus tectorum*. Herbaceous forb species with high constancy in this plant community include *Balsamorhiza sagittata, Lactuca serriola, Stanleya pinnata,* and *Astragalus whitneyi*.

Stands of this vegetation type are often found on highly weathered basalt outcrops in canyons. Sites are very hot and dry, occurring on moderate to steep slopes with southern or western aspects. Soils are very shallow and well-drained, with a high percentage of rock fragments. Soil texture ranges from gravelly sand to gravelly sandy loam. The soil surface has a high cover of pea-sized gravel and sand with cobbles.

CONSERVATION RANK N/A	DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 6, AA)

Tree

None

Shrub

Chrysothamnus viscidiflorus (green rabbitbrush) V.3, *Artemisia tridentata* ssp. *wyomingensis* (Wyoming big sagebrush) V.1, *Ericameria nauseosa* (rubber rabbitbrush) V.1

Dwarf-shrub

Eriogonum microthecum (slender buckwheat) V.6

Graminoid

Achnatherum hymenoides (Indian ricegrass), *Poa secunda* (Sandberg bluegrass) V.5, *Bromus tectorum* (cheatgrass) V.2, *Elymus elymoides* (bottlebrush squirreltail) V.<1

Forb

Balsamorhiza sagittata (arrowleaf balsamroot) V.1, *Lactuca serriola* (prickly lettuce) V.<1

RANGE

Hagerman Fossil Beds National Monument and Preserve

This association is uncommon within the park, but favors north-facing slopes where it is found.

Global

The *Eriogonum microthecum* Dwarf-shrub Alliance is found in limited distribution on unique substrate in the vicinity of the Snake River Canyon at the boundaries of Idaho, Oregon, and Washington states. The range of the Slender Buckwheat / Indian Ricegrass Dwarf-shrubland Association is likely further constrained within the range of the greater alliance.

COMMENTS

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on limited data from Hagerman Fossil Beds and 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.

MAP UNITS

This map code Sparsely Vegetated Badlands Complex contains *Eriogonum microthecum* / *Achnatherum hymenoides* Dwarf-shrubland (A24) and also contains the following associations; *Atriplex canescens* / *Achnatherum hymenoides* Shrubland (A15), *Atriplex canescens* / *Bromus tectorum* Semi-natural Shrubland (A16), *Atriplex confertifolia-Picrothamnus desertorum* / (*Achnatherum hymenoides*) – *Bromus tectorum* Semi-natural Shrubland (A17), *Atriplex confertifolia* - *Achnatherum hymenoides* Shrubland (A18), *Atriplex confertifolia – Bromus tectorum* Semi-natural Shrubland (A19), *Krascheninnikovia lanata* / *Poa secunda* Dwarf-shrubland (A22), and *Eriogonum ovalifolium* / *Achnatherum hymenoides* Dwarf-shrubland (A25). This map code occupies approximately (116) polygons containing a combination of the associations listed above. These polygons average about (2.11) ha in size and comprise nearly (245.8) ha of total area within the monument.

A25 Cushion Buckwheat / Indian Ricegrass Dwarf-shrubland

Eriogonum ovalifolium / Achnatherum hymenoides Dwarf-shrubland

Description

The vegetation of this plant community is characterized by a mix of herbaceous grasses and forbs. Total cover of all strata is low to moderate, though cover may be higher in the spring due to the presence of annuals. The most conspicuous perennial forb species in this plant community is *Eriogonum ovalifolium*. *Achnatherum hymenoides* is the most common graminoid species in this vegetation type, but it tends to occur in a patchy distribution at low cover values. Short-statured shrubs may occur sporadically in this association and several additional perennial grass and forb species may be common into mid-summer.

This association often occurs on shallow, relatively coarse textured soils. Slopes may range from shallow to steep and appropriate sites are often exposed and dry.

CONSERVATION RANK N/A	DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 0, AA)

Tree

N/A

Shrub

N/A

Dwarf-shrub

N/A

Graminoid

Achnatherum hymenoides (Indian ricegrass)

Forb

Eriogonum ovalifolium (cushion buckwheat)

RANGE

Hagerman Fossil Beds National Monument and Preserve

This association is uncommon within the park but occurs occasionally in open, exposed, dry sites.

Global

The *Eriogonum ovalifolium* Dwarf-shrubland alliance has been described primarily from the Craters of the Moon National Monument on the northern edge of the Snake River Plain of southern Idaho. It may also occur in the same region of southern Idaho on cinder cones on the Idaho National Engineering Laboratory. Occurrences at Hagerman Fossil Beds National Monument are likely found on different parent materials than occurrences elsewhere in southeast Idaho.

COMMENTS

This association is uncommon at Hagerman Fossil Beds National Monument. Due to the limited spatial extent of occurence and associated low sample size, the classification of this plant community is considered provisional. No plots were sampled at Hagerman Fossil Beds and only one observation point was recorded; therefore a thorough characteristic species list could not be compiled.

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on limited data from Hagerman Fossil Beds and 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.

MAP UNITS

This map code Sparsely Vegetated Badlands Complex contains *Eriogonum ovalifolium* / *Achnatherum hymenoides* Dwarf-shrubland (A25) and also contains the following associations; *Atriplex canescens* / *Achnatherum hymenoides* Shrubland (A15), *Atriplex canescens* / *Bromus tectorum* Semi-natural Shrubland (A16), *Atriplex confertifolia-Picrothamnus desertorum* / (*Achnatherum hymenoides*) – *Bromus tectorum* Semi-natural Shrubland (A17), *Atriplex confertifolia* - *Achnatherum hymenoides* Shrubland (A18), *Atriplex confertifolia – Bromus tectorum* Semi-natural Shrubland (A19), *Krascheninnikovia lanata* / *Poa secunda* Dwarf-shrubland (A22), and *Eriogonum microthecum* / *Achnatherum hymenoides* Dwarf-shrubland (A24). This map code occupies approximately (116) polygons containing a combination of the associations listed above. These polygons average about (2.11) ha in size and comprise nearly (245.8) ha of total area within the monument

A26 Coyote Willow / Mesic Forbs Shrubland

Salix exigua / Mesic Forbs Shrubland

Description

The vegetation of this association is visually dominated by a tall-shrub overstory of *Salix exigua*, with a canopy ranging from open to dense. *Salix lutea, Ribes* spp., and *Rosa woodsii* are also commonly present in the shrub stratum. The herbaceous understory of this plant community is populated by a lush layer of mixed tall forbs. The composition and cover of forb species are highly variable from one location to another and no single forb species has high constancy and cover across the association's range. Total mesic graminoid cover tends to be low, especially when compared to forb cover. Non-native herbaceous species are not uncommon in this plant community.

This association typically occurs on streambanks, terraces, and meadows along a wide variety of low- to moderate-gradient stream types. It has also been documented to occupy annually flooded banks, islands, and terraces of reservoirs and large rivers. This vegetation type usually occurs on well-developed sandy to silty alluvial loam soils, on the wettest (often flooded) but stable sites supporting *Salix exigua*.

CONSERVATION RANK G2	DATABASE CODE CEGL001202

CHARACTERISTIC SPECIES (n = 2, AA)

Tree

N/A

Shrub

Salix exigua (coyote willow)

Dwarf-shrub

N/A

Graminoid

N/A

Forb

N/A

RANGE

Hagerman Fossil Beds National Monument

This association is found along the river and creek corridors as well as adjacent to spring-fed drainages and seeps.

Global

This association has been documented to occur at mid elevations in central Nevada, Utah and western Colorado, north through eastern Idaho. It is expected to occur in similar habitats in Wyoming.

COMMENTS

This association is considered to be imperiled. It is thought to be moderately wide-ranging but infrequently sampled throughout the core of its range. Stands are often found in poor ecological condition and are threatened by livestock overgrazing leading to invasion by exotic graminoid species

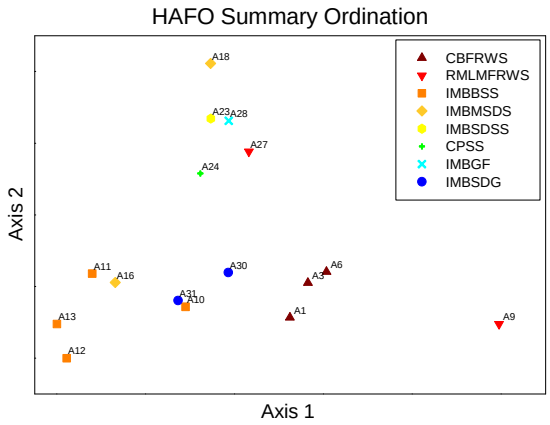
This association is uncommon at Hagerman Fossil Beds National Monument. Due to the limited spatial extent of occurence and associated low sample size, the classification of this plant community is considered provisional. Only two plots were sampled at Hagerman Fossil Beds; therefore, a thorough characteristic species list could not be compiled.

MAP UNITS

This map code Salix exigua – *Salix sucida spp. caudate* Shrubland Complex contains *Salix exigua* / Mesic Forbs Shrubland (A26) and also contains *Salix lucida spp. caudate* / *Thinopyrum intermedium* Semi-natural Shrubland (26A). This map code occupies approximately (9) polygons containing a combination of the associations listed above. These polygons average about (.33) ha in size and comprise nearly (3.0) ha of total area within the monument

A27 Shining Willow / Intermediate Wheatgrass Semi-natural Shrubland

Salix lucida / *Thinopyrum intermedium* Semi-natural Shrubland



Description

The dominant species in the overstory of this tall-shrub association is *Salix lucida*. The canopy is generally dense and other *Salix* spp. may co-dominate some stands. Lower-statured shrubs, including *Ericameria nauseosa* and *Artemisia* spp. are also occasionally present at a local scale. The understory of stands in this association has been invaded by the popular agriculture grass, *Thinopyrum intermedium*. *Thinopyrum intermedium* often contributes 90% or more of the herbaceous cover in this community; however, other exotic grasses such as *Bromus inermis* may also be present. Forb cover is generally sparse, and component forbs may be a mix of native and non-native species. Native grass and forb species rarely reestablish once they have been lost from areas dominated by *Thinopyrum intermedium*. Stands can occur in a wide variety of human-disturbed habitats.

Vegetation communities dominated by *Salix lucida* are located adjacent to small streams and rivers and are occasionally associated with abandoned beaver ponds and sloughs. Landforms diagnostic of these types include overflow channels of large rivers and alluvial deposits (point bars) of sands and gravels. Soils are typically Entisols; less frequently Mollisols. They are typically coarse-textured but remain moist with water tables above 1 m throughout the growing season. *Thinopyrum intermedium* typically occurs on drier, medium-textured soils, but has adapted to a broad range of soil textures and moisture conditions which has likely facilitated its spread into some *Salix* dominated communities.

CONSERVATION RANK N/A DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 1, AA)

Tree

None

Shrub

Salix lucida (shining willow), *Ericameria nauseosa* (rubber rabbitbrush) V.1, *Artemisia tridentata* ssp. *wyomingensis* (Wyoming big sagebrush) V.<1

Dwarf-shrub

None

Graminoid

Thinopyrum intermedium (intermediate wheatgrass), *Bromus tectorum* (cheatgrass) V.1

Forb

Cirsium arvense (Canada thistle) V.2, *Descurainia sophia* (herb sophia) V.<1, *Dipsacus fullonum* (Fuller's teasel) V.<1, *Lactuca serriola* (prickly lettuce) V.<1, *Tragopogon dubius* (yellow salsify) V.<1

RANGE

Hagerman Fossil Beds National Monument and Preserve

This association is found along the river and creek corridors as well as adjacent to spring-fed drainages and seeps.

Global

The Shining Willow Temporarily Flooded Shrubland Alliance is moderately widespread at lower to mid-elevations in the western United States. It has been reported from Oregon, Idaho, Washington, Montana and Colorado, and is likely to occur in California. The *Thinopyrum intermedium* type occurs widely throughout the northern Great Plains of the United States and at montane elevations in the Intermountain West. The Shining Willow / Intermediate Wheatgrass Semi-natural Shrubland Association likely occurs within the range of the greater alliances where intermediate wheatgrass has had the opportunity in invade the understory.

COMMENTS

This association is uncommon at Hagerman Fossil Beds National Monument. Due to the limited spatial extent of occurence and associated low sample size, the classification of this plant community is considered provisional. Only one plot was sampled at Hagerman Fossil Beds; despite the small sample size, a characteristic species list for this association was compiled as it was present in the classification relevee table, which included all species present one plot.

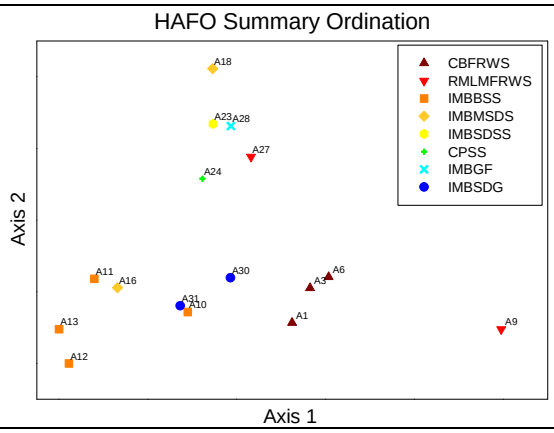
This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on limited data from Hagerman Fossil Beds and related plant communities 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.

MAP UNITS

This map code *Salix lucida* / *Thinopyrum intermedium* Semi-natural Shrubland contains *Salix exigua* / Mesic Forbs Shrubland (A26) and also contains *Salix exigua* / Barren Shrubland. This map code occupies approximately (9) polygons containing a combination of the associations listed above. These polygons average about (.33) ha in size and comprise nearly (3.0) ha of total area within the monument

A28 Greasewood / Cheatgrass Semi-natural Shrubland

Sarcobatus vermiculatus / Bromus tectorum Semi-natural Shrubland



Description

Sarcobatus vermiculatus dominates the sparse to moderately dense shrub layer of this vegetation association. Other shrubs species commonly include *Atriplex canescens, Atriplex confertifolia, Chrysothamnus viscidiflorus, Ericameria nauseosa, Grayia spinosa,* and *Tetradymia canescens*. If *Artemisia tridentata* is present, it is with very low cover. *Bromus tectorum* is the dominant herbaceous species in this vegetation type. The understory can range from sparse to dense in terms of cover, but native species typically have very low cover. Herbaceous species tend to be weedy and/or exotic; In addition to *Bromus tectorum, Descurainia pinnata, Sisymbrium altissimum, Alyssum desertorum*, and *Halogeton glomeratus* are the most prevalent.

Stands are found on terraces, swales, coppice dunes, playas, alluvial fans and flats, valley floors, toeslopes and ridges. Slopes tend to be gentle. Soils are typically derived from mixed alluvium or from eolian deposits. Soil textures range from sand to silty clay and tend to be alkaline and saline, often with a white salt crust on the soil surface.

CONSERVATION RANK N/A	DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 5, AA)

Tree

None

Shrub

Sarcobatus vermiculatus (greasewood) V.6, *Artemisia tridentata* ssp. *wyomingensis* (Wyoming big sagebrush) III.2, *Atriplex canescens* (fourwing saltbush) III.2

Dwarf-shrub

None

Graminoid

Bromus tectorum (cheatgrass) V.18

Forb

Sisymbrium altissimum (tall tumblemustard) V.2, *Descurainia sophia* (herb sophia) V.<1

RANGE

Hagerman Fossil Beds National Monument

This association is most often found close to waterways or in drainage channels where greater soil moisture is available.

Global

This widespread but patchy shrubland likely occurs throughout the Colorado Plateau and Great Basin and extends to mountain valleys in the southern Rocky Mountains where *Bromus tectorum* has had the opportunity to invade the understory.

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 shrublands in large parts of the western U.S. Consequently, this species tends to co-dominate primarily on sites that have been impacted by disturbance.

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on limited data from Hagerman Fossil Beds and 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.

MAP UNITS

This map code Sacobatus vermiculatus Intermittently Flooded Shrubland Alliance contains *Sarcobatus vermiculatus* / *Bromus tectorum* Semi-natural Shrubland (A28) and *Sarcobatus vermiculatus* / *Leymus cinereus* Shrubland (A29). This map code occupies approximately (20) polygons containing a combination of the associations listed above. These polygons average about (2.01) ha in size and comprise nearly (40.2) ha of total area within the monument.

A29 Greasewood / Basin Wildrye Shrubland

Sarcobatus vermiculatus / Leymus cinereus Shrubland

Description

This association has a moderately dense shrub canopy that is dominated by *Sarcobatus vermiculatus*. *Chrysothamnus viscidiflorus* is also often present in the shrub stratum. The moderately dense herbaceous layer is dominated by perennial graminoids, the most conspicuous of which is *Leymus cinereus*. *Pascopyrum smithii* regularly co-dominates the herbaceous stratum of this plant community. Forb cover tends to be low and component species may include *Comandra umbellata, Iva axillaris, Tragopogon dubius*, and *Sphaeralcea* spp. The cactus *Opuntia polyacantha* is typically present in this vegetation type as well.

This shrubland is restricted to a relatively narrow band on floodplains and toeslopes above drainages in semiarid environments. Substrates are poorly drained. Soil textures range from sand to silty clay and tend to be alkaline and saline, often with a white salt crust on the soil surface.

CONSERVATION RANK G3	DATABASE CODE CEGL001366

CHARACTERISTIC SPECIES (n = 0, AA)

Tree

N/A

Shrub

Sarcobatus vermiculatus (greasewood)

Dwarf-shrub

N/A

Graminoid

Leymus cinereus (basin wildrye)

Forb

N/A

RANGE

Hagerman Fossil Beds National Monument

This association is most often found close to waterways or in drainage channels where greater soil moisture is available.

Global

This association has been documented in western Montana and Oregon, and may occur in Washington, California, Nevada and Idaho.

COMMENTS

Much of the historic range of this association has been converted to cropland. Improper grazing by livestock can eliminate *Leymus cinereus* from the understory. Alteration of natural hydrologic processes may change the flood regimes that support this vegetation type and result in changes to the plant community as well.

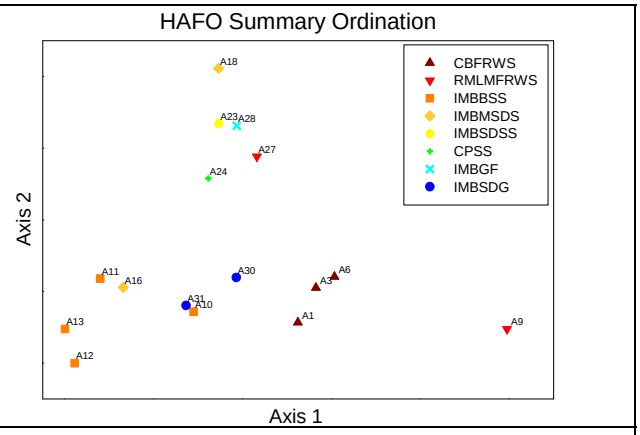
This association is uncommon at Hagerman Fossil Beds National Monument. Due to the limited spatial extent of occurence and associated low sample size, the classification of this plant community is considered provisional. No plots were sampled at Hagerman Fossil Beds and only one observation point was recorded; therefore a thorough characteristic species list could not be compiled.

MAP UNITS

This map code Sacobatus vermiculatus Intermittently Flooded Shrubland Alliance contains *Sarcobatus vermiculatus* / *Leymus cinereus* Shrubland (A29) and *Sarcobatus vermiculatus* / *Bromus tectorum* Semi-natural Shrubland (A28). This map code occupies approximately (20) polygons containing a combination of the associations listed above. These polygons average about (2.01) ha in size and comprise nearly (40.2) ha of total area within the monument

A30 Crested Wheatgrass / Tall Tumblemustard Semi-natural Herbaceous Vegetation

Agropyron cristatum / Sisymbrium altissimum Semi-natural Herbaceous Vegetation



Description

This herbaceous plant community is characterized by an abundance of introduced species with low to moderate total cover. The dominant species in this vegetation type is *Agropyron cristatum*, a perennial bunchgrass. *Sisymbrium altissimum*, an annual forb, is also characteristic of this plant community, but it typically occurs at low cover values. Other non-native grass species, such as *Bromus tectorum,* are often present with sparse cover. 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 grasses. *Poa secunda* is the most frequently occurring and abundant native grass in this community type. Other non-native forb species are common and typically include *Lactuca serriola, Descurainia sophia,* and *Chorispora tenella*.

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. Stands can occur in and adjacent to a wide variety of human-disturbed habitats, including highway rights-of-way, revegetation projects, etc.

CONSERVATION RANK N/A	DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 4, AA)

Tree

None

Shrub

None

Dwarf-shrub

None

Graminoid

Agropyron cristatum (crested wheatgrass) V.23, *Bromus tectorum* (cheatgrass) IV.1, *Poa secunda* (Sandberg bluegrass) IV.1

Forb

Sisymbrium altissimum (tall tumble mustard) V.1, *Lactuca serriola* (prickly lettuce) V.<1

RANGE

Hagerman Fossil Beds National Monument

This association is most often found adjacent to agricultural fields that were seeded to pasture or areas that were reseeded after a fire.

Global

The Crested Wheatgrass Semi-natural Herbaceous Alliance is found in Utah, Montana, Wyoming, Idaho, and North and South Dakota, and in Canada in Manitoba and Saskatchewan.

COMMENTS

Agropyron cristatum has been planted into pastures and rangelands to improve forage production and is well suited to the cold, semi-arid conditions of the Great Basin, northwestern Great Plains and higher elevation rangeland in more southern latitudes, facilitating its persistence and occasional spread.

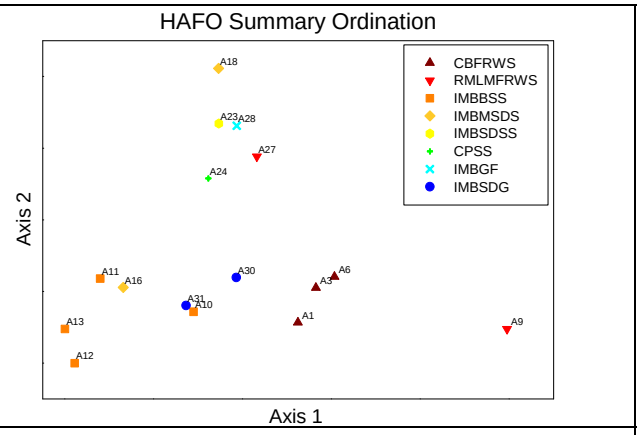
This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on limited data from Hagerman Fossil Beds and related plant communities 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.

MAP UNITS

This map code Agropyron cristatum / Sisymbrium altissimum Herbaceous Vegetation contains *Agropyron cristatum* / *Sisymbrium altissimum* Herbaceous Vegetation (A30). This map code occupies approximately (10) polygons containing the association listed above. These polygons average about (1.85) ha in size and comprise nearly (18.5) ha of total area within the monument

A31 Cheatgrass / Tall Tumblemustard Semi-natural Herbaceous Vegetation

Bromus tectorum / Sisymbrium altissimum Semi-natural Herbaceous Vegetation



Description

This herbaceous plant community is characterized by an abundance of introduced species. The vegetation in this association is dominated by *Bromus tectorum*, an annual grass, *Sisymbrium altissimum*, an annual forb, or a combination of both species. This association often occurs on or near sites that have been disturbed. Total vegetation cover ranges from 10 to 70%, generally with less than half from native species. 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 species. Native shrubs may occur sporadically with low densities. Several native and non-native forb species may also be sparse and variable across stands of this vegetation type and typically include *Descurainia sophia, Lactuca serriola, Salsola kali,* and *Chorispora tenella.*

This association can occur across a wide range of environmental conditions in semi-arid ecosystems but is likely to be found in low-lying areas that have fine soil-textures and experience occasional seasonal flooding.

CONSERVATION RANK N/A	DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 5, AA)

Tree

None

Shrub

None

Dwarf-shrub

None

Graminoid

Bromus tectorum (cheatgrass) V.27

Forb

Sisymbrium altissimum (tall tumblemustard) V.7, *Descurainia sophia* (herb sophia) IV.3

RANGE

Hagerman Fossil Beds National Monument

This association is fairly widespread throughout the park. It is most common adjacent to roads, agricultural fields, and other disturbed areas.

Global

This global distribution of this association likely 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 in large parts of the western U.S. *Sisymbrium altissimum* is also introduced and is characteristic of disturbed areas. Consequently, these species tend to co-dominate on or around sites that have been impacted.

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on limited data from Hagerman Fossil Beds and 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.

MAP UNITS

This map code Bromus tectorum / Sisymbrium altissimum Herbaceous Vegetation contains *Bromus tectortum* / *Sisymbrium altissimum* Herbaceous Vegetation (A31). This map code occupies approximately (170) polygons containing the association listed above. These polygons average about (1.37) ha in size and comprise nearly (234.1) ha of total area within the monument

A32 Blue Lettuce Semi-natural Herbaceous Vegetation

Lactuca tatarica Semi-natural Herbaceous Vegetation

Description

The dominant species in this herbaceous association, *Lactuca tatarica*, is perennial and native to North America; however, it tends to be considered weedy in many parts of the West as it creates a monoculture in disturbed areas. Other native species tend to be sparse and occur with very low cover and/or frequency. Non-native species may also occur sporadically throughout stands of this vegetation type.

Typical habitat for this plant community includes foothills, marshes, canal and stream banks, roadsides, meadows, pastures, and cultivated fields. It is more common in moist soil types but is highly adapted to survive a range of environmental conditions.

CONSERVATION RANK N/A	DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 0, AA)

Tree

N/A

Shrub

N/A

Dwarf-shrub

N/A

Graminoid

N/A

Forb

Lactuca tatarica (blue lettuce)

RANGE

Hagerman Fossil Beds National Monument

This association is most often found in moist meadows or drainage channels with sub-surface moisture.

Global

This widespread association may be found in disturbed patches across much of North America and Canada.

COMMENTS

This association is uncommon at Hagerman Fossil Beds National Monument. Due to the limited spatial extent of occurence and associated low sample size, the classification of this plant community is considered provisional. No plots were sampled and only one observation point was recorded at Hagerman Fossil Beds; therefore a thorough characteristic species list could not be compiled.

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on limited data from Hagerman Fossil Beds and 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.

MAP UNITS

This map code Annual Weedy Herbaceous Vegetation Complex contains *Lactuca tatarica var. pulchella* Herbaceous Vegetation (A32). This map code occupies approximately (15) polygons containing the association listed above. These polygons average about (.23) ha in size and comprise nearly (3.4) ha of total area within the monument

A33 Western Wheatgrass – Indian Ricegrass Herbaceous Vegetation

Pascopyrum smithii - Achnatherum hymenoides Herbaceous Vegetation

Description

This association is characterized by an open to moderated herbaceous layer that grows 0.5-1 m tall and is strongly dominated by *Pascopyrum smithii*. Herbaceous cover may be significantly less on drier sites or after scarce cool-season precipitation. *Achnatherum hymenoides* is also characteristic of this community type, but may occur in a sparse and/or patchy distribution. Additional graminoid species vary from one stand to another. Shrubs and dwarf-shrubs are rare in this vegetation type, but occasional woody species that are common to sagebrush steppe plant communities may be present. Forbs are common but are variable in terms of species composition and sparse in terms of vegetation cover. Additional non-native, weedy species may also be locally abundant, especially in stands that have been disturbed.

Stands occur on level to gently sloping terrain. They may be found on alluvial fans, swales, floodplains, valley bottoms and basins. The soils are typically deep (40-100 cm), slightly alkaline and well-developed with clay, clay loam, and silt loam textures, but also coarser textures such as sand and loamy sand. Some stands occur on perched water tables. Parent materials include landslide deposits, volcanic rocks, sandstones and shale that have eroded and deposited as secondary stream alluvium.

CONSERVATION RANK N/A	DATABASE CODE N/A

CHARACTERISTIC SPECIES (n = 1, AA)

Tree

N/A

Shrub

N/A

Dwarf-shrub

N/A

Graminoid

Pascopyrum smithii (western wheatgrass), *Achnatherum hymenoides* (Indian ricegrass)

Forb

N/A

RANGE

Hagerman Fossil Beds National Monument

This uncommon association may be found in open sites where sandy soils overlay a soil layer containing more clay.

Global

This grassland vegetation type is likely found as small, somewhat isolated patches throughout the northern and western Great Plains, Rocky Mountains, intermountain western United States and Canada, ranging from North Dakota and Saskatchewan, south to Nebraska and Colorado, and west to northern Arizona, Utah and Idaho.

COMMENTS

This association is uncommon at Hagerman Fossil Beds National Monument. Due to the limited spatial extent of occurence and associated low sample size, the classification of this plant community is considered provisional. Only one plot was sampled at Hagerman Fossil Beds; therefore a thorough characteristic species list could not be compiled.

This association was not recognized in the National Vegetation Classification (NVC) and had not been documented or described by NatureServe (2009) at the time this document was produced. Therefore, the plant community description is based on limited data from Hagerman Fossil Beds and 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.

MAP UNITS

This map code Pascopyrum smithii – Achnatherum hymenoides Herbaceous Vegetation contains *Achnatherum hymenoides* Herbaceous Vegetation (A33). This map code occupies approximately (0) polygons containing the association listed above. These polygons average about (0) ha in size and comprise nearly (0) ha of total area within the monument

A34 Common Spikerush Herbaceous Vegetation

Eleocharis palustris Herbaceous Vegetation

Description

This wetland association is dominated by submersed and emergent rooted vegetation under 1 m tall. This community is easily recognized by bright green stands of *Eleocharis palustris*. Vegetation cover can be sparse to dense (10-90%), but *Eleocharis palustris* is the dominant species, and the only species with 100% constancy. Other species, when present, can contribute as much as 40% cover, but never exceed that of the *Eleocharis palustri*. Co-occurring species in low-elevation stands can include native species such as, *Juncus balticus, Hordeum jubatum, Equisetum* spp., *Pascopyrum smithii,* as well as the introduced species *Melilotus officinalis* and *Bromus inermis*. Forb cover is typically low but may occasionally approach moderate levels in some stands.

This herbaceous wetland occurs across a range of elevations in valleys and canyon bottoms on the banks and in the overflow channels of low-gradient streams, as well as along the margins of ponds and lakes. It can also occur in the bottom of ephemeral ponds or playas on floodplain terraces of large rivers. In wet years, stands may remain ponded throughout the growing season. Soils range from organic to silty clay to fine loam formed from weathered siltstone and shale or eolian loess. Soils are reported as slightly alkaline.

CONSERVATION RANK G5	DATABASE CODE CEGL001833

CHARACTERISTIC SPECIES (n = 1, AA)

Tree

N/A

Shrub

N/A

Dwarf-shrub

N/A

Graminoid

Eleocharis palustris (common spikerush)

Forb

N/A

RANGE

Hagerman Fossil Beds National Monument

This uncommon association may be found in slow-moving waterways or where water is ponded for much or all of the year.

Global

This spikerush wet meadow community is found in the central Great Plains of the United States and Canada and throughout the western United States including the desert Southwest.

COMMENTS

The hydrological regime is critically important to this association. Most stands are seasonally to permanently flooded.

This association is uncommon at Hagerman Fossil Beds National Monument. Due to the limited spatial extent of occurence and associated low sample size, the classification of this plant community is considered provisional. Only one plot was sampled at Hagerman Fossil Beds; therefore a thorough characteristic species list could not be compiled.

MAP UNITS

This map code Eleocharis palustris – Typha latifolia Weltand Vegetation Complex contains *Eleocharis palustris* Herbaceous Vegetation (A34). This map code occupies approximately (30) polygons containing the association listed above. These polygons average about (.32) ha in size and comprise nearly (9.7) ha of total area within the monument

APPENDIX E: HAFO Species List

This is not a complete list for HAFO.

Hagerman Fossil Beds NM Vascular Plants			
TSN	**Family**	**Standard Scientific Name**	**Standard Common Name**
28749	Aceraceae	*Acer negundo*	ashleaf maple, box elder, boxelder, boxelder maple, california boxelder, manitoba maple, western boxelder
38917	Alismataceae	*Sagittaria cuneata*	arum-leaf arrowhead, arumleaf arrowhead, northern arrowhead, wapato
20719	Amaranthaceae	*Amaranthus albus*	pigweed, pigweed amaranth, prostrate pigweed, tumble pigweed, tumbleweed, white pigweed
20745	Amaranthaceae	*Amaranthus retroflexus*	Pigweed, careless weed, red-root amaranth, redroot amaranth, redroot pigweed, rough pigweed
539586	Anacardiaceae	*Rhus aromatica* var. *trilobata*	No data
28822	Anacardiaceae	*Toxicodendron rydbergii*	W. Poison ivy, poison ivy, western poison ivy, western poison-ivy
192931	Apiaceae	*Berula erecta* var. *incisa*	No data
182152	Apiaceae	*Cicuta maculata* var. *angustifolia*	common water hemlock, poison parsnip, spotted cowbane, spotted parsley, spotted water hemlock, spotted water-hemlock, water hemlock
29628	Apiaceae	*Cymopterus acaulis*	plains spring parsley, plains springparsley, stemless springparsley, wild parsley
527615	Apiaceae	*Cymopterus acaulis* var. *greeleyorum*	Greeley springparsley
536919	Apiaceae	*Lomatium dissectum* var. *eatonii*	No data
29704	Apiaceae	*Lomatium foeniculaceum* ssp. *macdougalii*	Macdougal's biscuitroot, carrot-leaf desert-parsley
526072	Apiaceae	*Lomatium triternatum* ssp. *platycarpum*	No data
-1E+07	Apiaceae	*Lomatium triternatum* ssp. *triternatum* var. *triternatum*	No data
184783	Apocynaceae	*Apocynum cannabinum* var. *glaberrimum*	No data
532381	Asclepiadaceae	*Asclepias cryptoceras* var. *davisii*	No data
30241	Asclepiadaceae	*Asclepias incarnata*	rose milkweed, swamp milkweed
30304	Asclepiadaceae	*Asclepias speciosa*	showy milkweed
-501892	Asteraceae	*Achillea millefolium* ssp. *lanulosa* var. *lanulosa*	white yarrow
36497	Asteraceae	*Ambrosia acanthicarpa*	annual bursage, bursage, bursage ragweed, flat-spine burr-ragweed, flatspine burr ragweed, sand bursage
36508	Asteraceae	*Ambrosia grayi*	bur ragweed, lagoonweed, woollyleaf burr ragweed, woollyleaf bursage, woollyleaf franseria, woollyleaf povertyweed
36727	Asteraceae	*Antennaria dimorpha*	low everlasting, low pussytoes
36546	Asteraceae	*Arctium minus*	bardane, beggar's button, burdock, common burdock, lesser burdock, lesser burrdock, small burdock, smaller burdock, wild burdock, wild rhubarb

Hagerman Fossil Beds NM Vascular Plants			
TSN	**Family**	**Standard Scientific Name**	**Standard Common Name**
35449	Asteraceae	*Artemisia arbuscula*	little sagebrush, low sagebrush
500971	Asteraceae	*Artemisia nova*	black sagebrush
35496	Asteraceae	*Artemisia spinescens*	bud sagebrush
-1E+07	Asteraceae	*Artemisia tridentata* var. *tridentata*	No data
-1E+07	Asteraceae	*Artemisia tridentata* var. *tridentata* X var. *vaseyana*	No data
532368	Asteraceae	*Artemisia tridentata* var. *vaseyana*	No data
532369	Asteraceae	*Artemisia tridentata* var. *wyomingensis*	No data
35502	Asteraceae	*Artemisia tripartita*	threetip sagebrush
35560	Asteraceae	*Aster eatonii*	Eaton's aster
36811	Asteraceae	*Balsamorhiza hookeri*	Hooker balsamroot, Hooker's balsamroot, hairy balsamroot
36818	Asteraceae	*Balsamorhiza sagittata*	arrowleaf balsamroot
35710	Asteraceae	*Bidens cernua*	bur marigold, nodding beggartick, nodding beggarticks, nodding bur marigold, nodding burmarigold, nodding burr-marigold, sticktight
35707	Asteraceae	*Bidens frondosa*	bur marigold, devil's beggartick, devil's beggarticks, devil's bootjack, devil's-pitchfork, devils beggartick, pitchfork weed, sticktight, sticktights, tickseed sunflower
526983	Asteraceae	*Brickellia microphylla* var. *microphylla*	littleleaf brickellbush
36958	Asteraceae	*Centaurea diffusa*	diffuse knapweed, diffuse knaweed, white knapweed
36964	Asteraceae	*Centaurea maculosa*	spotted knapweed
36987	Asteraceae	*Chaenactis douglasii*	Douglas dustymaiden, Douglas' dustymaiden, Douglas' pincushion, dusty maiden, dusty-maiden
533335	Asteraceae	*Chaenactis douglasii* var. *achilleifolia*	No data
37029	Asteraceae	*Chondrilla juncea*	hogbite, rush skeletonweed, skeletonweed
37055	Asteraceae	*Chrysothamnus nauseosus*	gray rabbitbrush
533554	Asteraceae	*Chrysothamnus nauseosus* var. *graveolens*	No data
533555	Asteraceae	*Chrysothamnus nauseosus* var. *hololeucus*	No data
533563	Asteraceae	*Chrysothamnus nauseosus* var. *oreophilus*	No data
533586	Asteraceae	*Chrysothamnus viscidiflorus* var. *puberulus*	No data
566625	Asteraceae	*Chrysothamnus viscidiflorus* var. *viscidiflorus*	yellow rabbitbrush
36335	Asteraceae	*Cirsium arvense*	Californian thistle, Canada thistle, Canadian thistle, creeping thistle, field thistle
36351	Asteraceae	*Cirsium canovirens*	graygreen thistle
36416	Asteraceae	*Cirsium subniveum*	Jackson Hole thistle, gray thistle
36428	Asteraceae	*Cirsium vulgare*	bull thistle, common thistle, spear thistle
527477	Asteraceae	*Conyza canadensis* var. *glabrata*	Canadian horseweed
37169	Asteraceae	*Crepis acuminata*	long-leaf hawksbeard, longleaf hawksbeard, tapertip hawksbeard
37186	Asteraceae	*Crepis modocensis*	Modoc hawksbeard, Siskiyou hawksbeard, common hawksbeard
37198	Asteraceae	*Crepis occidentalis* ssp. *conjuncta*	largeflower hawksbeard
527921	Asteraceae	*Erigeron bloomeri* var. *bloomeri*	scabland daisy, scabland fleabane

Hagerman Fossil Beds NM Vascular Plants			
TSN	**Family**	**Standard Scientific Name**	**Standard Common Name**
531624	Asteraceae	*Erigeron pumilus* ssp. *intermedius* var. *gracilior*	shaggy daisy, shaggy fleabane
35951	Asteraceae	*Erigeron strigosus*	Daisy Fleabane, prairie fleabane, rough fleabane
528052	Asteraceae	*Eriophyllum lanatum* var. *integrifolium*	common woolly sunflower, wholeleaf eriophyllum
37356	Asteraceae	*Euthamia occidentalis*	western goldenrod, western goldentop
528278	Asteraceae	*Grindelia integrifolia* var. *integrifolia*	Puget Sound gumweed
37472	Asteraceae	*Grindelia squarrosa*	Curleycup gumweed, curlycup gumweed, curlytop gumweed, gumweed, rosinweed, tarweed
528288	Asteraceae	*Grindelia squarrosa* var. *serrulata*	curly-cup gumweed, curlycup gumweed, curlytop gumweed, gumweed, rosinweed, tarweed
37483	Asteraceae	*Gutierrezia sarothrae*	Broomsnakeweed, broom snakeweed, broomweed, perennial snakeweed, stinkweed, turpentine weed, yellow top
37499	Asteraceae	*Haplopappus acaulis*	No data
528350	Asteraceae	*Helenium autumnale* var. *montanum*	mountain sneezeweed
36616	Asteraceae	*Helianthus annuus*	annual sunflower, common sunflower, sunflower, wild sunflower
36033	Asteraceae	*Iva axillaris*	Iva poverty weed, deer-root, lesser marshelder, mouseear pvertyweed, poverty sumpweed, poverty weed, povertyweed, smallflowered marshelder
515577	Asteraceae	*Lactuca pulchella*	blue lettuce
36608	Asteraceae	*Lactuca serriola*	China lettuce, prickly lettuce, wild lettuce
37863	Asteraceae	*Layia glandulosa*	white tidytips, whitedaisy tidytips
537311	Asteraceae	*Lygodesmia grandiflora* var. *dianthopsis*	No data
37984	Asteraceae	*Machaeranthera canescens*	hoary aster, hoary goldenweed, hoary machaeranthera, hoary tansy-aster, hoary tansyaster, purple aster
566724	Asteraceae	*Machaeranthera canescens* var. *sessiliflora*	hoary tansyaster
38058	Asteraceae	*Malacothrix torreyi*	Mohave aster, Torrey's desert dandelion, Torrey's desertdandelion
38140	Asteraceae	*Onopordum acanthium*	Scotch cotton thistle, Scotch cottonthistle, Scotch thistle, cotton thistle, heraldic thistle
36224	Asteraceae	*Solidago canadensis*	Canada goldenrod, Canadian goldenrod, common goldenrod
540753	Asteraceae	*Solidago gigantea* var. *serotina*	No data
38421	Asteraceae	*Sonchus arvensis*	creeping sowthistle, field sow-thistle, field sowthistle, perennial sowthistle, sowthistle
38424	Asteraceae	*Sonchus asper*	perennial sowthistle, prickly sowthistle, spiny sowthistle, spiny-leaf sow-thistle
38427	Asteraceae	*Sonchus oleraceus*	annual sowthistle, common sow-thistle, common sowthistle, pualele, sow thistle, sow-thistle
36213	Asteraceae	*Taraxacum officinale*	blowball, common dandelion, dandelion, faceclock
38497	Asteraceae	*Tetradymia glabrata*	littleleaf horsebrush
38499	Asteraceae	*Tetradymia spinosa*	shortspine horsebrush, spiny horsebrush

Hagerman Fossil Beds NM Vascular Plants			
TSN	**Family**	**Standard Scientific Name**	**Standard Common Name**
38544	Asteraceae	*Townsendia florifera*	showy Townsend daisy, showy townsendia
38564	Asteraceae	*Tragopogon dubius*	Western goat's beard, common salsify, goat's beard, goatsbeard, meadow goat's-beard, salsifis majeur, salsify, western salsify, wild oysterplant, yellow goat's beard, yellow salsify
530872	Asteraceae	*Xanthium strumarium* var. *canadense*	Canada cocklebur, Canada cockleburr, cocklebur, common cocklebur, rough cocklebur, rough cockleburr
31706	Boraginaceae	*Amsinckia tessellata*	bristly fiddleneck, western fiddleneck
31723	Boraginaceae	*Asperugo procumbens*	German mugwort, German-madwort, madwort
31793	Boraginaceae	*Cryptantha circumscissa*	cushion catseye, cushion cryptantha, matted cryptantha
31813	Boraginaceae	*Cryptantha gracilis*	narrowstem catseye, narrowstem cryptantha, narrowstem pick-me-not
31825	Boraginaceae	*Cryptantha interrupta*	Elko cryptantha
527573	Boraginaceae	*Cryptantha pterocarya* var. *pterocarya*	wingnut catseye, wingnut cryptantha
31875	Boraginaceae	*Cryptantha spiculifera*	Snake River cryptantha
527576	Boraginaceae	*Cryptantha torreyana* var. *torreyana*	Torrey's catseye
31890	Boraginaceae	*Cynoglossum officinale*	common houndstongue, gypsy-flower, gypsyflower, hound's tongue, houndstongue
31931	Boraginaceae	*Hackelia micrantha*	Jessica sticktight, meadow stickseed
528677	Boraginaceae	*Lappula occidentalis* var. *cupulata*	flat-spine sheepburr, flatspine stickseed
505521	Boraginaceae	*Tiquilia nuttallii*	Nuttall's crinklemat, Nuttall's tiquilia, rosette crinklemat
23032	Brassicaceae	*Alyssum desertorum*	desert alyssum, desert madwort
22702	Brassicaceae	*Arabis holboellii*	Holboell rockcress, Holboell's rockcress
184362	Brassicaceae	*Arabis holboellii* var. *retrofracta*	a holboell rock-cress, second rockcress
184443	Brassicaceae	*Arabis sparsiflora* var. *sparsiflora*	sicklepod rockcress
22599	Brassicaceae	*Camelina microcarpa*	false flax, little-pod false flax, littlepod false flax, littlepod falseflax, littleseed falseflax, small fruited falseflax, smallseed falseflax
22766	Brassicaceae	*Capsella bursa-pastoris*	shepardspurse, shepherd's purse, shepherd's-purse, shepherdspurse
23099	Brassicaceae	*Chorispora tenella*	beanpodded mustard, blue mustard, bluemustard, chorispora, common blue mustard, common bluemustard, crossflower, purple mustard, tenella mustard
534402	Brassicaceae	*Descurainia richardsonii* var. *sonnei*	No data
534403	Brassicaceae	*Descurainia richardsonii* var. *viscosa*	No data
22843	Brassicaceae	*Descurainia sophia*	flaxweed tansymustard, flixweed, flixweed tansymustard, herb sophia, herb-sophia, pinnate tansymustard, tansymustard
22923	Brassicaceae	*Draba verna*	spring Whitlowgrass, spring draba
22931	Brassicaceae	*Erysimum asperum*	No data
22945	Brassicaceae	*Erysimum occidentale*	pale wallflower, western wallflower
22974	Brassicaceae	*Lepidium perfoliatum*	clasping pepperweed, clasping pepperwort, claspingleaf pepperweed

Hagerman Fossil Beds NM Vascular Plants			
TSN	**Family**	**Standard Scientific Name**	**Standard Common Name**
23243	Brassicaceae	*Malcolmia africana*	African addersmouth, African malcomia, African mustard
22993	Brassicaceae	*Rorippa nasturtium-aquaticum*	watercress
539694	Brassicaceae	*Rorippa palustris* var. *hispida*	No data
23014	Brassicaceae	*Rorippa sinuata*	spreading yellowcress
23015	Brassicaceae	*Rorippa sphaerocarpa*	round-fruit yellowcress, roundfruit yellowcress
23312	Brassicaceae	*Sisymbrium altissimum*	Jim Hill mustard, tall hedge-mustard, tall mustard, tall tumblemustard, tumble mustard, tumblemustard, tumbleweed mustard
23329	Brassicaceae	*Stanleya pinnata*	desert prince'splume, desert princesplume, golden prince's-plume
23333	Brassicaceae	*Streptanthella longirostris*	longbeak fiddle mustard, longbeak streptanthella
23422	Brassicaceae	*Thlaspi arvense*	Frenchweed, fanweed, field pennycress, pennycress, stinkweed
19726	Cactaceae	*Opuntia polyacantha*	plains pricklypear
19109	Cannabaceae	*Cannabis sativa*	Mary Jane, grass, hashish, hemp, marijuana, pot
22620	Capparaceae	*Cleome lutea*	yellow beeplant, yellow spiderflower
184233	Caryophyllaceae	*Arenaria franklinii* var. *franklinii*	Franklin's sandwort
503057	Caryophyllaceae	*Holosteum umbellatum*	jagged chickweed
530371	Caryophyllaceae	*Silene scaposa* var. *lobata*	Lost River silene, lostriver campion
18403	Ceratophyllaceae	*Ceratophyllum demersum*	common hornwort, coon's tail, coon's-tail, coontail, hornwort
192226	Chenopodiaceae	*Atriplex canescens* var. *canescens*	fourwing saltbush
20519	Chenopodiaceae	*Atriplex confertifolia*	shadscale, shadscale saltbush, spiny saltbush
20536	Chenopodiaceae	*Atriplex heterosperma*	No data
532462	Chenopodiaceae	*Atriplex patula* var. *hastata*	No data
509370	Chenopodiaceae	*Atriplex spinosa*	No data
20588	Chenopodiaceae	*Bassia hyssopifolia*	fivehook bassia, fivehorn smotherweed, smother weed, smotherweed
20592	Chenopodiaceae	*Chenopodium album*	common lambsquarters, lambsquarters, lambsquarters goosefoot, white goosefoot
20687	Chenopodiaceae	*Eurotia lanata*	No data
20692	Chenopodiaceae	*Halogeton glomeratus*	barilla, halogeton, saltlover
20696	Chenopodiaceae	*Kochia scoparia*	Mexican burningbush, Mexican fireweed, Mexican-fireweed, common kochia, fireweed, kochia, mock cypress, summer cypress
20655	Chenopodiaceae	*Salsola kali*	Russian thistle, prickly Russian thistle, tumbleweed
20707	Chenopodiaceae	*Sarcobatus vermiculatus*	black greasewood, greasewood
30705	Convolvulaceae	*Convolvulus arvensis*	European bindweed, creeping jenny, field bindweed, morningglory, perennial morningglory, smallflowered morning glory
194872	Cupressaceae	*Juniperus scopulorum*	Rocky Mountain juniper
534120	Cuscutaceae	*Cuscuta pentagona* var. *calycina*	No data
39456	Cyperaceae	*Carex hystericina*	bottlebrush sedge, porcupine sedge
39458	Cyperaceae	*Carex lanuginosa*	woolly sedge
39711	Cyperaceae	*Carex nebrascensis*	Nebraska sedge

Hagerman Fossil Beds NM Vascular Plants			
TSN	**Family**	**Standard Scientific Name**	**Standard Common Name**
39767	Cyperaceae	*Carex praegracilis*	clustered field sedge, slim sedge
40030	Cyperaceae	*Eleocharis bella*	beautiful spikerush
40019	Cyperaceae	*Eleocharis palustris*	common spikerush, creeping spikerush, spikesedge
40240	Cyperaceae	*Scirpus acutus*	hardstem bulrush
40226	Cyperaceae	*Scirpus americanus*	No data
40275	Cyperaceae	*Scirpus pungens*	No data
35406	Dipsacaceae	*Dipsacus sylvestris*	Fuller's teasel, common teasel
27770	Elaeagnaceae	*Elaeagnus angustifolia*	Russian olive, Russian-olive, oleaster
17152	Equisetaceae	*Equisetum arvense*	field horsetail, scouring rush, western horsetail
17154	Equisetaceae	*Equisetum hyemale*	horsetail, scouring horsetail, scouringrush, scouringrush horsetail, tall scouring-rush, western scouringrush
17156	Equisetaceae	*Equisetum laevigatum*	horsetail, smooth horsetail, smooth scouring-rush, smooth scouringrush
17159	Equisetaceae	*Equisetum pratense*	meadow horsetail
501422	Euphorbiaceae	*Chamaesyce glyptosperma*	rib-seed sandmat, ribseed sandmat, ridgeseed spurge
565061	Euphorbiaceae	*Chamaesyce maculata*	large spurge, spotted sandmat, spotted spurge
501458	Euphorbiaceae	*Chamaesyce serpyllifolia*	thyme-leaf sandmat, thymeleaf sandmat
502543	Euphorbiaceae	*Euphorbia myrsinites*	myrtle spurge
192359	Fabaceae	*Astragalus atratus* var. *inseptus*	Fairfield milkvetch
192362	Fabaceae	*Astragalus atratus* var. *owyheensis*	Owyhee milkvetch
192389	Fabaceae	*Astragalus calycosus* var. *calycosus*	Torrey milkvetch, Torrey's milkvetch
25453	Fabaceae	*Astragalus caricinus*	buckwheat milkvetch
25515	Fabaceae	*Astragalus filipes*	basalt milkvetch, threadstalk milkvetch
192508	Fabaceae	*Astragalus geyeri* var. *geyeri*	Geyer's milkvetch
25574	Fabaceae	*Astragalus malacus*	shaggy milkvetch
25605	Fabaceae	*Astragalus nudisiliquus*	cobblestone milkvetch
192713	Fabaceae	*Astragalus purshii* var. *glareosus*	gravel milkvetch, woollypod milkvetch
192721	Fabaceae	*Astragalus purshii* var. *ophiogenes*	Snake River milkvetch
192724	Fabaceae	*Astragalus purshii var. purshii*	Pursh's milk-vetch, Pursh's milkvetch, woollypod milkvetch
25705	Fabaceae	*Astragalus toanus*	Toano milkvetch
26635	Fabaceae	*Dalea ornata*	Blue Mountain prairie clover, showy prairieclover
192912	Fabaceae	*Dalea purpurea* var. *purpurea*	Purple prairieclover, violet dalea, violet prairie clover, violet prairie-clover, violet prairieclover
-502401	Fabaceae	*Glycyrrhiza lepidota* var. *lepidota*	No data
566682	Fabaceae	*Lupinus argenteus* var. *argenteus*	silvery lupine
537009	Fabaceae	*Lupinus argenteus* var. *holosericeus*	No data
-1E+07	Fabaceae	*Lupinus pusillus* var. *pusillus*	No data
183623	Fabaceae	*Medicago sativa*	alfalfa
26149	Fabaceae	*Melilotus alba*	white sweetclover
26150	Fabaceae	*Melilotus officinalis*	yellow sweet-clover, yellow sweetclover
504645	Fabaceae	*Psoralidium lanceolatum*	dune scurfpea, lemmon scurfpea, lemon scurfpea, wild lemonweed

Hagerman Fossil Beds NM Vascular Plants			
TSN	**Family**	**Standard Scientific Name**	**Standard Common Name**
26185	Fabaceae	*Robinia pseudo-acacia*	black locust
26251	Fabaceae	*Trifolium fragiferum*	strawberry clover
29147	Geraniaceae	*Erodium cicutarium*	California filaree, alfilaree, alfilaria, cutleaf filaree, filaree, red-stem stork's-bill, redstem, redstem filaree, redstem stork's bill, stork's bill, storksbill
24452	Grossulariaceae	*Ribes aureum*	golden currant
38937	Hydrocharitaceae	*Elodea canadensis*	Canada waterweed, Canadian waterweed, broad waterweed
529255	Hydrophyllaceae	*Nama densum* var. *parviflorum*	leafy fiddleleaf
31521	Hydrophyllaceae	*Phacelia glandulifera*	sticky phacelia
504271	Hydrophyllaceae	*Phacelia heterophylla*	variable-leaf scorpion-weed, varileaf phacelia, virgate phacelia, wand phacelia
504273	Hydrophyllaceae	*Phacelia ivesiana*	Ives phacelia, Ives scorpion-weed, Ives' phacelia
43194	Iridaceae	*Iris pseudacorus*	paleyellow iris, yellow flag
39249	Juncaceae	*Juncus articulatus*	jointed rush, jointleaf rush
39223	Juncaceae	*Juncus balticus*	Baltic rush
39320	Juncaceae	*Juncus torreyi*	Torrey's rush, torrey rush
32254	Lamiaceae	*Lycopus americanus*	American bugleweed, American water horehound, American waterhorehound, cut-leaf water-horehound, water horehound, waterhorehound
32256	Lamiaceae	*Lycopus asper*	rough bugleweed, rough water-horehound
537473	Lamiaceae	*Mentha arvensis* var. *glabrata*	No data
32272	Lamiaceae	*Mentha spicata*	bush mint (spearmint), spearmint
32275	Lamiaceae	*Mentha X piperita*	peppermint
32623	Lamiaceae	*Nepeta cataria*	catmint, catnip, catwort, field balm
32798	Lamiaceae	*Scutellaria galericulata*	hooded skullcap, marsh scullcap, marsh skullcap
42590	Lemnaceae	*Lemna minor*	common duckweed, least duckweed, lesser duckweed
503361	Lemnaceae	*Lemna minuta*	least duckweed
42707	Liliaceae	*Allium acuminatum*	taper-tip onion, tapertip onion
182634	Liliaceae	*Allium bisceptrum var. bisceptrum*	twincrest onion
182610	Liliaceae	*Allium geyeri* var. *geyeri*	Geyer onion, Geyer's onion
182626	Liliaceae	*Allium nevadense* var. *nevadense*	Nevada onion
42670	Liliaceae	*Allium textile*	prairie onion, textile onion, wild onion
42784	Liliaceae	*Asparagus officinalis*	asparagus, garden asparagus, garden-asparagus
42837	Liliaceae	*Calochortus bruneaunis*	Bruneau mariposa lily
42936	Liliaceae	*Fritillaria pudica*	yellow bells, yellow fritillary, yellow missionbells, yellowbells
514632	Liliaceae	*Hemerocallis flava*	No data
43038	Liliaceae	*Smilacina stellata*	No data
43167	Liliaceae	*Zigadenus paniculatus*	foothill deathcamas, sand-corn
503757	Loasaceae	*Mentzelia albicaulis*	white blazingstar, whitestem blazingstar, whitestem stickleaf
503769	Loasaceae	*Mentzelia dispersa*	Nevada blazingstar, bushy blazingstar, scattered blazingstar

Hagerman Fossil Beds NM Vascular Plants			
TSN	**Family**	**Standard Scientific Name**	**Standard Common Name**
503779	Loasaceae	*Mentzelia laevicaulis*	blazingstar mentzelia, smoothstem blazingstar
529156	Loasaceae	*Mentzelia torreyi* var. *acerosa*	Torrey's blazingstar
27079	Lythraceae	*Lythrum salicaria*	purple loosestrife, purple loosestrife or lythrum, purple lythrum, rainbow weed, salicaire, spiked loosestrife
21836	Malvaceae	*Malva neglecta*	buttonweed, cheeseplant, cheeseweed, common mallow, dwarf mallow, roundleaf mallow
19066	Moraceae	*Morus alba*	mulberry, white mulberry
32929	Oleaceae	*Fraxinus pennsylvanica*	green ash
32996	Oleaceae	*Syringa vulgaris*	common lilac
532883	Onagraceae	*Camissonia claviformis* var. *cruciformis*	No data
-1E+07	Onagraceae	*Camissonia scapoidea* var. *scapoidea*	No data
27293	Onagraceae	*Epilobium ciliatum*	fringed willowherb, hairy willowherb, hairy willowweed
-502303	Onagraceae	*Epilobium ciliatum* var. *ciliatum*	No data
27320	Onagraceae	*Epilobium palustre*	marsh willowherb, marsh willowweed
-502619	Onagraceae	*Oenothera caespitosa* var. *caespitosa*	No data
566494	Onagraceae	*Oenothera caespitosa* var. *marginata*	No data
566496	Onagraceae	*Oenothera elata* var. *hirsutissima*	No data
-1E+07	Onagraceae	*Oenothera pallida* ssp. *pallida var. pallida*	No data
537972	Onagraceae	*Oenothera villosa* var. *strigosa*	No data
43481	Orchidaceae	*Epipactis gigantea*	giant hellebore, giant helleborine, stream orchid
34287	Orobanchaceae	*Orobanche corymbosa*	Rydberg's broomrape, flat-top broomrape
34290	Orobanchaceae	*Orobanche fasciculata*	clustered broom-rape, clustered broomrape, purple broomrape, tufted broomrape
183389	Pinaceae	*Pinus sylvestris*	Scotch pine, Scots pine
504434	Plantaginaceae	*Plantago eriopoda*	alkali plantain, red-woolly plantain, redwood plantain, redwool plantain, saline plantain
32874	Plantaginaceae	*Plantago lanceolata*	English plantain, buckhorn plantain, lanceleaf Indianwheat, lanceleaf plantain, narrowleaf plantain, ribgrass, ribwort
32907	Plantaginaceae	*Plantago patagonica*	woolly Indianwheat, woolly plantain, woolly plantian, wooly Indianwheat, wooly plantain
-1E+07	Poaceae	*Agropyron cristatum, sensu amplo*	No data
185249	Poaceae	*Agrostis capillaris*	colonial bent, colonial bentgrass
40400	Poaceae	*Agrostis stolonifera*	carpet bentgrass, creeping bent, creeping bentgrass, redtop, redtop bent, seaside bentgrass, spreading bent
41458	Poaceae	*Avena fatua*	flaxgrass, oatgrass, wheat oats, wild oat, wild oats
41459	Poaceae	*Avena sativa*	Common oats, common oat, oat, oatgrass (common), oats, wild oats
40502	Poaceae	*Bromus inermis*	awnless brome, smooth brome
40479	Poaceae	*Bromus japonicus*	Japanese brome, Japanese bromegrass, Japanese chess

Hagerman Fossil Beds NM Vascular Plants			
TSN	**Family**	**Standard Scientific Name**	**Standard Common Name**
40524	Poaceae	*Bromus tectorum*	cheat grass, cheatgrass, downy brome, early chess, military grass, wild oats
193446	Poaceae	*Dactylis glomerata*	cocksfoot, orchard grass, orchardgrass
40662	Poaceae	*Distichlis spicata*	desert saltgrass, inland saltgrass, marsh spikegrass, saltgrass, seashore saltgrass
40689	Poaceae	*Elymus cinereus*	No data
-1E+07	Poaceae	*Elymus elongatus* ssp. *ponticus*	No data
502264	Poaceae	*Elymus elymoides*	bottlebrush squirreltail, squirreltail, western bottle-brush grass
40692	Poaceae	*Elymus flavescens*	No data
512825	Poaceae	*Elymus hispidus*	No data
502267	Poaceae	*Elymus lanceolatus*	streambank wheatgrass, streamside wild rye
512839	Poaceae	*Elymus repens*	quackgrass
512844	Poaceae	*Elymus smithii*	No data
512845	Poaceae	*Elymus spicatus*	No data
40719	Poaceae	*Eragrostis cilianensis*	candy grass, lovegrass, stink grass, stinkgrass, strongscented lovegrass
41717	Poaceae	*Eremopyrum triticeum*	annual false wheatgrass, annual wheatgrass
40800	Poaceae	*Festuca arida*	No data
40810	Poaceae	*Festuca arundinacea*	Alta fescue, coarse fescue, reed fescue, tall fescue
513551	Poaceae	*Festuca octoflora*	No data
565873	Poaceae	*Festuca ovina*	No data
40822	Poaceae	*Festuca pratensis*	No data
502613	Poaceae	*Festuca trachyphylla*	hard fescue
40871	Poaceae	*Hordeum jubatum*	foxtail barley
-1E+07	Poaceae	*Hordeum marinum, sensu amplo*	No data
40874	Poaceae	*Hordeum vulgare*	Barley, cereal barley, common barley
503284	Poaceae	*Koeleria macrantha*	junegrass, prairie Junegrass
40886	Poaceae	*Leersia oryzoides*	rice cut grass, rice cutgrass
40893	Poaceae	*Lolium perenne*	italian ryegrass, perennial rye grass, perennial ryegrass
41899	Poaceae	*Muhlenbergia asperifolia*	alkali muhly, scratchgrass
41335	Poaceae	*Phalaris arundinacea*	reed canary grass, reed canarygrass
41072	Poaceae	*Phragmites australis*	common reed
41116	Poaceae	*Poa bulbosa*	bulbous blue grass, bulbous bluegrass
41082	Poaceae	*Poa compressa*	Canada bluegrass, flat-stem blue grass
-1E+07	Poaceae	*Poa pratensis, sensu amplo*	No data
-1E+07	Poaceae	*Poa secunda, sensu amplo*	No data
-1E+07	Poaceae	*Poa secunda, sensu stricto*	No data
41171	Poaceae	*Polypogon monspeliensis*	annual rabbit's-foot grass, annual rabbitsfoot grass, rabbit'sfootgrass, rabbitfoot beardgrass, rabbitfoot grass, rabbitfoot polypogon, rabbitfootgrass
41197	Poaceae	*Puccinellia distans*	European alkaligrass, spreading alkali grass, weeping alkaligrass
42081	Poaceae	*Sclerochloa dura*	common hardgrass, hardgrass, tufted hardgrass

Hagerman Fossil Beds NM Vascular Plants			
TSN	**Family**	**Standard Scientific Name**	**Standard Common Name**
42090	Poaceae	*Secale cereale*	Cultivated annual rye, cereal rye, common rye, cultivated rye, rye
41231	Poaceae	*Setaria viridis*	bottle grass, green bristle grass, green bristlegrass, green foxtail, pigeongrass, wild millet
42132	Poaceae	*Sporobolus cryptandrus*	sand dropseed
42172	Poaceae	*Stipa comata*	No data
522063	Poaceae	*Stipa hymenoides*	No data
522071	Poaceae	*Stipa thurberiana*	No data
42237	Poaceae	*Triticum aestivum*	common wheat, wheat
535005	Polemoniaceae	*Eriastrum sparsiflorum* var. *wilcoxii*	No data
-1E+07	Polemoniaceae	*Gilia congesta* var. *congesta*	No data
-1E+07	Polemoniaceae	*Gilia inconspicua* var. *inconspicua*	No data
535797	Polemoniaceae	*Gilia inconspicua* var. *sinuata*	No data
-1E+07	Polemoniaceae	*Gilia leptomeria* var. *leptomeria*	No data
31189	Polemoniaceae	*Gymnosteris nudicaulis*	nakedstem gymnosteris
31225	Polemoniaceae	*Langloisia punctata*	No data
31233	Polemoniaceae	*Leptodactylon pungens*	common pricklygilia, granite gilia, granite prickly gilia, granite prickly phlox, granite pricklygilia
31254	Polemoniaceae	*Linanthus harknessii*	Harkness' flaxflower, threeseed linanthus
537538	Polemoniaceae	*Microsteris gracilis* var. *humilior*	No data
30904	Polemoniaceae	*Phlox aculeata*	sagebrush phlox
538685	Polemoniaceae	*Phlox hoodii* var. *canescens*	No data
-502696	Polemoniaceae	*Phlox longifolia* var. *longifolia*	No data
31017	Polemoniaceae	*Polemonium micranthum*	annual jacob's-ladder, annual polemonium, liitlebell Jacob's-ladder
21090	Polygonaceae	*Eriogonum cernuum*	nodding buckwheat, nodding eriogonum, nodding wild buckwheat
528009	Polygonaceae	*Eriogonum microthecum* var. *laxiflorum*	slender buckwheat
195552	Polygonaceae	*Eriogonum ochrocephalum* var. *sceptrum*	whitewoolly buckwheat
21212	Polygonaceae	*Eriogonum ovalifolium*	cushion buckwheat, cushion wild buckwheat, ovalleaf eriogonum
528013	Polygonaceae	*Eriogonum ovalifolium* var. *ochroleucum*	cushion buckwheat
195553	Polygonaceae	*Eriogonum ovalifolium* var. *ovalifolium*	cushion buckwheat, cushion wild buckwheat
195575	Polygonaceae	*Eriogonum shockleyi* var. *shockleyi*	Shockley buckwheat, Shockley's buckwheat
21276	Polygonaceae	*Eriogonum watsonii*	Watson's buckwheat
-1E+07	Polygonaceae	*Eriogonum watsonii form deflexum*	No data
20865	Polygonaceae	*Polygonum amphibium*	water knotweed, water smartweed
20876	Polygonaceae	*Polygonum aviculare*	prostrate knotweed, yard knotweed
20915	Polygonaceae	*Polygonum persicaria*	lady's-thumb, ladysthumb, ladysthumb smartweed, smartweed, spotted knotweed, spotted ladysthumb, spotted smartweed
20937	Polygonaceae	*Rumex crispus*	Curley dock, curly dock, narrowleaf dock, sour dock, yellow dock
20980	Polygonaceae	*Rumex venosus*	veiny dock

Hagerman Fossil Beds NM Vascular Plants			
TSN	**Family**	**Standard Scientific Name**	**Standard Common Name**
20422	Portulacaceae	*Portulaca oleracea*	akulikuli-kula, common purslane, duckweed, garden purslane, little hogweed, little-hogweed, purslane, pursley, pusley, wild portulaca
39007	Potamogetonaceae	*Potamogeton crispus*	curly pondweed, curly-leaved pondweed
-1E+07	Potamogetonaceae	*Potamogeton foliosus* var. *foliosus*	No data
39010	Potamogetonaceae	*Potamogeton pectinatus*	sago pondweed
39017	Potamogetonaceae	*Potamogeton pusillus*	baby pondweed, small pondweed
527664	Ranunculaceae	*Delphinium nuttallianum* var. *nuttallianum*	Nuttal's larkspur
18783	Ranunculaceae	*Myosurus aristatus*	bristle mousetail
18786	Ranunculaceae	*Myosurus minimus*	No data
194946	Ranunculaceae	*Ranunculus cymbalaria* var. *cymbalaria*	alkali buttercup
529968	Ranunculaceae	*Ranunculus glaberrimus* var. *glaberrimus*	sagebrush buttercup
18649	Ranunculaceae	*Ranunculus testiculatus*	bur buttercup, curveseed butterwort, little bur, testiculate buttercup
182033	Rosaceae	*Amelanchier alnifolia* var. *alnifolia*	Saskatoon service-berry, Saskatoon serviceberry
539216	Rosaceae	*Potentilla gracilis* var. *pulcherrima*	No data
24769	Rosaceae	*Prunus armeniaca*	apricot
24765	Rosaceae	*Prunus persica*	peach
24806	Rosaceae	*Prunus virginiana*	Virginia chokecherry, chokecherry, chokecherry (common), common chokecherry
25290	Rosaceae	*Purshia tridentata*	antelope bitterbrush
530129	Rosaceae	*Rosa woodsii* var. *ultramontana*	Woods' rose
24852	Rosaceae	*Rubus discolor*	Himalaya blackberry, Himalayan blackberry
34806	Rubiaceae	*Galium trifidum*	small bedstraw, three-petal bedstraw, threepetal bedstraw
22449	Salicaceae	*Populus deltoides* var. *occidentalis*	No data
195735	Salicaceae	*Populus trichocarpa*	No data
22499	Salicaceae	*Salix amygdaloides*	peach-leaf willow, peachleaf willow
-502874	Salicaceae	*Salix exigua ssp. exigua* var. *exigua*	No data
-502875	Salicaceae	*Salix exigua ssp. exigua* var. *stenophylla*	No data
22550	Salicaceae	*Salix lasiandra*	pacific willow
540235	Salicaceae	*Salix rigida* var. *watsonii*	No data
24395	Saxifragaceae	*Lithophragma glabrum*	bulbous woodland-star, bulbous woodlandstar, smooth woodlandstar
527192	Scrophulariaceae	*Castilleja angustifolia* var. *angustifolia*	northwestern Indian paintbrush
33113	Scrophulariaceae	*Castilleja exilis*	No data
33534	Scrophulariaceae	*Collinsia parviflora*	blue-eyed Mary, littleflower collinsia, maiden blue eyed Mary, small-flower blue-eyed mary, smallflower blue eyed Mary
33574	Scrophulariaceae	*Cordylanthus ramosus*	Busby bird's-beak, bushy bird's beak, bushy birdbeak, muchbranched bird'sbeak
33236	Scrophulariaceae	*Mimulus guttatus*	common monkeyflower, seep monkeyflower
529457	Scrophulariaceae	*Penstemon acuminatus* var. *latebracteatus*	sharpleaf penstemon
33684	Scrophulariaceae	*Penstemon cyaneus*	blue penstemon
33977	Scrophulariaceae	*Penstemon perpulcher*	Minidoka beardtongue

Hagerman Fossil Beds NM Vascular Plants			
TSN	**Family**	**Standard Scientific Name**	**Standard Common Name**
33394	Scrophulariaceae	*Verbascum thapsus*	big taper, common mullein, flannel mullein, flannel plant, great mullein, mullein, velvet dock, velvet plant, woolly mullein
565594	Scrophulariaceae	*Veronica anagallis-aquatica*	blue water speedwell, water speedwell
30414	Solanaceae	*Solanum dulcamara*	European bittersweet, bitter nightshade, bittersweet nightshade, blue nightshade, climbing nightshade, fellenwort, woody nightshade
30461	Solanaceae	*Solanum triflorum*	cut-leaf nightshade, cutleaf nightshade
505272	Solanaceae	*Solanum tuberosum*	Irish potato
22309	Tamaricaceae	*Tamarix parviflora*	saltcedar, small-flower tamarisk, smallflower tamarisk, tamarisk, tamarix
22310	Tamaricaceae	*Tamarix ramosissima*	salt cedar, salt-cedar, saltcedar, tamarisk, tamarix
42326	Typhaceae	*Typha latifolia*	broadleaf cattail, cattail, cattail (common), common cattail
19049	Ulmaceae	*Ulmus americana*	American elm
19055	Ulmaceae	*Ulmus parvifolia*	Chinese elm, lacebark elm
19056	Ulmaceae	*Ulmus procera*	English elm
19057	Ulmaceae	*Ulmus pumila*	Chinese elm, Siberian elm
-1E+07	Urticaceae	*Urtica dioica ssp. gracilis* var. *gracilis*	No data
-1E+07	Urticaceae	*Urtica dioica ssp. gracilis* var. *holosericea*	No data
35383	Valerianaceae	*Plectritis macrocera*	longhorn plectritis, white cornsalad
32085	Verbenaceae	*Verbena bracteata*	bigbract verbena, bracted vervain, carpet vervain, prostrate verbena, prostrate vervain
22042	Violaceae	*Viola beckwithii*	Beckwith's violet
39068	Zannichelliaceae	*Zannichellia palustris*	horned pondweed, horned poolmat, horned-pondweed
29057	Zygophyllaceae	*Tribulus terrestris*	Mexican sandbur, Texas sandbur, bullhead, caltrop, goathead, puncture vine, puncturevine

APPENDIX F: Photo Interpretation Mapping Conventions and Visual Key

Hagerman Fossil Beds National Monument - Map Units

This section describes the map units for the Hagerman Fossil Beds National Monument Vegetation Classification and Mapping Project. Its purpose is to:

- Describe the vegetation of each map unit;
- Provide a ground photo image for each map unit;
- Describe the link between each map unit and the U.S. National Vegetation Classification;
- Provide visual examples of each map unit with aerial photographs and delineated overlays.

The map units for HAFO were based on a combination of NVCS plant associations/alliances, local requests (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. Lookup tables that include the names of each code are included on the DVD. Non-vegetated map units are not described in this key.

Each map unit is described by a variety of characteristics and features. These include vegetation descriptions, a ground photograph and typical digital imagery signatures taken from the 2006 true color NAIP digital orthophoto used as a basemap for this project. Many of the map unit descriptions rely heavily on the vegetation plot data collected in 2007.

The sample ground photographs were taken during the 2007 plot data collection or during the 2007 accuracy assessment by Northwest Management, Inc.

Forests and Woodlands

Map Code 1 — ***Ulmus americana / Bromus tectorum* Woodland**
American Elm / Cheatgrass Woodland

Common Species

Ulmus americana,
Bromus tectorum,
Elaeagnus angustifolia,
Elymus cinereus,
Ericameria nauseosa,
Sarcobatus vermiculatus,
Salix lucidia,
Salix exigua,
Artemisia tridentata var. wyomingensis

NVCS Association

Ulmus americana / Bromus tectorum Woodland

Representative Ground Photo

Description

This map unit occurred in HAFO as a few small stands located in disturbed mesic draws, low spots and along the Snake River. Stands of this class usually occurred adjacent to and intermixed with other trees, especially Russian olive and cottonwoods. Introduced and exotic species were common. The elm trees were generally small, often less than 15 meters tall. On the 2006 imagery the elm trees had a very dark green signature compared to the ligher pale green of the Russian-olive. Mapping of this type was based partly on its signature and partially on its landscape location and where it was known to occur.

Range and Distribution

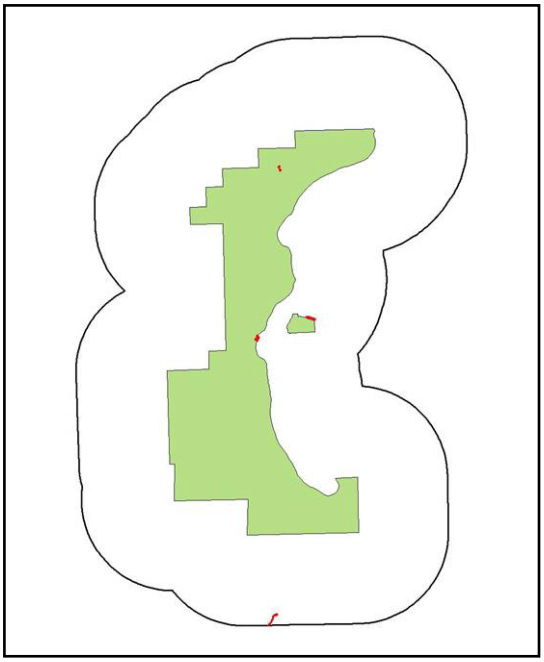


Photo Signature Example

Map Code ***Elaeagnus angustifolia*** **Woodland Alliance**
2 **Russian-olive Woodland**

Common Species

Elaeagnus angustifolia,
Bromus tectorum,
Chrysothamnus nauseosus,
Sarcobatus vermiculatus,
Artemisia tridentata var. wyomingensis

Representative Ground Photo

NVCS Associations

Elaeagnus angustifolia / Bromus tectorum Semi-natural Woodland
Elaeagnus angustifolia / Equisetum laevigatum Semi-natural Woodland
Elaeagnus angustifolia / Leymus cinereus Semi-natural Woodland
Elaeagnus angustifolia / Poa secunda Semi-natural Woodland
Elaeagnus angustifolia / Purshia tridentata / Leymus cinereus Semi-natural Woodland
Elaeagnus angustifolia / Rhus trilobata var. trilobata - Rosa woodsii Semi-natural Woodland
Elaeagnus angustifolia / Sarcobatus vermiculatus / Mesic Graminoids Semi-natural Woodland

Description

Russian olive trees were common throughout the study area and were found in much of the riparian zone along the Snake River and its tributaries and in mesic upland pockets. Polygons of this map unit contained high levels of introduced and exotic species although some natives were also present. Adjacent polygons often contained other tree species such as elms and cottonwoods. This map unit had a very distinct pale, blue-green signature and individual trees could be discerned on the 2006 imagery allowing for straight-forward mapping.

Range and Distribution

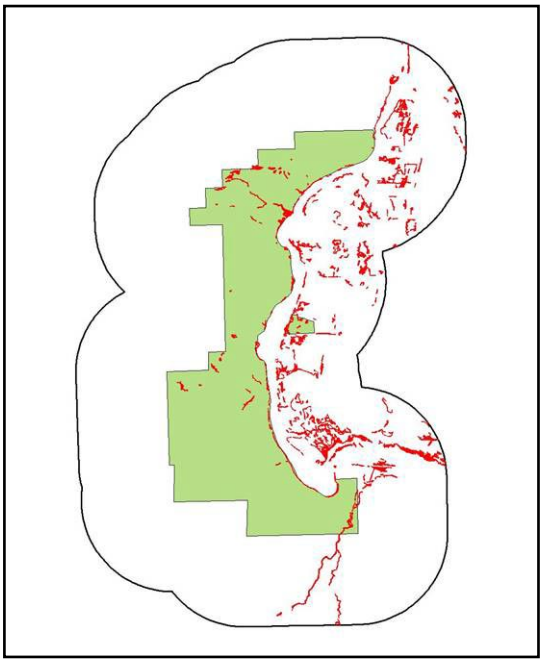


Photo Signature Example

Map Unit 3 — *Populus angustifolia / Typha latifolia* Woodland
Narrowleaf Cottonwood / Broadleaf Cattail Woodland

Common Species
Populus angustifolia,
Typha latifolia,
Elaeagnus angustifolia,
Ribes aureum,
Sarcobatus vermiculatus,
Chrysothamnus viscidiflorus,
Cirsium arvense,
Poa pratensis

Representative Ground Photo

NVCS Association
Populus angustifolia / Typha latifolia Woodland

Description
Narrowleaf cottonwoods were fairly rare in the project area, occurring in the southwest portion in wet areas along a major tributary of the Snake River and in a very small stand directly adjacent to the river. Stands of this type contained many native species in the understory and often occurred next to stands of other trees such as Russian olive. On the 2006 imagery this map unit had a distinct rough texture (due the even aged stand of trees) and appeared as a darker green than the Russian olive map unit. Some confusion may have occurred in the mapping between this type and the other cottonwood map unit due to their similarity.

Range and Distribution

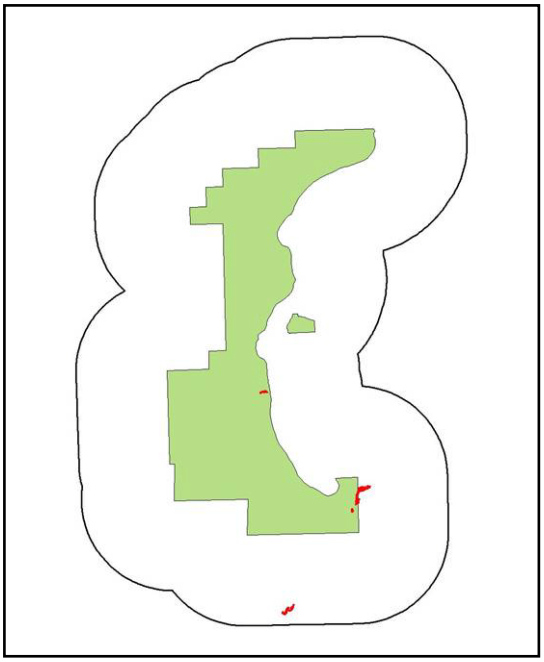
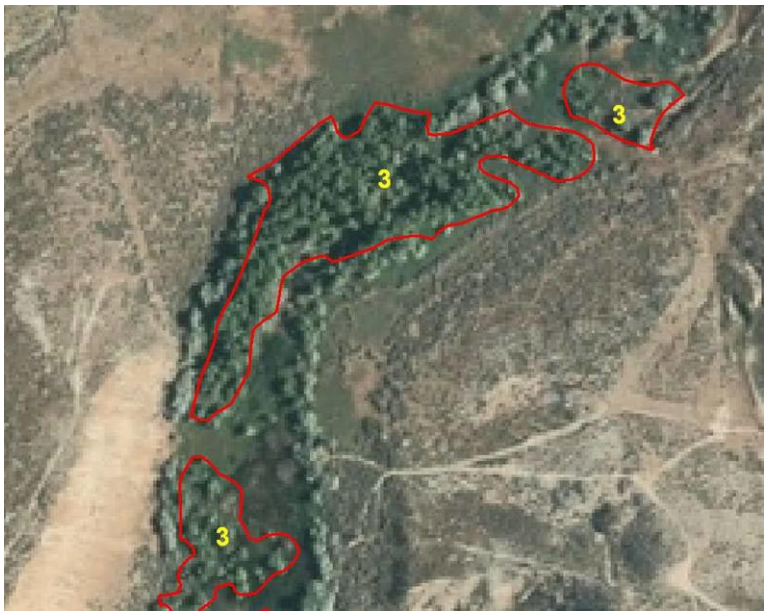


Photo Signature Example



Map Unit 4 ***Populus balsamifera ssp. trichocarpa - Elaeagnus angustifolia / Bromus tectorum* Woodland**
Black Cottonwood – Russian-olive / Cheatgrass Woodland

Common Species

Populus balsamifera ssp. trichocarpa,
Elaeagnus angustifolia,
Bromus tectorum,
Salix exigua,
Salix spp.

NVCS Association

Populus balsamifera ssp. trichocarpa - Elaeagnus angustifolia / Bromus tectorum Woodland

Representative Ground Photo

Description

This map unit was fairly common in the environs and occurred within HAFO only on the east side of the Snake River and in one small stand along the river on the west side. Polygons of this map unit tended to occur in strips along drainages and in riparian areas. In the environs this type was found in stands that may have been planted. This type was mapped from the 2006 imagery where it appeared as large trees with a dark green signature. This type did appear similar to the other cottonwood map unit although the black cottonwood trees usually appeared larger with more robust crowns.

Range and Distribution

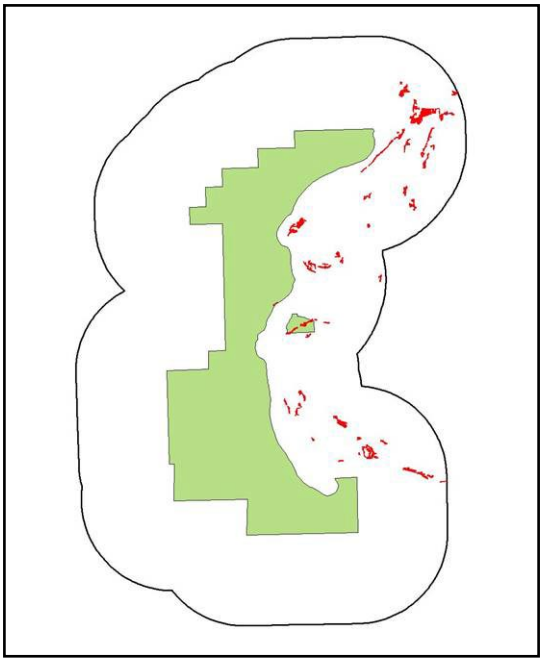


Photo Signature Example

Shrublands

Map Unit 5 — ***Artemisia tridentata ssp. wyomingensis* Shrubland Alliance**
Wyoming Big Sagebrush Shrubland Alliance

Representative Ground Photo

Common Species

Artemisia tridentata ssp. wyomingensis,
Poa secunda, Atriplex canescens,
Achnatherum hymenoides,
Chrysothamnus viscidiflorus,
Atriplex confertifolia, Bromus tectorum,
Hesperostipa comata

NVCS Associations

Artemisia tridentata ssp. wyomingensis / Achnatherum hymenoides Shrubland
Artemisia tridentata ssp. wyomingensis / Hesperostipa comata Shrubland
Artemisia tridentata ssp. wyomingensis / Poa secunda Shrubland
Artemisia tridentata ssp. wyomingensis - Atriplex confertifolia Shrubland
Artemisia tridentata spp. wyomingensis - Chrysothamnus viscidiflorus / Achnatherum hymenoides Shrubland

Description

This was a very common map unit occurring on upland slopes, benches and terraces. This map unit also occurred as a sparse type on some of the more vegetated badland slopes. Although cheatgrass was usually present it did not dominate the understory as with Map Class 6. Instead, native bunch grasses and dwarf shrubs were common varying in presence and density depending on the soil type and moisture availability. On the 2006 imagery this type varied in appearance from dispersed small gray dots against a white or tan background (sparse situations) to a more homogenous gray mottled texture (dense stands). Due to the similarity in size, shape and color to the dominate shrubs this type was likely confused with Map Units 6, 8 and 9 during mapping.

Range and Distribution

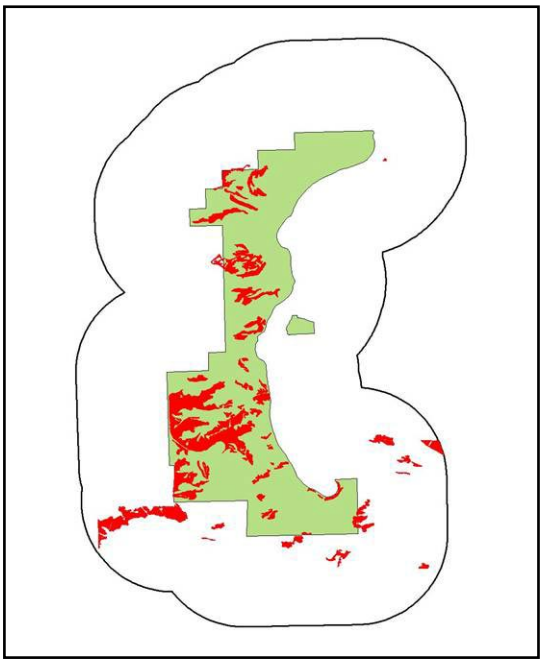
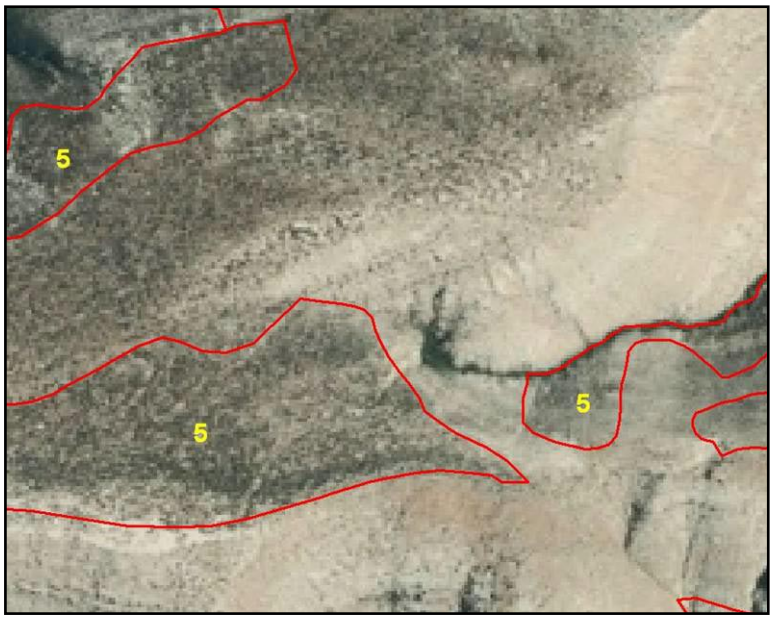


Photo Signature Example



Map Unit 6 — *Artemisia tridentata ssp. wyomingensis / Bromus tectorum* Shrubland Alliance
Wyoming Big Sagebrush / Cheatgrass Shrubland Alliance

Common Species
Artemisia tridentata ssp. wyomingensis,
Poa secunda,
Atriplex canescens,
Achnatherum hymenoides,
Chrysothamnus viscidiflorus,
Atriplex confertifolia,
Bromus tectorum,
Hesperostipa comata

Representative Ground Photo

NVCS Associations
Artemisia tridentata ssp. wyomingensis / Bromus tectorum Semi-natural Shrubland
Artemisia tridentata ssp. wyomingensis / Bromus tectorum Semi-natural Shrub Herbaceous Vegetation

Description
This map unit was widespread throughout the project area occurring on upland terraces, slopes and valleys. Much like Map Unit 5, this type occurred as both dense shrublands on flat plains and as sparse shrublands on eroding slopes. This unit is characterized by the high cover of cheatgrass in the understory, often excluding all other vegetation except the sagebrush. In some areas the sagebrush appeared nearly dead due to fire or insect infestations. On the 2006 imagery this unit had similar signatures as Map Unit 5 (grey dots = sparse and a grey mottled = dense) but contained a very strong orange-yellow background color due to the high cover of cheatgrass. Since this map unit contained many of the same species as the other sagebrush map units, some confusion likely occurred when trying to delineate between them.

Range and Distribution

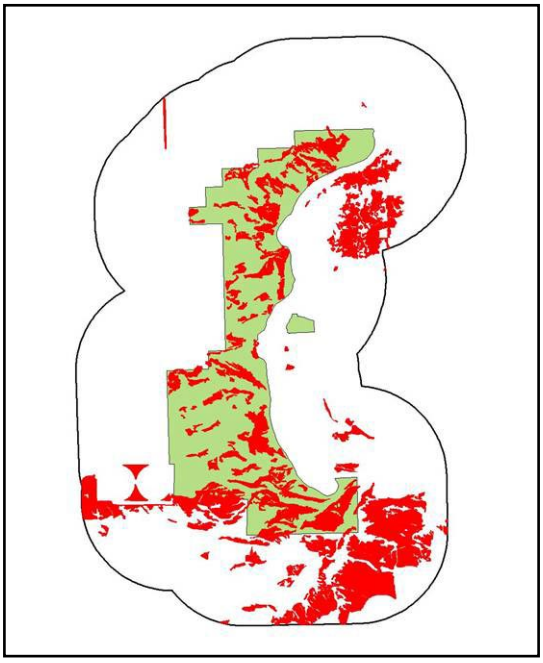
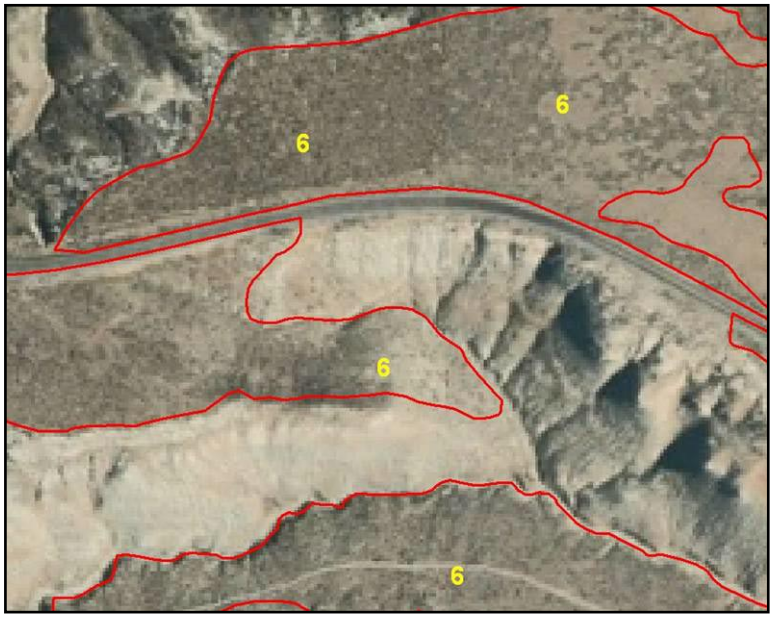


Photo Signature Example



Map Unit	*Artemisia tridentata ssp. tridentata / Bromus tectorum* Shrubland Alliance
8	Basin Big Sagebrush / Cheatgrass Shrubland Alliance

Common Species

Artemisia tridentata ssp. tridentata,
Bromus tectorum

NVCS Association

Artemisia tridentata ssp. tridentata / Bromus tectorum Semi-natural Shrubland

Representative Ground Photo

Description

Of the three sagebrush map units this type was less prevalent, occurring primarily in the northern portion of the study area and in some valley bottoms in the southwest corner. On HAFO this type often intermixed with Wyoming Big Sagebrush. Basin Big Sagebrush was only found to occur with cheatgrass in the understory although small pockets with native species may exist. On the 2006 imagery Basin Big Sagebrush normally appeared as larger individual shrubs (i.e. bigger grey dots) than the Wyoming Big Sagbrush. However, the cheatgrass background color was very similar to the other cheatgrass map units (orange-yellow). Since this map unit contained many of the same species as the other sagebrush map units, some confusion likely occurred when trying to delineate between them.

Range and Distribution

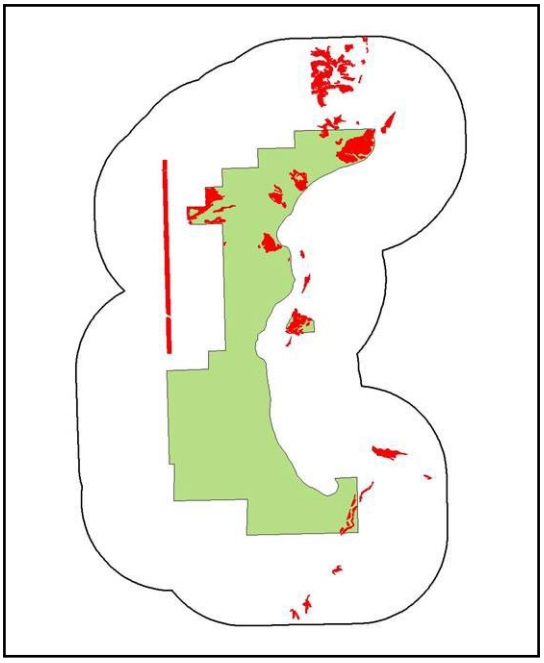
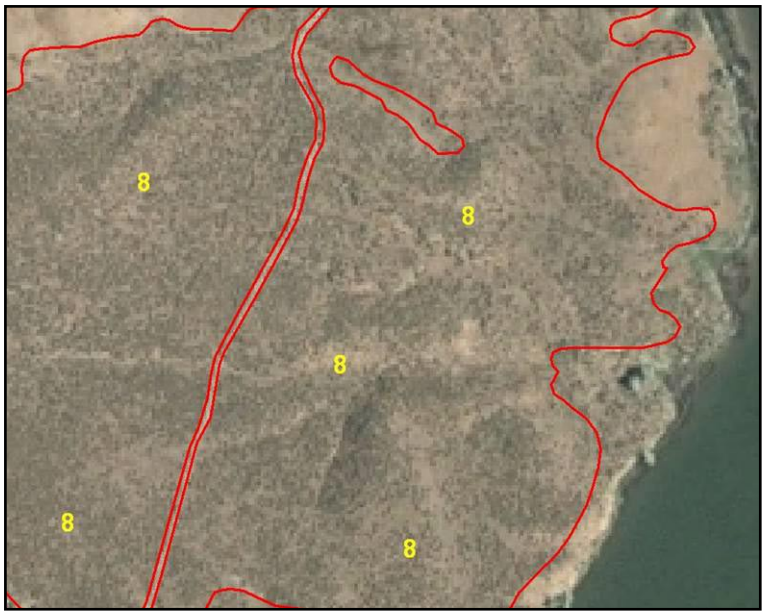


Photo Signature Example



Map Unit 9 Sparsely Vegetated Badlands Complex

Common Species

Atriplex canescens var. canescens, Atriplex confertifolia, Eriogonum microthecum, Eriogonum ovalifolium, Krascheninnikovia lanata, Purshia tridentata, Bromus tectorum, Achnatherum hymenoides, Poa secunda

Representative Ground Photo

NVCS Associations

Atriplex canescens / Leymus cinereus Shrubland
Atriplex canescens / Achnatherum hymenoides Shrubland
Atriplex canescens / Poa secunda - Bromus tectorum Shrubland
Atriplex confertifolia / Achnatherum hymenoides Shrubland
Atriplex confertifolia - Picrothamnus desertorum / (Achnatherum hymenoides) - Bromus tectorum Semi-natural Shrubland
Eriogonum microthecum / Achnatherum hymenoides Dwarf-shrubland
Eriogonum ovalifolium / Achnatherum hymenoides Dwarf-shrubland
Krascheninnikovia lanata / Poa secunda Dwarf-shrubland Dwarf-shrubland

Description

This was a common type throughout the project area, representing the sparse vegetation found on many of the eroding badland slopes characteristic of HAFO. This map class combined multiple alliances including saltbushes, buckwheats and winterfat. Of the three, the saltbushes were probably the most common occurring in varying degrees of cover. The buckwheats were less prevalent occurring in the more barren areas in the southern half of the Monument and winterfat was only documented as the dominate in a couple of polygons. On the imagery this type varied from a solid white, orange, tan, or brown depending on soil color. Under magnification some vegetation was visible as grey smudges and this characteristic was used to separate this map unit from the Badlands (Map Unit 24)

Range and Distribution

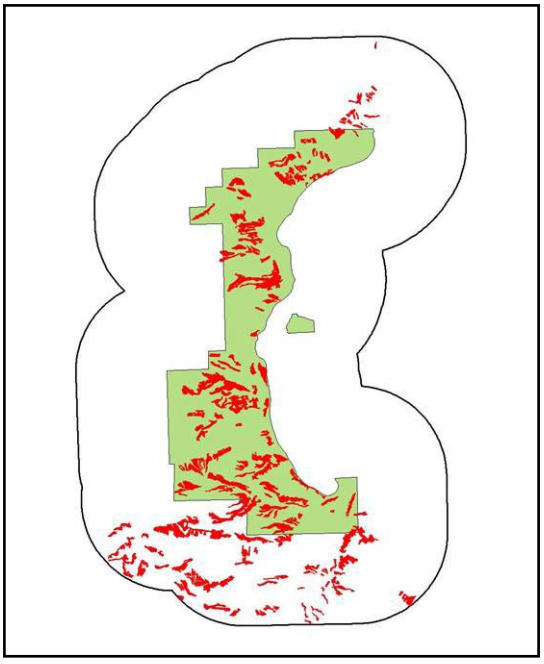
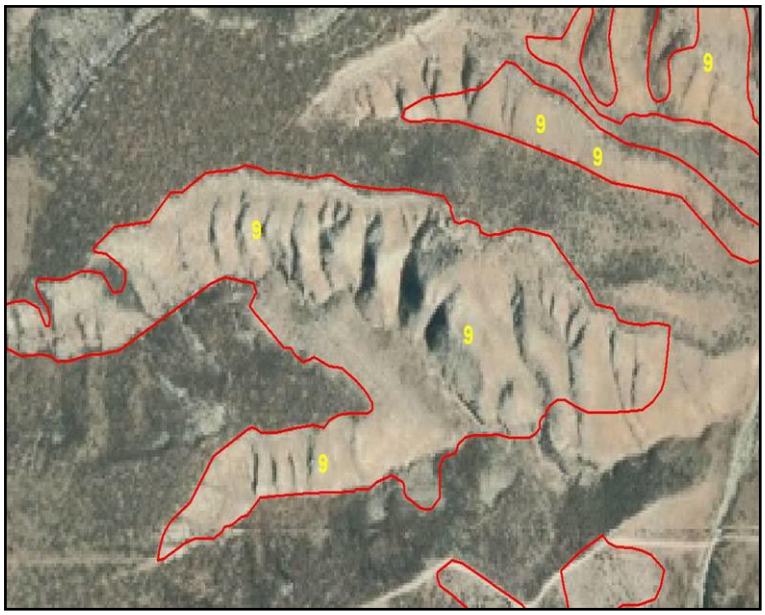


Photo Signature Example



Map Unit 10 — *Tamarisk ramosissima* Shrubland Stand / Salt Cedar Shrubland Stand

Common Species
Tamarisk ramosissima,
Bromus tectorum,
Ericameria nauseosa

NVCS Alliance
Tamarisk ramosissima Semi-natural Temporarily Flooded Shrubland Alliance

Representative Ground Photo

Description
This map unit only occurred in four known sites clustered together in the center of the Monument. The type was mapping off the 2006 imagery and recent control efforts may have reduced or eliminated these polygons since the mapping occurred. On the imagery this type had a olive-green mottled signature against a tan background. The shrubs appeared short to medium in stature and varied from dense to sparse in cover.

Range and Distribution

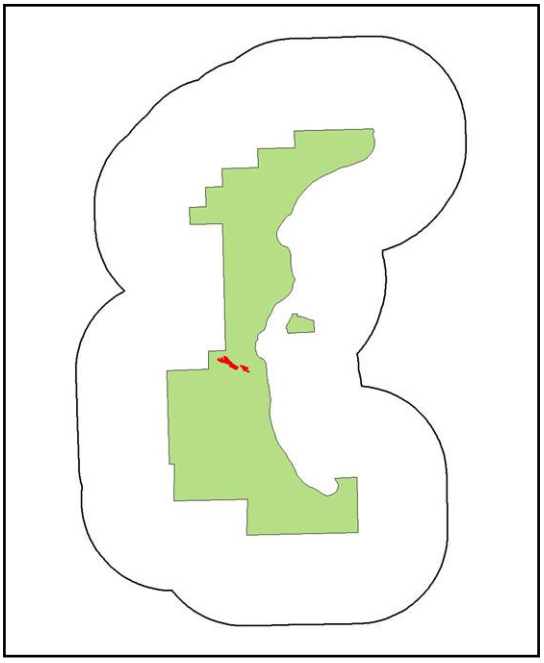
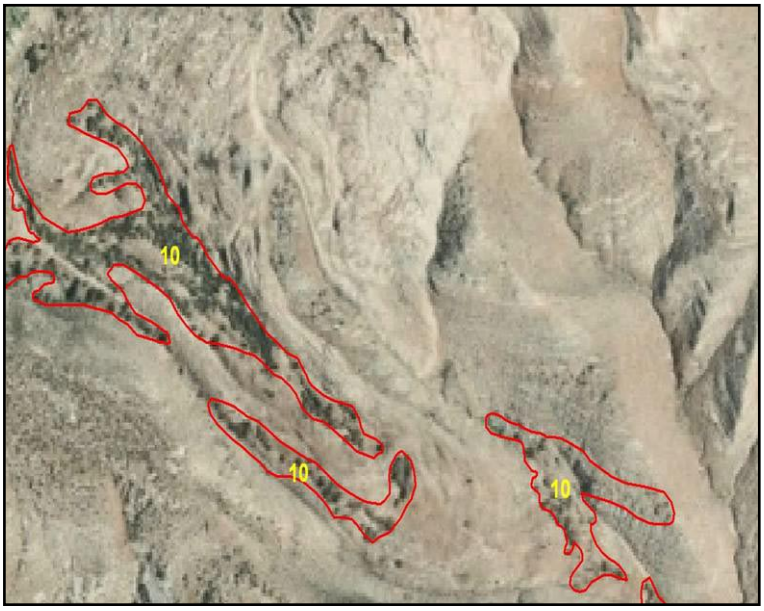


Photo Signature Example



Map Unit 11 — *Ericameria (Chrysothamnus)* spp. Shrubland Complex / Rabbitbrush Shrubland Complex

Common Species

Ericameria nauseosa,
Chrysothamnus viscidiflorus,
Achnatherum hymenoides,
Bromus tectorum,
Chrysothamnus viscidiflorus,
Hesperostipa comata,
Artemisia tridentata ssp. wyomingensis

NVCS Associations

Ericameria nauseosa - Chrysothamnus viscidiflorus / (Achnatherum hymenoides) - Bromus tectorum Semi-natural Shrubland
Chrysothamnus viscidiflorus / Hesperostipa comata Shrubland

Representative Ground Photo

Description

Stands of this type were common throughout the project area with rubber rabbitbrush more common on disturbed, flat uplands and the green rabbitbrush on rolling hills and eroding slopes. This map unit often intermixed with the sagebrush map units and often contained similar associated species such as cheatgrass. On the 2006 imagery, this type had a characteristic smooth green signature that varied from solid green in dense stands of rubber rabbitbrush to light green with a tan background for green rabbitbrush dominated sites.

Range and Distribution

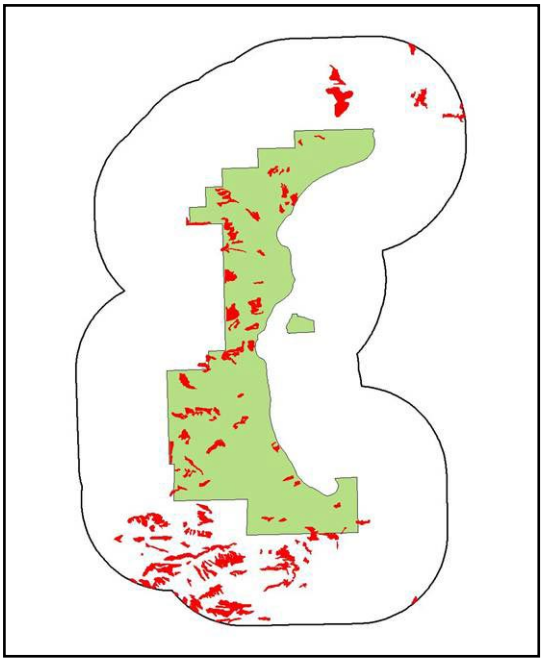


Photo Signature Example

Map Unit ***Purshia tridentata*** **Shrubland Alliance**
12 **Bitterbrush Shrubland Alliance**

Common Species

Purshia tridentate,
Ribes aureum,
Chrysothamnus nauseosus,
Chrysothamnus viscidiflorus,
Bromus tectorum,
Elymus cinereus,
Elymus elymoides,
Achnatherum hymenoides,
Artemisia tridentata ssp. wyomingensis

NVCS Associations

Purshia tridentata / Achnatherum hymenoides Shrubland
Purshia tridentata / Elymus elymoides Shrubland

Representative Ground Photo

Description

Small stands of bitterbrush were observed in throughout the project area primarily on eroding badland slopes. Although bitterbrush was found throughout the project area associated with the sagebrush and the sparsely vegetated badlands types it was only mapped when the bitterbrush had relatively high cover. This type was characterized by having small to medium-sized plants that appeared as dark grey circles on the 2006 imagery. Where it was dense, the bitterbrush had a mottled to smooth appearance and when it was sparse it had a tan or brown background.

Range and Distribution

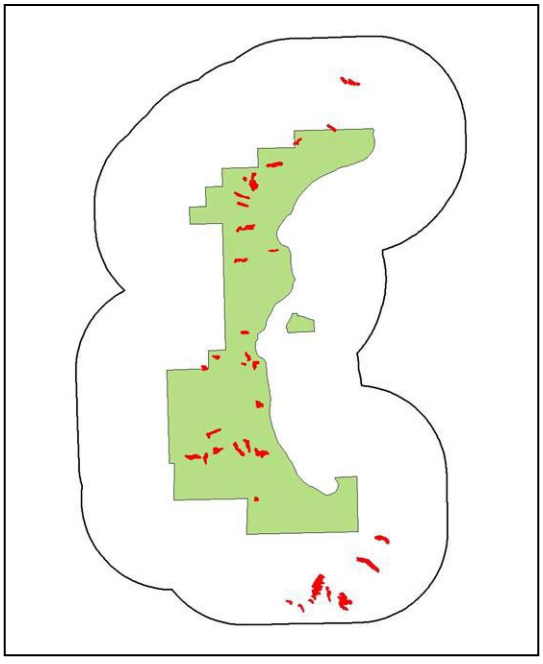
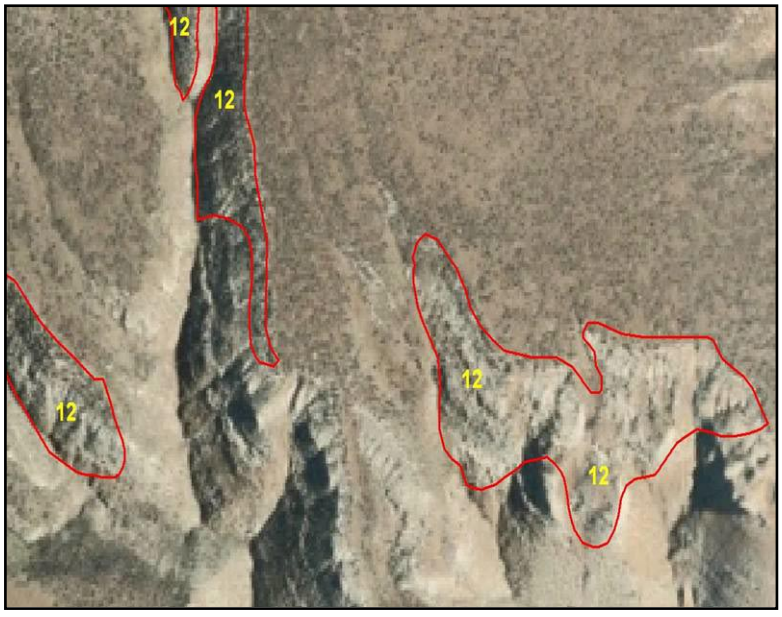


Photo Signature Example



Map Unit	***Salix exigua* - *Salix lucida ssp. caudata* Shrubland Complex**
13	**Coyote Willow – Whiplash Willow Shrubland Complex**

Common Species

Salix exigua,
Salix lucidia,
Artemisia tridentata var. wyomingensis,
Bromus tectorum,
Elymus cinereus,
Typha latifolia

Representative Ground Photos

NVCS Associations

Salix exigua / Barren Shrubland
Salix exigua / Mesic Forbs Shrubland
Salix lucida ssp. caudata / Thinopyrum intermedium Semi-natural Shrubland

Description

Small stands of willow were observed in riparian and mesic sites throughout the project area, often intermixed or occurring adjacent to the cottonwood and Russian olive map units. This type is characterized by having small to medium-sized willow shrubs often with associated trees. When the willows were small (mostly *Salix exigua*) they appeared as a slightly mottled to smooth light green signature changing to a more dark green when they became larger (likely *Salix lucidia*). Due to the close similarity of their signatures and their intermixing, the two species of willow could not be accurately separated in the mapping.

Range and Distribution

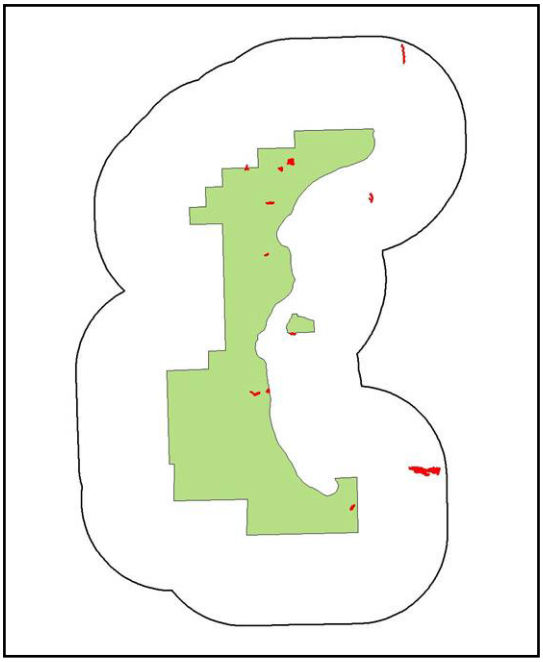
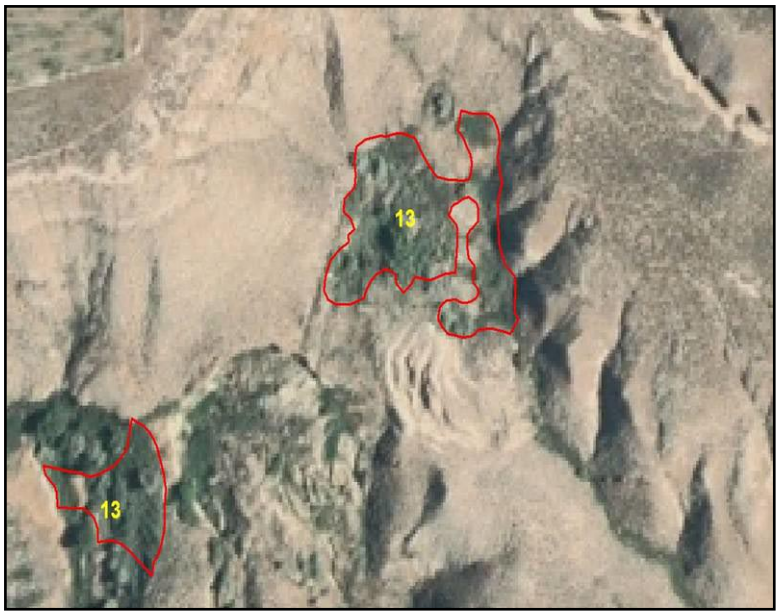


Photo Signature Example



Map Unit	*Sacobatus vermiculatus* Intermittently Flooded Shrubland Alliance
14	Black Greasewood Intermittently Flooded Shrubland Alliance

Common Species

Sarcobatus vermiculatus,
Bromus tectorum,
Leymus cinereus,
Artemisia tridentata ssp. wyomingensis,
Artemisia tridentata ssp. tridentata

NVCS Association

Sarcobatus vermiculatus / Bromus tectorum Semi-natural Shrubland
Sarcobatus vermiculatus / Leymus cinereus Shrubland

Representative Ground Photo

Description

Greasewood was a common map unit throughout the floodplains along the Snake River and its tributaries. Polygons of this type often contained cheatgrass in the understory along with similar species found in the sagebrush map units. On the 2006 imagery this type appeared as dark dots against a tan or brown background. When greasewood occurred in higher densities it often had a rougher signature and was less brown and greyer in appearance.

Range and Distribution

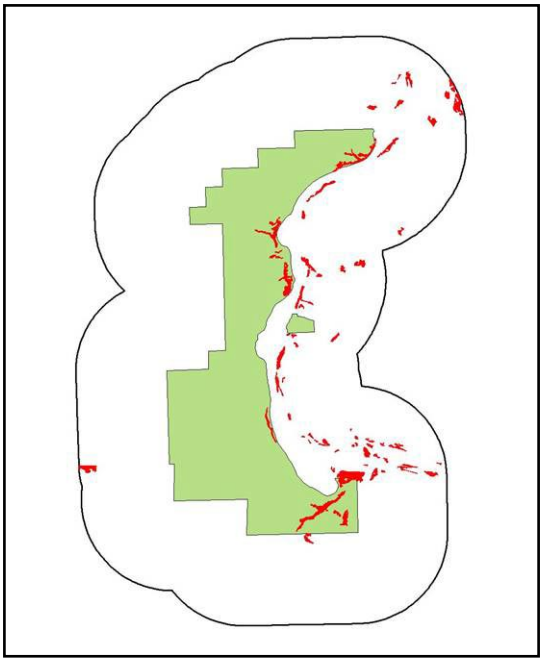


Photo Signature Example

Map Unit 15 — *Rhus trilobata / Ribes aureum* Shrubland Stand
Skunkbush – Golden Currant Shrubland Stand

Common Species
Rhus aromatica var. trilobata,
Typha latifolia,
Ribes aureum,
Elymus cinereus,
Bromus tectorum

NVCS Alliance
Rhus trilobata Intermittently Flooded Shrubland Alliance

Representative Ground Photo

Description
Two small stands of skunkbush sumac were observed in HAFO along mesic drainages. These two stands were the only mapable stands and no plot sampling was conducted in this type due to their small size. This type is characterized by having medium-sized skunkbush shrubs occurring in thick, dense stands with few associated species. Stands of this type may also have occurred in the environs where they intermixed or where the dominate understory species in cottonwood and Russian-olive polygons. On the 2006 imagery this type appeared as very dark green, smooth stands. Due to their height, the skunkbushes also had a rough signature that contrasted sharply with the surrounding badlands.

Range and Distribution

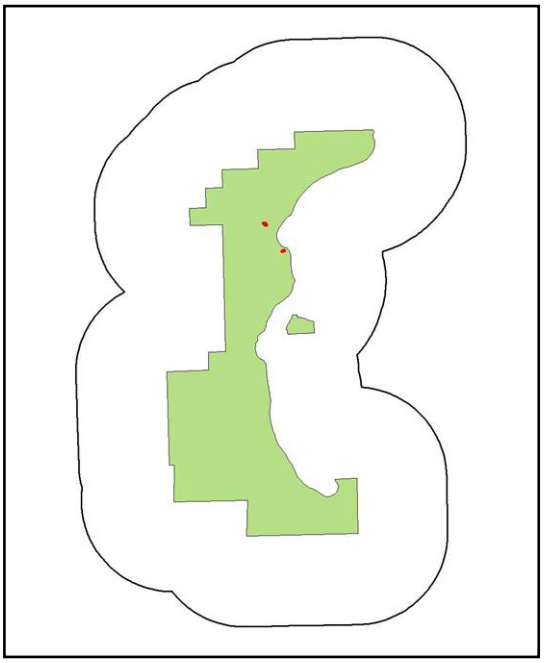


Photo Signature Example

Herbaceous Vegetation

Map Unit 18 — ***Agropyron cristatum / Sisymbrium altissimum* Herbaceous Vegetation**
Crested Wheatgrass / Tumble Mustard Herbaceous Vegetation

Representative Ground Photo

Common Species
Agropyron cristatum
Sisymbrium altissimum
Bromus tectorum

NVCS Association
Agropyron cristatum / Sisymbrium altissimum
Herbaceous Vegetation

Description
This type was used to map primarily pasture and previously cultivated lands that were planted with crested wheatgrass. These areas occurred primarily in the western environs in large flat fields. On the 2006 imagery this type usually had a dark brown-grey color and old field lines were apparent. Mapping of this type like includes areas with high cheatgrass cover and possibly some pockets of native grasses.

Range and Distribution

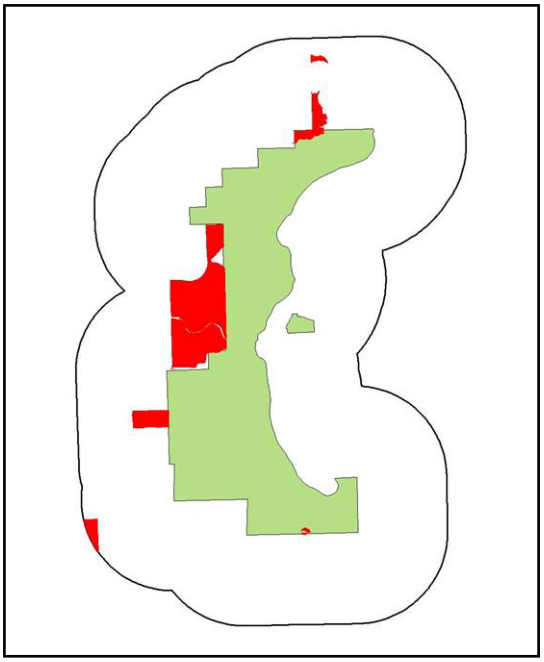


Photo Signature Example

Map Unit	*Bromus tectorum / Sisymbrium altissimum Herbaceous Vegetation*
19	**Cheatgrass / Tumble Mustard Herbaceous Vegetation**

Common Species

Bromus tectorum,
Sisymbrium altissimum

NVCS Association

Bromus tectorum / Sisymbrium altissimum
Herbaceous Vegetation

Representative Ground Photo

Description

Cheatgrass was very common at HAFO and this map unit was used to map large areas containing very little shrub cover. Stands of cheatgrass ranged from thick, lush stands on flat uplands to sparser areas within the badlands. This map unit was also used to map areas that were recently burned or where the sagebrush was dead. On the 2006 imagery stands of cheatgrass with sufficient cover (>20%) had a characteristic smooth, orange brown color.

Range and Distribution

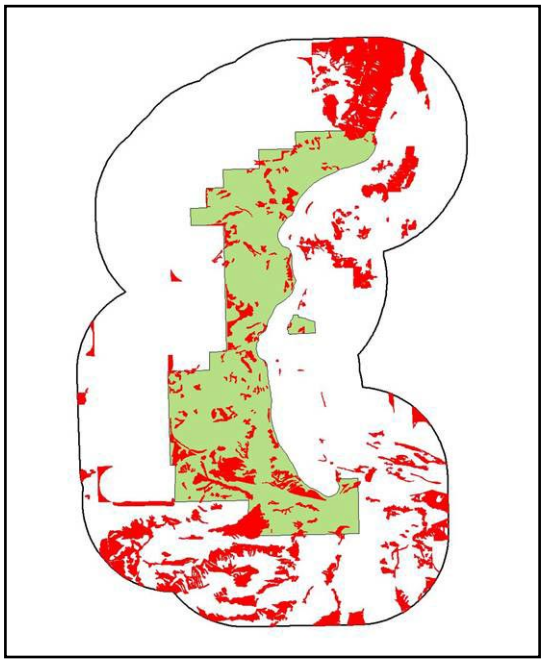
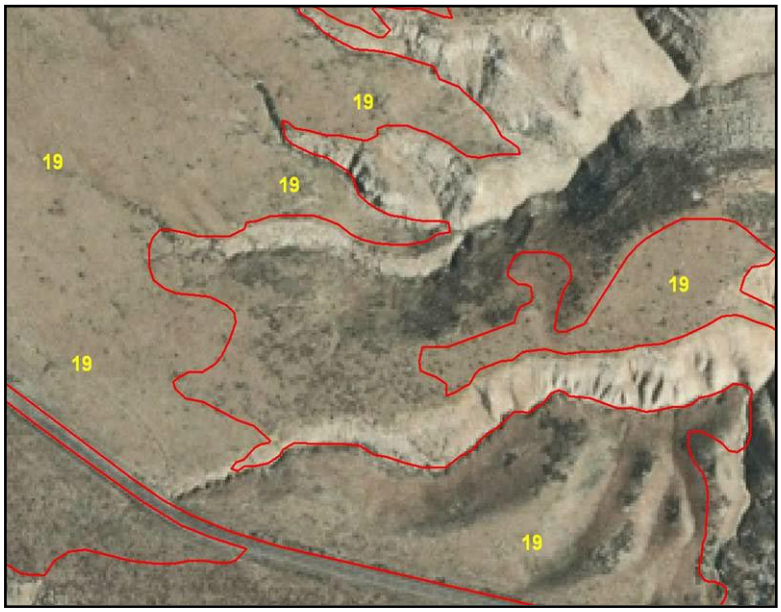


Photo Signature Example



Map Unit 20 — ***Eleocharis palustris* - *Typha latifolia* Wetland Vegetation Complex**
Marsh Spikerush – Broadleaf Cattail Wetland Vegetation Complex

Common Species

Typha latifolia,
Eleocharis palustris,
Schoenoplectus spp.,
Elymus elymoides

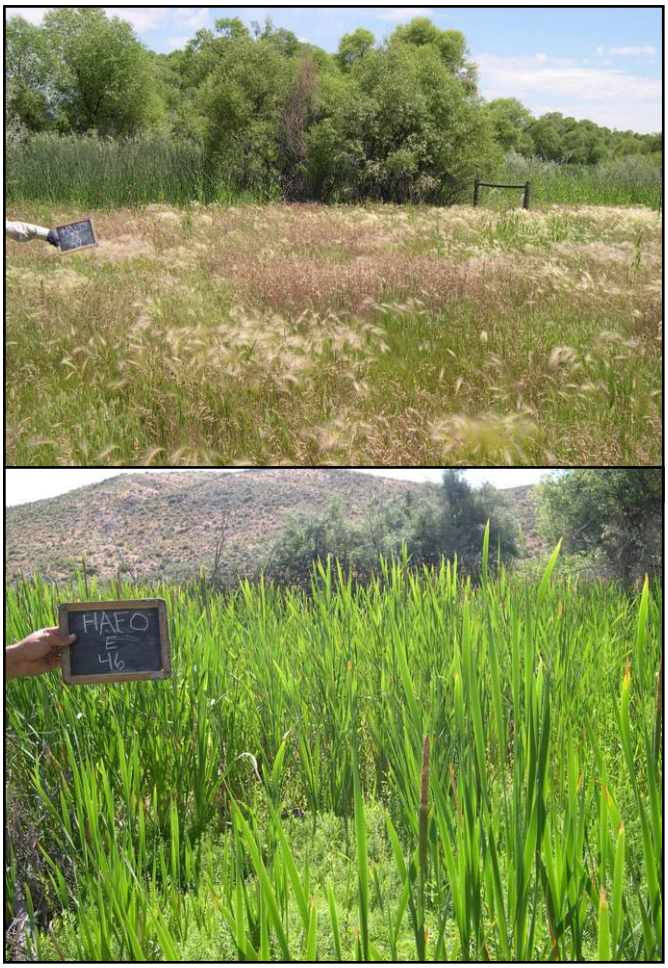
NVCS Association

Eleocharis palustris Herbaceous Vegetation
Typha (angustifolia, latifolia) - (Schoenoplectus spp.) Semipermanently Flooded Herbaceous Alliance

Description

This herbaceous wetland type was common at HAFO in mesic drainage bottoms and along the edges of the Snake River. Polygons of this type typically contained pure stands of cattails and/or solid stands of spikerush. Stands of both types were indistinguishable from one another on the imagery and appeared to often intermix with one another. On the 2006 imagery this type was mapped partially by its landscape position in drainage bottoms and partially by its characteristic solid, smooth light green color. Polygons of this type may have been confused with small willow stands and the emergent wetland map class.

Representative Ground Photos



Range and Distribution

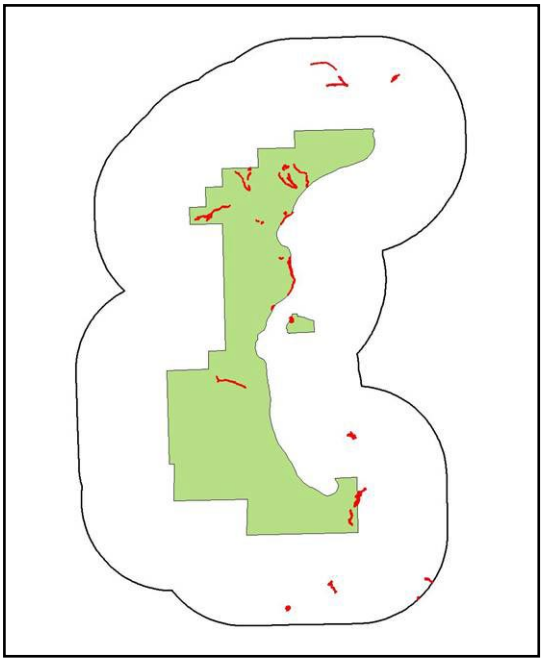


Photo Signature Example

Map Unit 21 — Annual Weedy Herbaceous Vegetation Complex

Common Species

Lactuca tatarica,
Lactuca serriola,
Cirsium arvense,
Bromus inermis,
Bromus japonicus,
Cryptantha spp.,
Helianthus annuus,
Kochia scoparia,
Lepidium perfoliatum,
Sisymbrium altissimum

NVCS Association

Lactuca tatarica var. pulchella Herbaceous Vegetation

Representative Ground Photo

Description

This type represents disturbed sites primarily in the environs, including fallow fields, field boundaries, road edges and old pastures. Although cheatgrass and crested wheatgrass were usually present in these stands they were not the clear dominant. Other common species in this map unit were mainly weedy annuals varying greatly in composition and density from site to site. This successional type has likely replaced native grasslands or big sagebrush shrublands. At HAFO this type had various signatures on the 2006 imagery ranging from mottled tans, to blotchy greens all characteristic of disturbed sites.

Range and Distribution

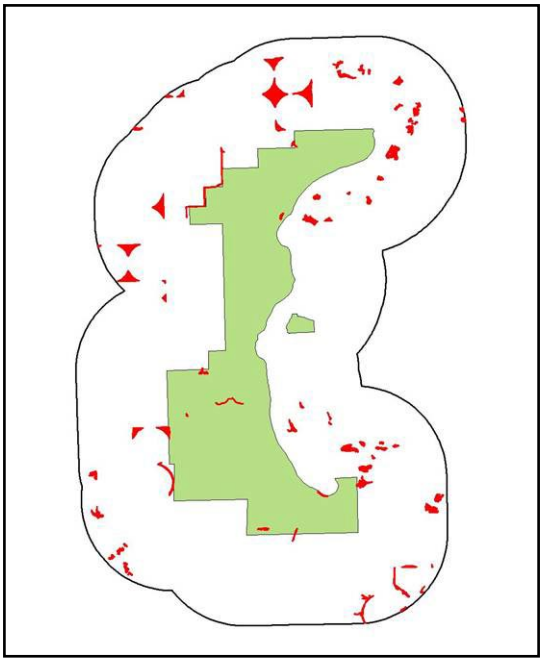
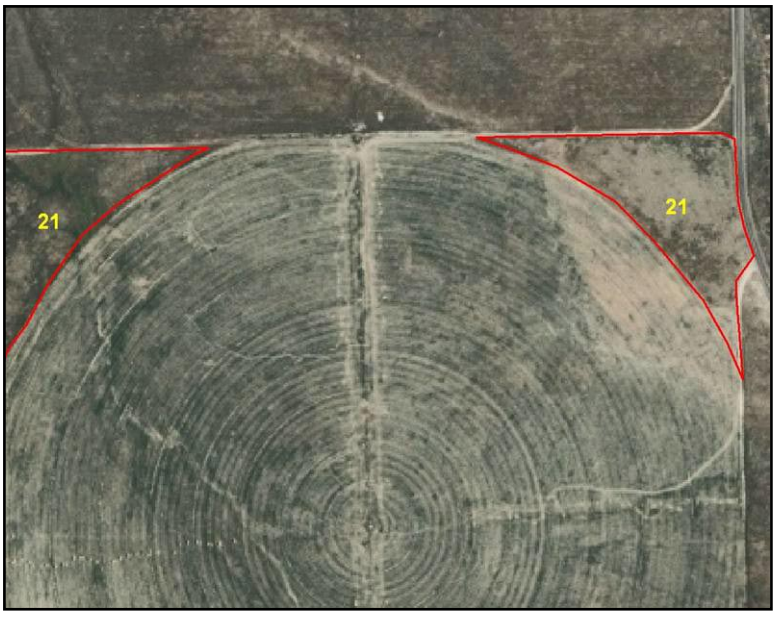


Photo Signature Example



Map Unit 22 ***Pascopyrum smithii - Achnatherum hymenoides*** **Herbaceous Vegetation**
Western Wheatgrass - Ricegrass Herbaceous Vegetation

Common Species

Pascopyrum smithii,
Achnatherum hymenoides,
Hesperostipa comata,
Bromus tectorum,

NVCS Association

Pascopyrum smithii - Achnatherum hymenoides
Herbaceous Vegetation

Representative Ground Photo

Description

The western wheatgrass map unit was used to map areas appearing to have moderate to high cover of native grasses primarily on lands south of the Monument. In these areas, western wheatgrass along with a handful of other natives occurred on large flat terraces, rolling hills and along badland formations. Although cheatgrass was usually present it did not form monotypic stands as found throughout HAFO. The density of the native grasses varied greatly from sparse communities on sandy soils to stands with moderate cover on other soil types. On the imagery this map unit appeared as a mottled, smooth signature due to the lack of shrubs and varied in color from dark grey to orange to almost white in sandy areas.

Range and Distribution

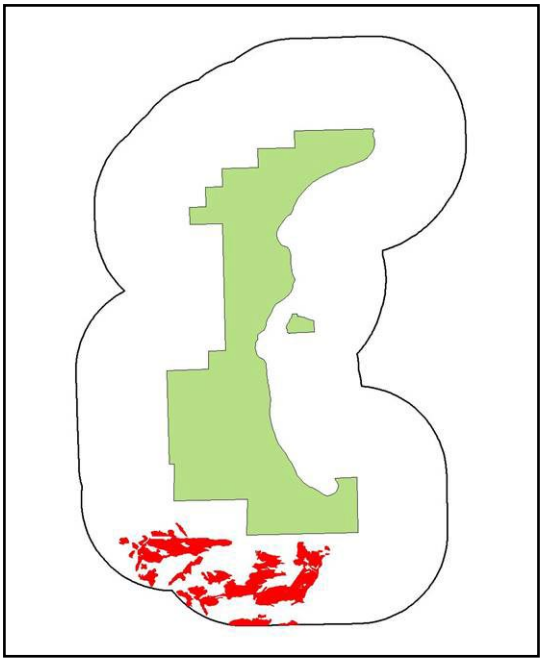
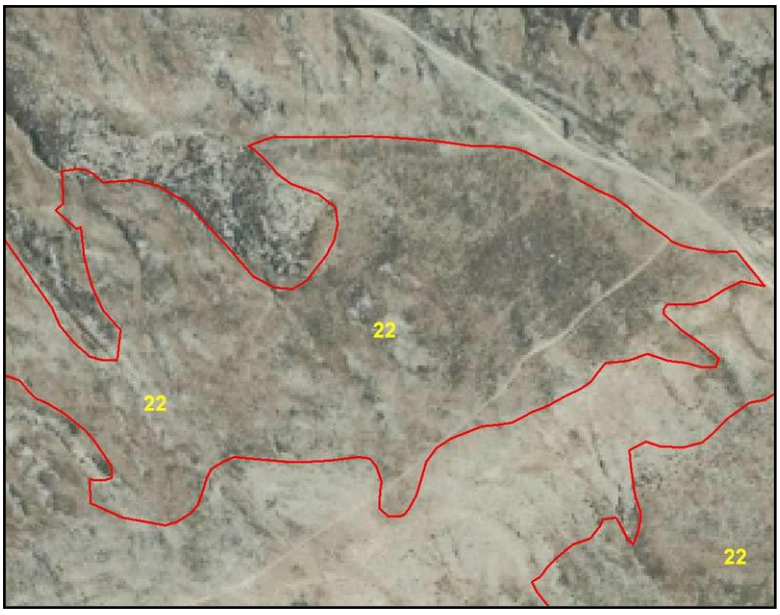


Photo Signature Example



Map Unit 23 — Emergent and Floating Aquatic Herbaceous Vegetation Complex

Common Species
(Unknown at this time)

NVCS Association
Local Stand (no NVCS Alliance at this time)

Representative Ground Photo

Description
This map unit was used exclusively in the environs surrounding the Monument to indicate vegetated wet areas surrounding ponds, lakes and streams. Due to access issues no data was collected in these polygons. However plants likely to be found in these polygons include sedges, rushes, bulrushes, cattails, lily pads, non-native aquatic species and possibly algae. Some individual trees and shrubs were also common in some of the polygons. On the 2006 imagery this type appeared different than the other wetland map units although further sampling may reveal similarities. The signature for this type was usually bright green with splotches of intermixed light green.

Range and Distribution

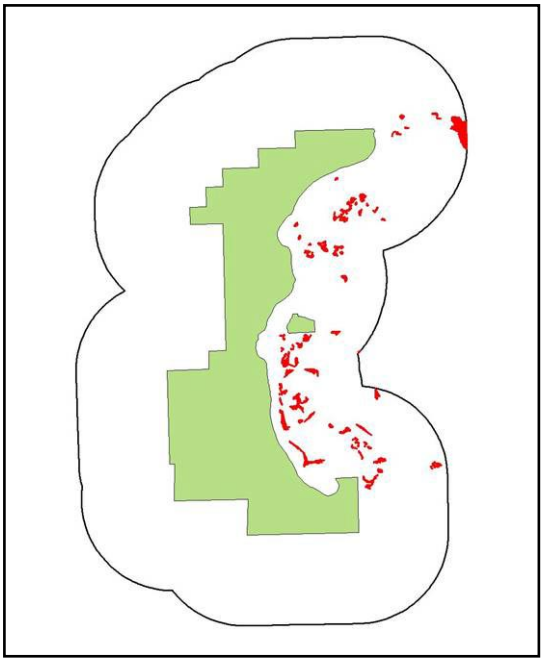


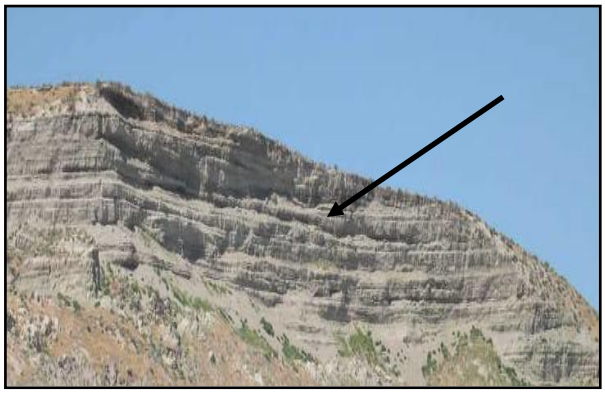
Photo Signature Example

Map Unit 24 **Badlands (Barren)**

Common Species
(Geology type, no vegetation)

NVCS Association
Local Stand (no NVCS Alliance)

Photo Signature Example



Description
This unique map unit was used to map non-vegetated badlands within, and adjacent to the Monument. This type differed from the sparsely vegetated badlands due to its location on the steepest slopes, active erosion and lack of vegetation. In contrast, the bare rock /sand land cover map unit (Map Unit 36) was used to map bare rock outcrops or sand deposits that were not badland formations. On the 2006 imagery this type had very smooth bright white and grey signature with no grey or green specks indicating vegetation.

Range and Distribution

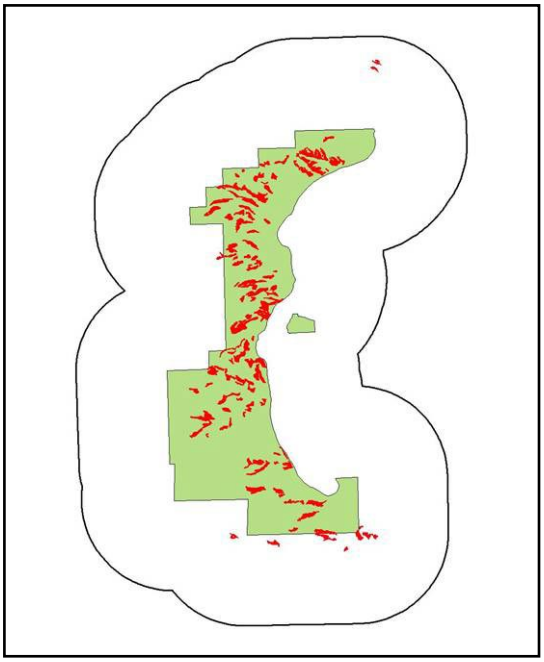
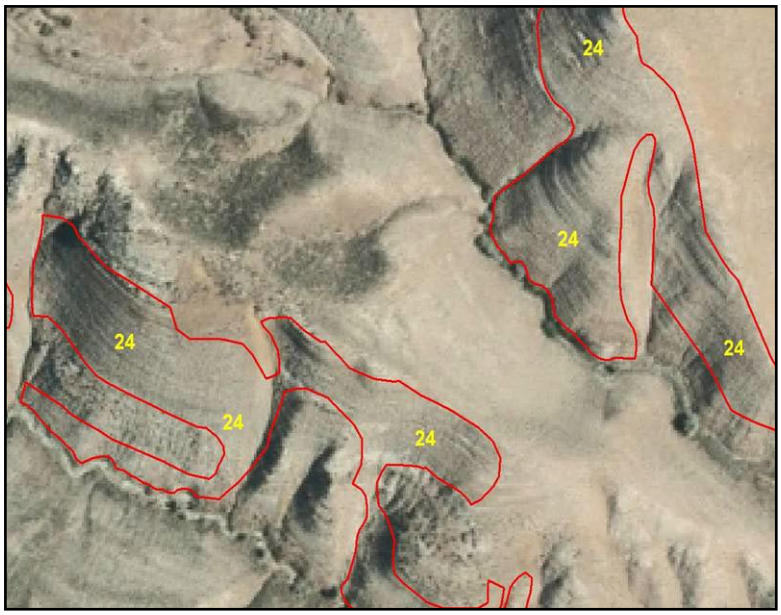
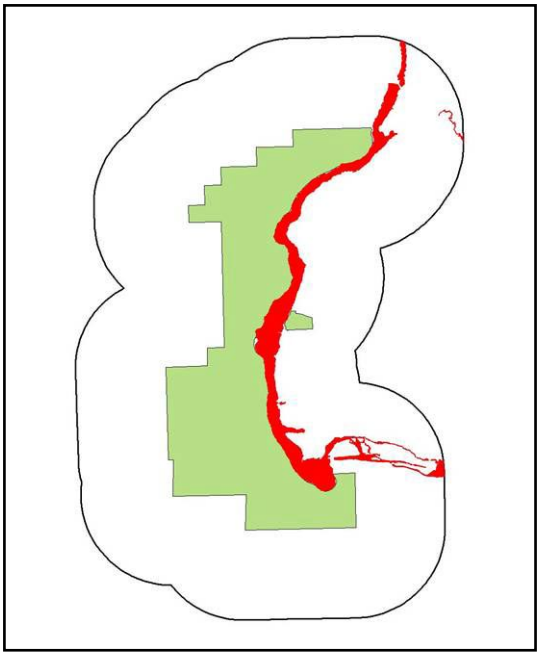


Photo Signature Examples

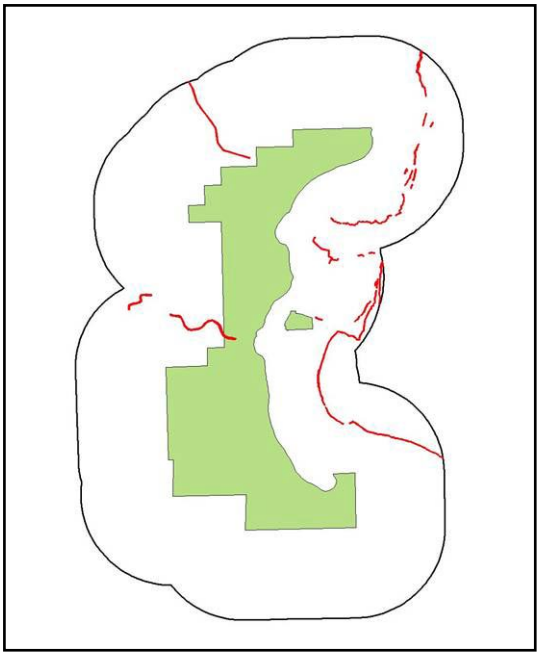


LAND COVER – LAND USE

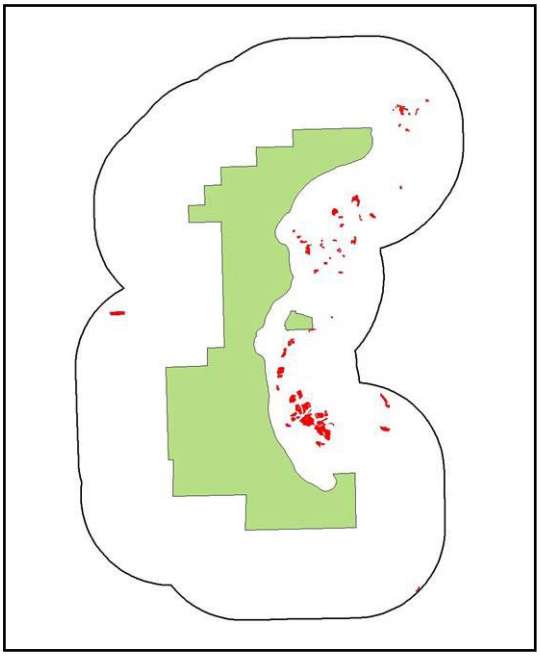
MAP CODE 25 **Stream / River**



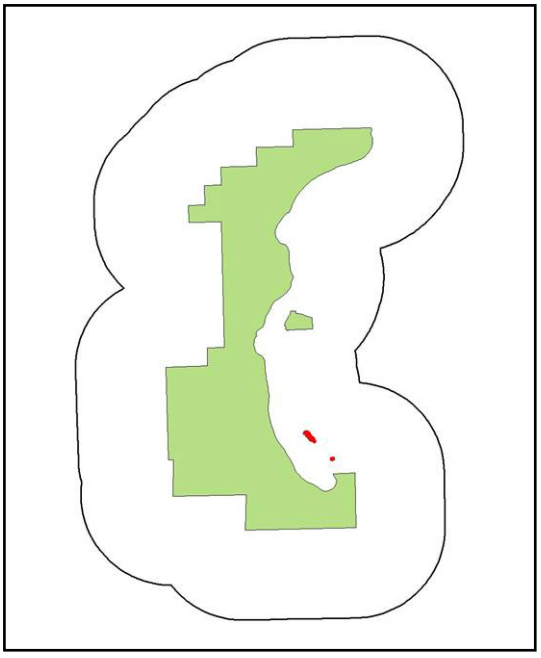
MAP CODE 26 **Canal / Ditch**



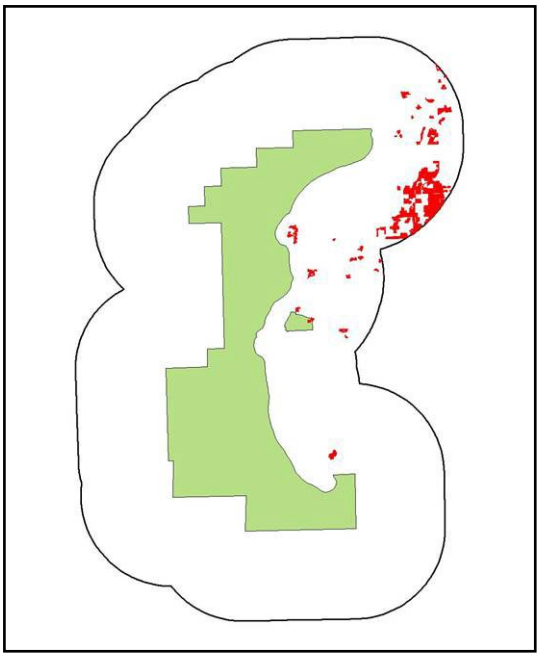
MAP CODE 27 **Lake / Pond**



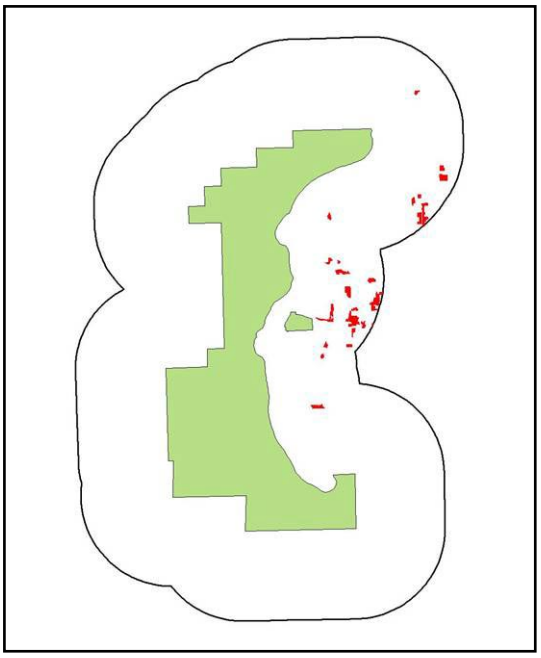
MAP CODE 28 **Reservoir**



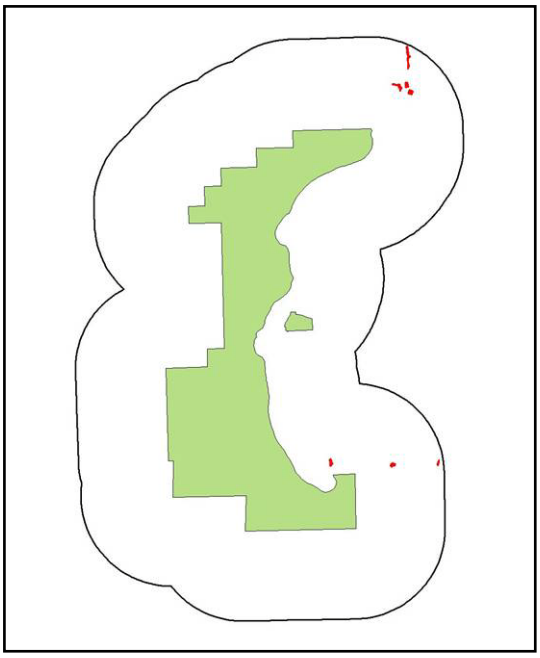
MAP CODE 29 **Residential**



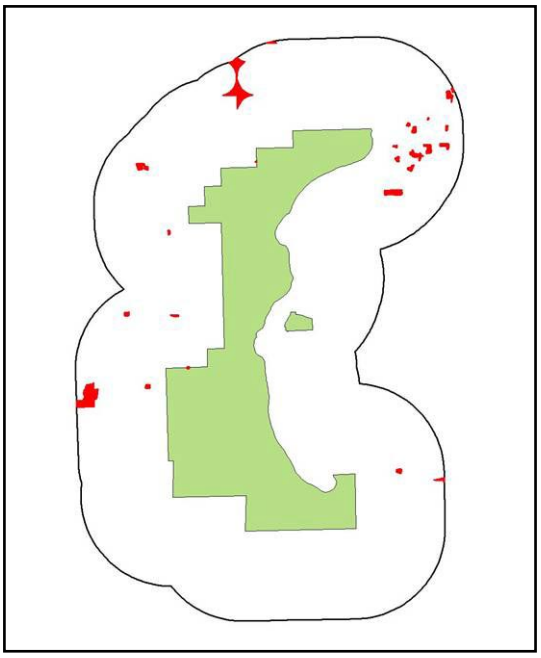
MAP CODE 30 **Commercial / Light Industry**



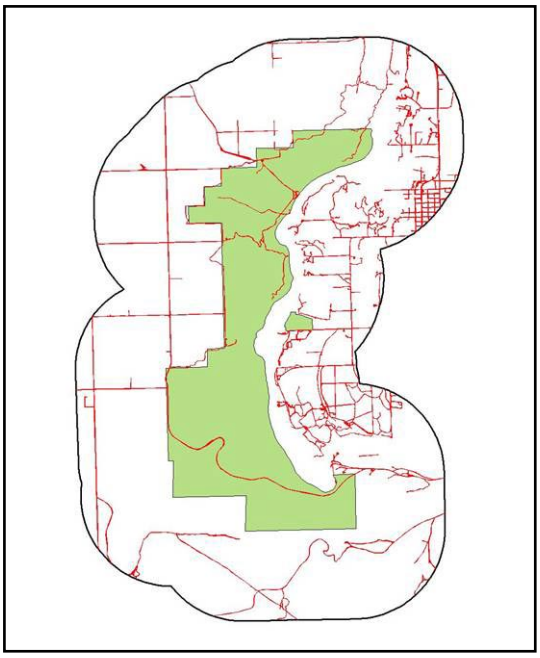
MAP CODE 31 **Communications and Utilities**



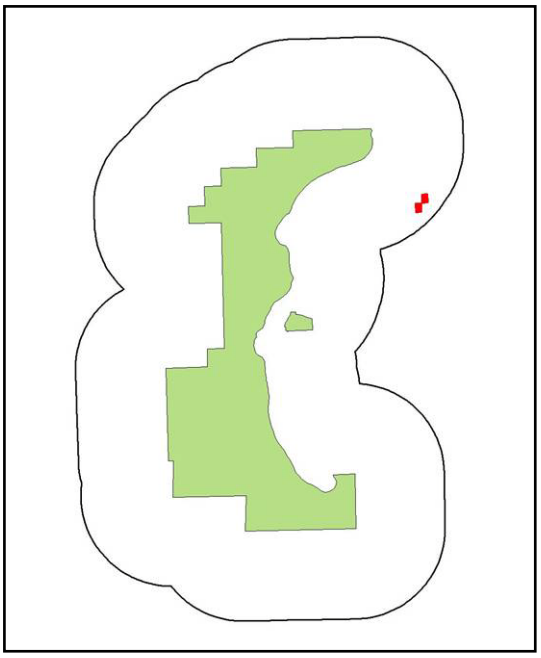
MAP CODE 32 **Agricultural Business**



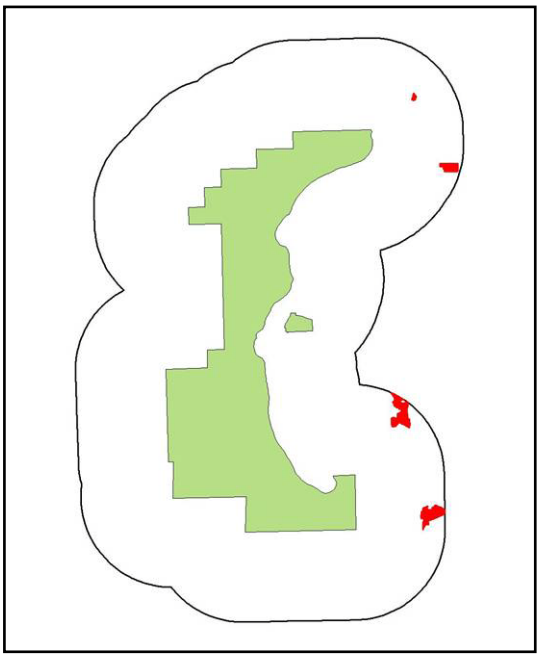
MAP CODE 33 **Transportation**



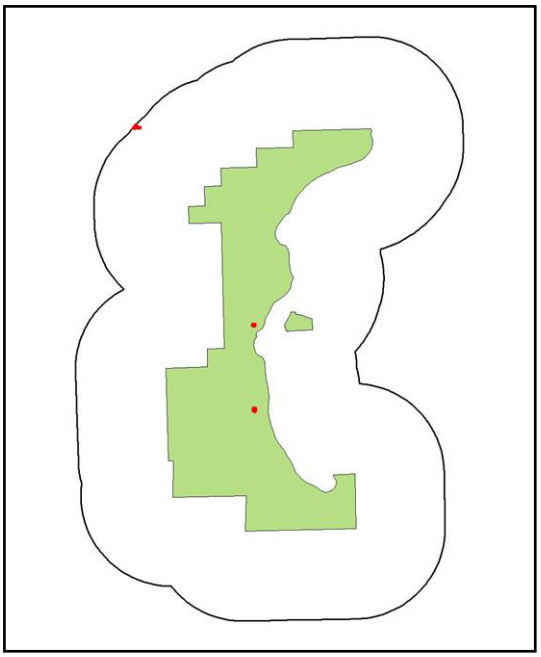
MAP CODE 34 **Entertainment / Recreation**



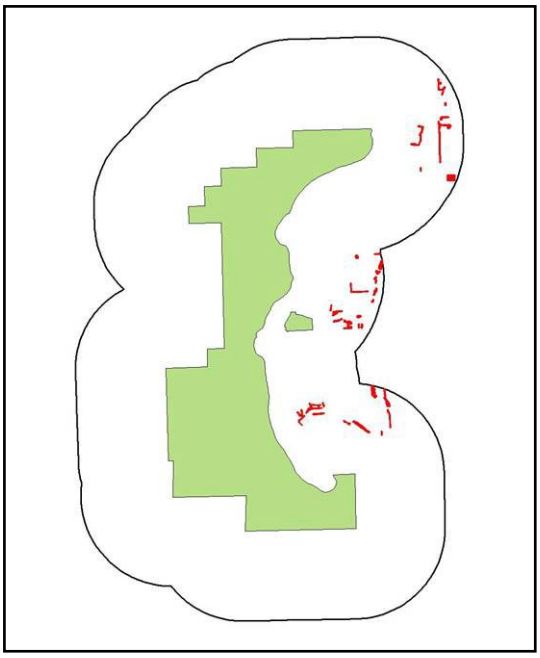
MAP CODE 35 **Quarries / Strip Mines / Gravel Pits**



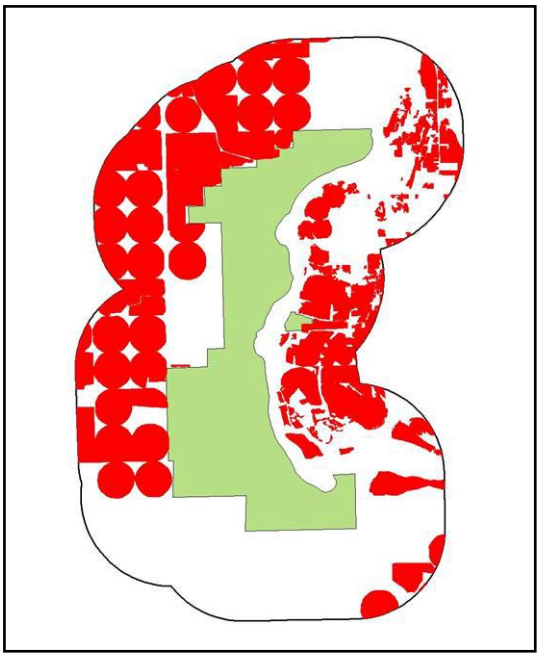
MAP CODE 36 **Bare Rock / Sand**



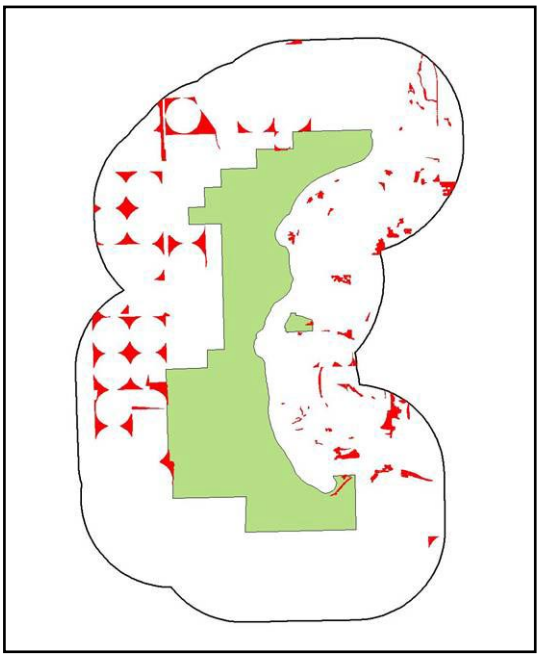
MAP CODE 37 **Irrigated Orchard / Vineyards / Groves**



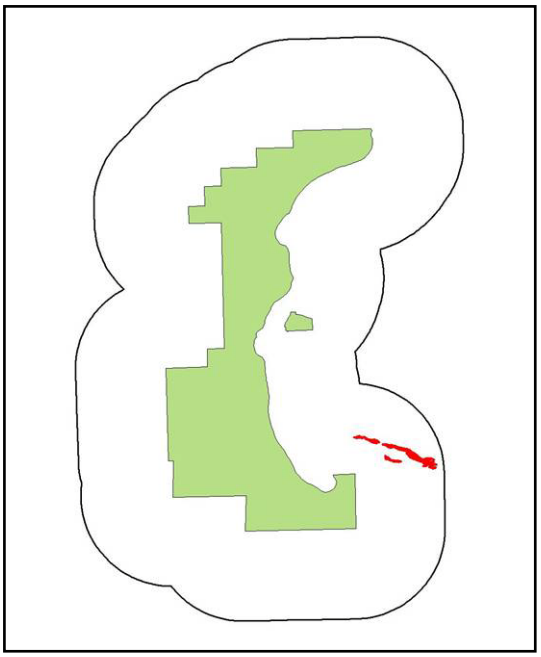
MAP CODE 38 **Planted / Cultivated**



MAP CODE 39 **Transistional**

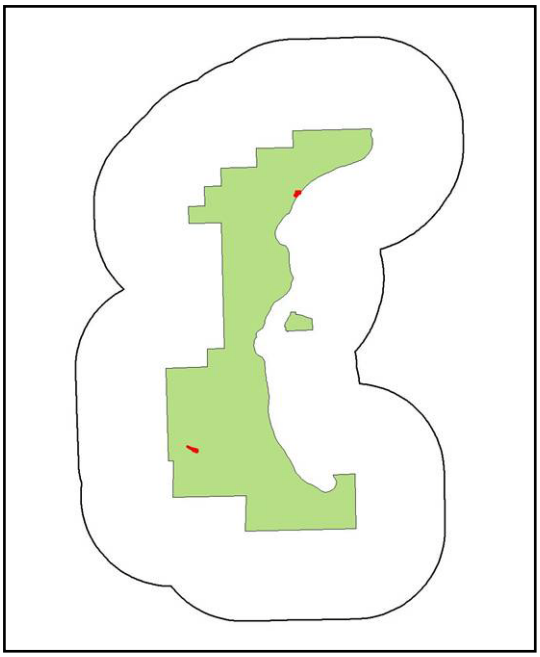


MAP CODE 40 **Flats**

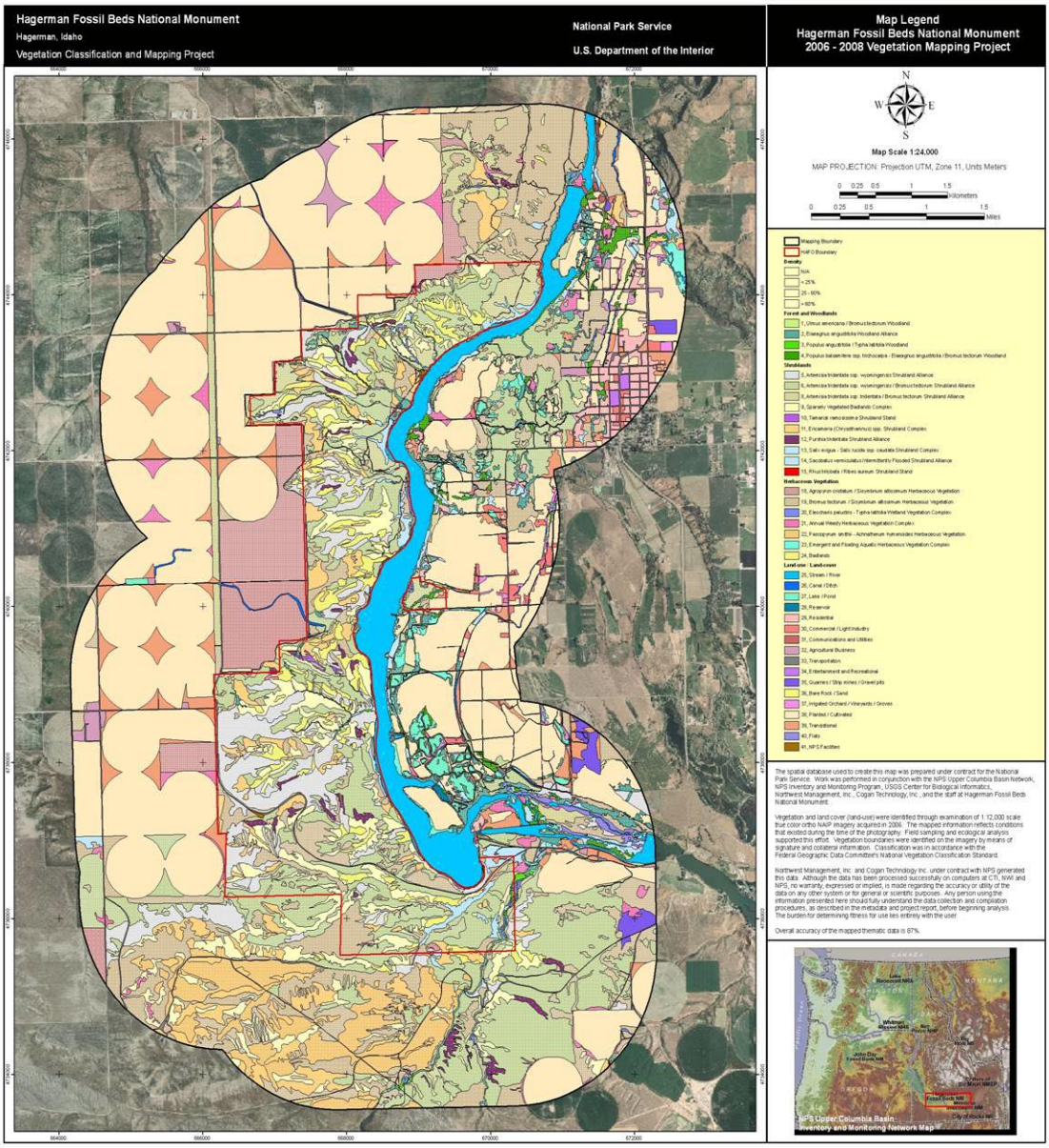


MAP CODE **NPS Facilities**

41



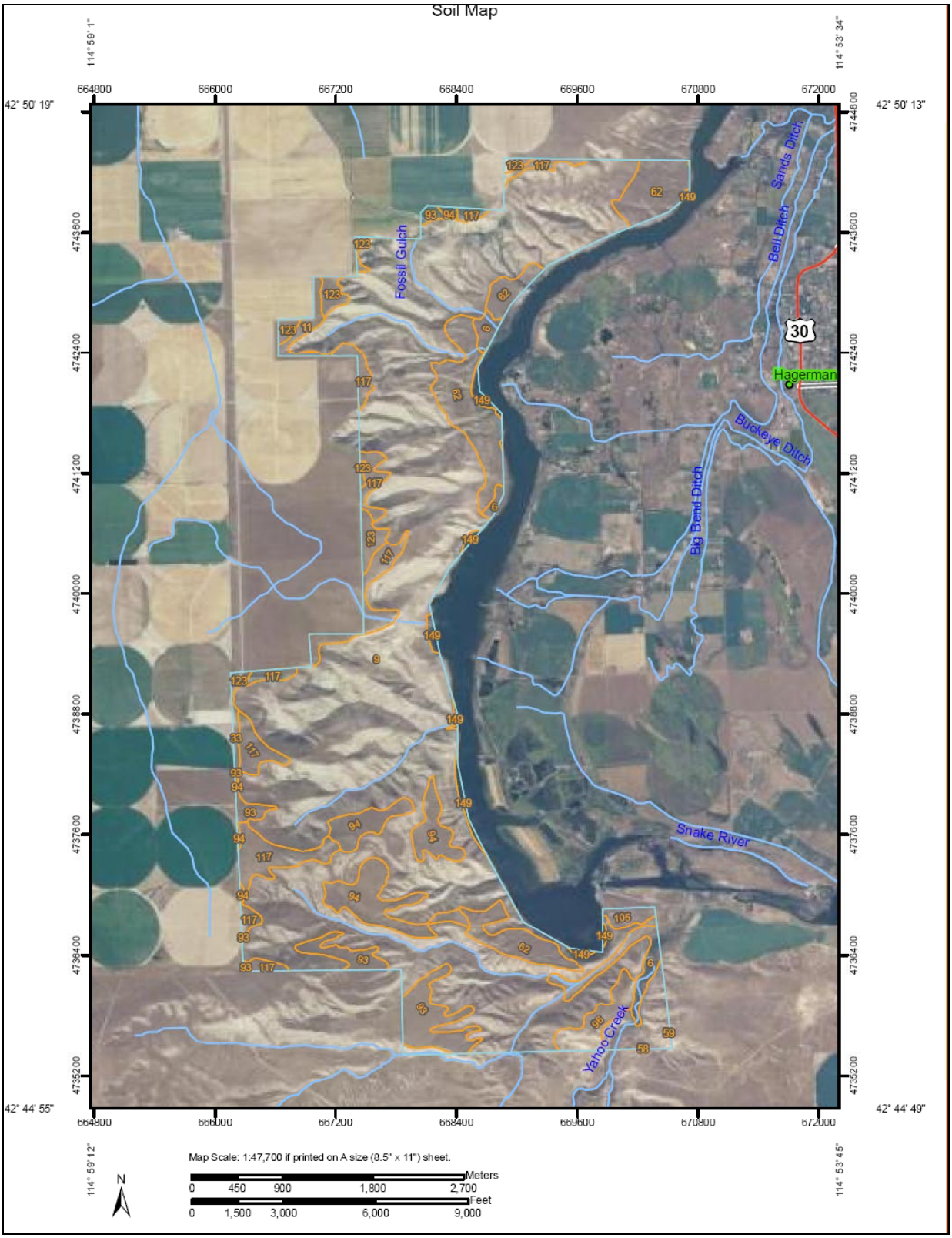
APPENDIX G: Final HAFO Vegetation Map



APPENDIX H: Soil Map and Legend HAFO

Map Unit Legend

Jerome County and Part of Twin Falls County, Idaho (ID704)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
6	Antelope Springs loam, 0 to 4 percent slopes	75.9	1.7%
9	Badland-Kudlac association, 30 to 90 percent slopes	3,132.1	71.8%
11	Bahem silt loam, 4 to 8 percent slopes	26.3	0.6%
33	Dolman silt loam, 1 to 4 percent slopes	9.7	0.2%
58	Kecko fine sandy loam, 1 to 4 percent slopes	0.9	0.0%
59	Kecko fine sandy loam, 4 to 8 percent slopes	0.6	0.0%
62	Kudlac silty clay, 4 to 30 percent slopes	329.0	7.5%
93	Purdam silt loam, 1 to 4 percent slopes	143.4	3.3%
94	Purdam silt loam, 4 to 8 percent slopes	198.9	4.6%
96	Quincy loamy fine sand, 2 to 20 percent slopes	57.7	1.3%
105	Rakane-Blacknest complex, 4 to 8 percent slopes	20.0	0.5%
117	Scoon fine sandy loam, 1 to 4 percent slopes	254.1	5.8%
123	Sluka silt loam, 1 to 4 percent slopes	73.3	1.7%
149	Water	38.6	0.9%
Totals for Area of Interest		**4,360.5**	**100.0%**


Soil Map
114° 59' 1"
114° 53' 34"
664800
666000
667200
668400
669600
670800
672000
42° 50' 19"
42° 50' 13"
4744800
4743600
4742400
4741200
4740000
4738800
4737600
4736400
4735200
42° 44' 55"
42° 44' 49"
114° 59' 12"
114° 53' 45"
Fossil Gulch
Sands Ditch
Bell Ditch
Buckeye Ditch
Big Bend Ditch
Snake River
Yahoo Creek
Hagerman
30
Map Scale: 1:47,700 if printed on A size (8.5" x 11") sheet.
N
Meters
0 450 900 1,800 2,700
Feet
0 1,500 3,000 6,000 9,000

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities

NPS D-43, April 2009

National Park Service
U.S. Department of the Interior

Natural Resource Program Center
1201 Oakridge Drive, Suite 150
Fort Collins, Colorado

www.nature.nps.gov