VEGETATION MAP OF THE ROCKING M RANCH WILDLIFE CONSERVATION EASEMENT, WASHINGTON COUNTY, IDAHO

Steven K. Rust
Michael Mancuso
Christopher J. Murphy
P. Robin Jones

December 2000

Conservation Data Center
Idaho Department of Fish and Game
600 South Walnut, P.O. Box 25
Boise, Idaho 83707

Rodney Sando, Director

Cooperative Challenge Cost-Share Project
Idaho Department of Fish and Game
USDI Bureau of Land Management, Lower Snake River District

TABLE OF CONTENTS

INTRODUCTION

In 1996 Idaho Department of Fish and Game (IDF&G) acquired wildlife conservation easements on Rocking M Ranch. IDF&G manages the 16,900 acre conservation area cooperatively with the Bureau of Land Management (BLM). In the 1995 - 1997 field seasons vegetation mapping projects occurred on the IDF&G conservation easement lands (Mancuso 1995 and 1997). The objectives of this study are to (1) extend the vegetation map to cover Bureau lands, (2) assist in the classification and description of the vegetation within the area, and (3) provide recommendations for the conservation of wildlife habitats within the conservation easement area.

Vegetation within the Rocking M Ranch conservation easement area is mapped at the 1:24,000 scale using attributes of natural potential vegetation, cover type, and ecological condition. The vegetation mapping product consists of a relational spatial database as well as the printed maps produced from the digital data. The classification and description of composition and ecological condition of vegetation located within the easement area is supported by information gathered at ecological reference areas within the upper Hells Canyon region. A crosswalk summary between alternative vegetation classification systems that apply to the study area is provided.

STUDY AREA

Location--The study occurs within two geographical areas: (1) Rocking M Ranch Wildlife Conservation Easement Area (henceforth referred to as the Rocking M Ranch study area, the conservation easement area, or simply the study area) and (2) the upper Hells Canyon region - the area from which reference information concerning the conservation easement area is drawn.

The Rocking M Ranch Wildlife Conservation Easement Area is located approximately 26 miles northwest of Weiser, in Washington County, Idaho (Figure 1). The Conservation Easement Area includes both private land and public land managed by the Bureau of Land Management (BLM). In 1996, Idaho Department of Fish and Game acquired wildlife conservation easements on private land within the area. The 16,900 acre Conservation Easement Area is managed cooperatively by the Department and BLM. The study area includes large portions of the Raft, Dennett, Sumac, Wolf, Trail, Rock, and Perkins creek drainages on the west slope of the Hitt Mountains.

Access to the Rocking M Ranch study area is via the Henley Basin Road (also called the Rock Creek Road) north from Weiser, to Brownlee Reservoir, and continuing north along the Reservoir. The road to Mineral provides access to the 4-wheel drive spur roads leading into the North Fork Dennett Creek and Middle Fork Dennett Creek drainages. Public access to Raft Creek past the Mountain Man Lodge has been acquired as part of the Conservation Easement agreement. Access to the general area is also possible from the east via the Adams Creek road (USFS roads #025) on the Payette National Forest. The Adams Creek road joins USFS road #010, which leads to the steep, 4-wheel drive road down to Mineral, near the open pit gypsum mine. The Mann Creek Road, off of Highway 95, provides access to the Adams Creek road.

Reference information concerning the easement area was collected at the following ecological reference areas located in the upper Hells Canyon region: Emery Creek Research Natural Area (RNA), Lost Basin Grassland RNA, Cuddy Mountain RNA, Rocky Comfort Flat RNA, Summer Creek RNA, and Andrus Wildlife Management Area (Figure 2). Detailed descriptions of these sites is provided as follows: Emery Creek RNA, Lichthardt and Rust (1994a); Lost Basin Grassland RNA, Lichthardt and Rust (1994b) and Caicco and Wellner (1983); Cuddy Mountain RNA, Lichthardt and Rust (1994c); Rocky Comfort Flat RNA, Wellner and Moseley (1992); Summer Creek RNA, Moseley (1998); and Andrus Wildlife Management Area, Mancuso and Moseley (1995). The following discussion concerning physical setting, geology, soils, climate, and vegetation focuses on the conservation easement area.

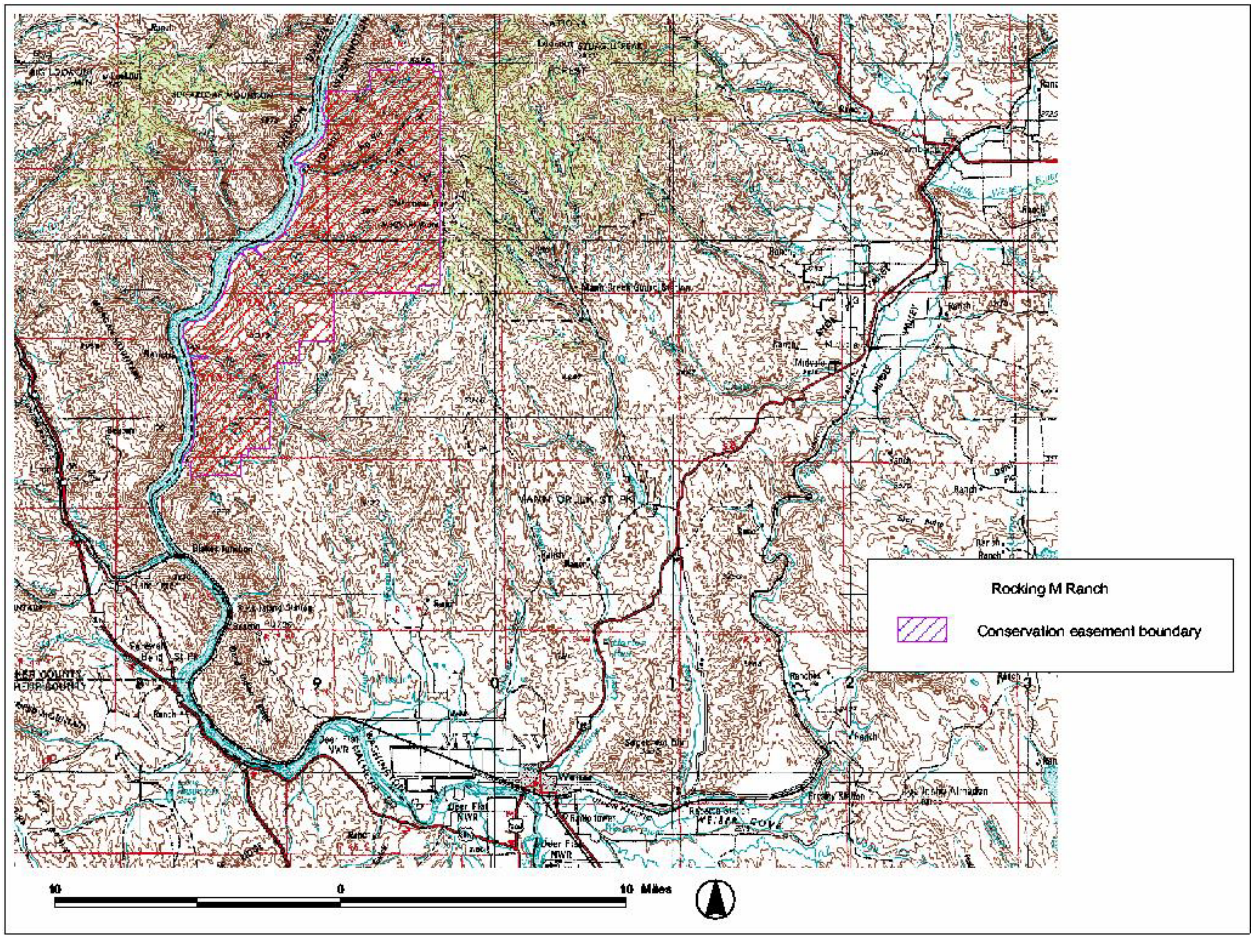

Figure 1. Rocking M Ranch Wildlife Conservation Easement. The location of the conservation easement is shown with respect to towns and important geographical features.

Physical setting--The study area is located along the steep western flank of the Hitt Mountains. Upper elevations form a major share of the headwaters for Raft, Dennett, Sumac, Wolf, Trail, Rock, and Perkins creeks, which drain westward through the study area into the Snake River (Brownlee Reservoir). The dissected topography is characterized by a series of moderately-sloping, west to southwest-trending primary ridges dividing the three drainages, and associated north and south-trending steep spur ridges, all with steep sideslopes descending to the narrow stream corridors below. Areas of gentle, bench-like topography occasionally interrupt the steep slopes, or are found along the stream corridors. Elevations within the study area range from approximately 5880 to 2077 feet.

Ross and Savage (1967) place the Rocking M Ranch study area within the Wallowa-Seven Devils Section of the Columbia Intermontane Province. It is part of the Seven Devils Unit of the Columbia Division in Ertter and Moseley's (1992) classification of Idaho floristic regions. The study area is considered part of the Blue Mountain Section of the Middle Rocky Mountain Province by McNab and Avers (1994).

Geology--The Rocking M Ranch study area is located on the western flanks of the Hitt Mountains. The Hitt Mountains lie within an area characterized by north-northwest trending faults and anticlinal uplifts. Several faults are located proximate to the study area. There is no evidence of glaciation in the area.

The pre-Tertiary basement rocks of eastern Oregon and western Idaho were covered by flows of

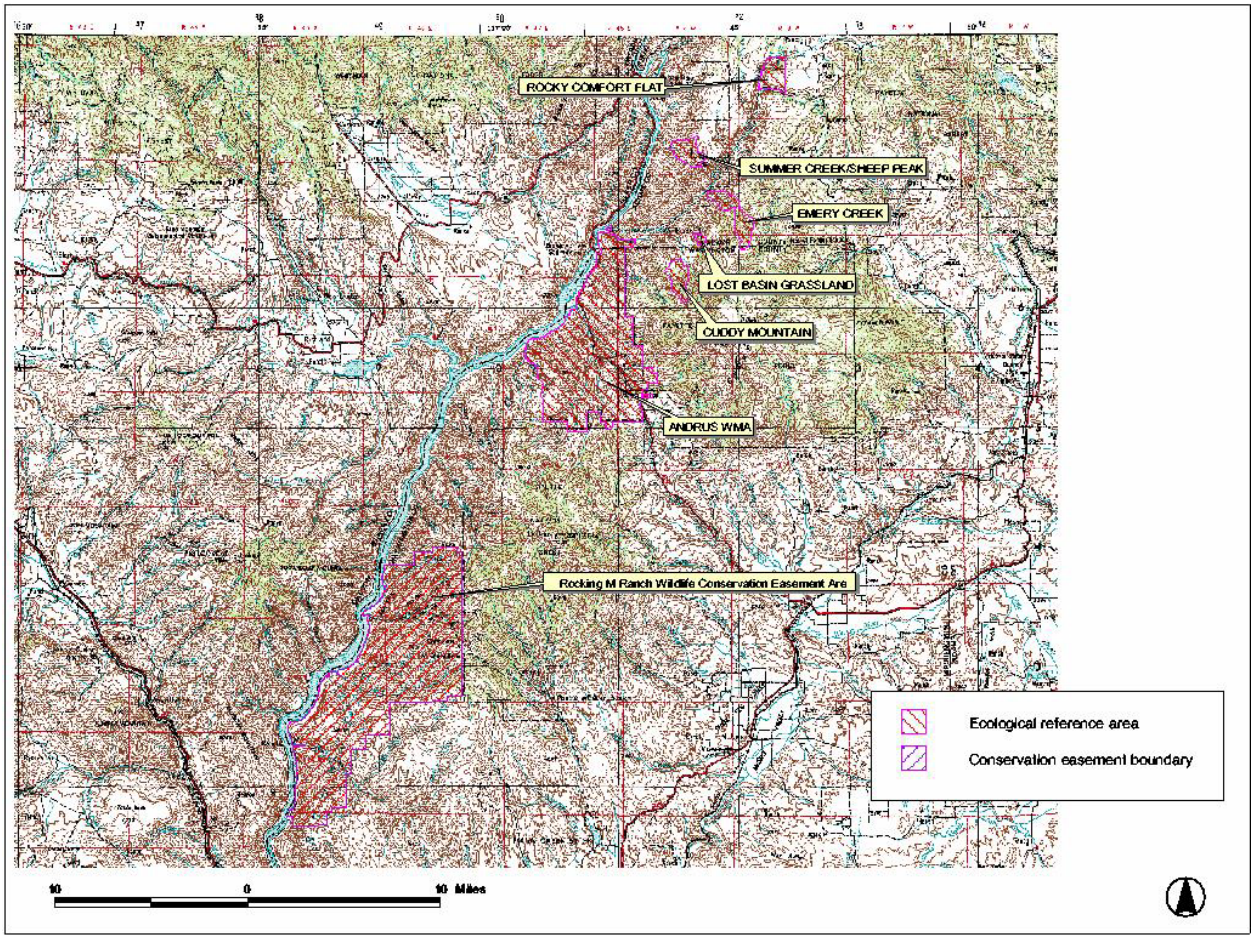

Figure 2. Ecological reference areas and Rocking M Ranch Wildlife Conservation Easement. The location of the conservation easement area is shown in relation to adjacent conservation areas and ecological reference areas.

Columbia River basalt during Miocene and early Pliocene time. Subsequent erosion produced several pre-Tertiary "windows", especially near the Snake River Canyon. The study area is an example of one of these "windows" (Henricksen 1975). The study area is dominated by sequences of Jurassic-age sedimentary lithologies that were probably deposited in an island arc environment. Extensive outcrops of Big Hill Wacke rock dominate the study area. Small amounts of Tate Shale and Dennett Creek Limestone are also present. All three of these formations are of Jurassic age (Henricksen 1975; Mitchell and Bennett 1979).

The Big Hill Wacke formation is mostly an undifferentiated assemblage of wackes (a poorly sorted sedimentary rock with particle sizes ranging from 1/16 mm to 2 mm) characterized by a fine-grained slaty cleavage. The formation is at least several thousand feet thick. One of the most common rock types within the study area is phyllite, a cleaved metamorphic rock with a texture between shales and schists. The phyllite is slightly calcareous, light-colored and often with a greenish tinge.

Tate Shale is a black shale that outcrops on hillsides in the north-central part of the study area above the Middle and North forks of Dennett Creek. Access roads to mining drill sites provide good exposures of this rock type. The Dennett Creek Limestone is nearly pure (>95%) carbonate. It is finely crystalline and light-gray in color (Henricksen 1975). It outcrops above the North Fork Dennett Creek at the base of Big Hill

within the study area. Unconsolidated Quaternary-age alluvium fills the stream channels and also occurs as terraced deposits in a few places.

Portions of the study area are located within the Mineral-Iron Mountain Mining District. Evidence of past mining for copper, lead and silver surrounds the site of Mineral, within the Dennett Creek drainage. An open-pit gypsum mine is also present. This mine is presently inactive.

Soils--Soils in the study area are derived from metamorphosed sedimentary rocks, and to a lesser extent from basalt. Oldsferry shaly loam is the major soil unit on the extensive, steep south-facing slopes within the study area. It is a moderately deep, well-drained, shaly-loam textured soil, with very rapid runoff and severe to very severe water erosion hazard properties. The Meland-Riggins complex soil type is less common on south-facing slopes. It is characterized by a stony loam upper and clay loam lower profile, is well-drained, and ranges from shallow to moderately deep. Northerly slopes are dominated by the DeMasters loam soil type. This is a deep, well-drained, dark loam soil and has very rapid water runoff and severe water erosion hazard properties. To a lesser extent, north-facing slopes contain the Gross silt loam soil type. This is a moderately deep, well-drained, silty loam-textured soil (Natural Resources Conservation Service 1995).

Climate--From late fall to early spring the climate of west-central Idaho is typically influenced by cool and moist Pacific marine air. Periodically this westerly flow is interrupted by outbreaks of cold, dry continental air from the north. During the summer months, a Pacific high pressure system dominates weather patterns, resulting in minimal precipitation and more continental climatic conditions overall (Ross and Savage 1967). The BLM maintains a rain gauge near Mineral. Precipitation averaged 14.2 inches between 1987 and 1994, with a high of 21.1 inches in 1993 (149% of average) and a low of 8.8 inches in 1992 (62% of average) (Bureau of Land Management 1995). Weather data from Weiser, Idaho, 26 miles to the south gives general climate trends for the area. At Weiser, 49% of the average annual precipitation falls during the November through January winter months. There is a spike of increased precipitation during June before the dry summer months begin, when only 14% of the average annual precipitation falls from July through October. The average annual temperature at Weiser is 54.2^0 F, with December the coldest and July the warmest months of the year (Johnson 1981). Average temperatures at the study area are lower compared to Weiser, and upper elevations have higher annual precipitation than at Mineral.

Vegetation--The steep and dissected topography of the Rocking M Ranch study area is typical of the Hells Canyon region in west-central Idaho. In the Snake River Canyon system, aspect is the dominant feature controlling environmental parameters such as length of season of available water and soil type. As a result, vegetation patterns in the study area often closely correlate to changes in aspect. *Agropyron spicatum*-dominated grassland associations, or degraded versions defined by invasive annual grasses are common on south-facing slopes. More mesic aspects support *Festuca idahoensis*-dominated plant associations in areas of steep topography. Mid-slope benches, upper slope bowls and other places of moderate topography usually support *Artemisia tridentata vaseyana*-dominated associations. *Artemisia tridentata xericensis*-dominated plant associations are often present in lower and toe slope positions. Broad riparian bottomlands and lower slope benchs support *Artemisia tridentata tridentata* plant associations. *Purshia tridentata* plant associations are more restricted within the study area and occur on substrates other than the phyllitic rock. Bands of deciduous shrubs occur in draws that regularly dissect the slopes. Riparian zones are characterized by mixed deciduous shrub communities along middle and lower stream segments, and aspen-dominated vegetation along their upper reaches. Conifer stands dominated by *Pseudotsuga menziesii* are small within the study area and are restricted to steep, north-facing upper slopes. Several stands have been logged recently. Conifer forests are extensive on nearby Payette National Forest land. Open stands of *Juniperus occidentalis* occur south- and north-facing slopes above Mineral.

The understory of grassland, sagebrush and bitterbrush communities are susceptible to disturbance and subsequent weed invasion, such as the annual brome (*Bromus* spp.) grasses. To varying degrees, extensive areas are now dominated by weedy species and plant communities in better than mid-seral

condition are uncommon in the study area. This is largely the result of cumulative effects of livestock grazing, the introduction of exotic species, and wildfire. On a more restricted, local scale, past mining and logging operations have also influenced the condition of vegetation within the study area.

Cyclical wildfire is an important natural element of the Hells Canyon ecosystem. On many sites the resilience of the vegetation to natural disturbance agents has, however, been reduced by livestock grazing. In recent decades fire has contributed to the conversion of high quality native steppe and shrub-steppe vegetation to exotic annual grass-dominated vegetation.

METHODS

Ecological point observation and plot data was collected to describe the distribution, composition and structure of the vegetation. Point observation data was intended to rapidly accumulate a large number of geographically referenced points where knowledge of the vegetation is linked to base information available to assist with mapping the vegetation (e.g., simple environmental data such as elevation and slope aspect and gradient). On a walking route through the a selected area for study, data on the plant association present, stand level ecological condition and seral status, and the physical environment are repeatedly collected. New data is collected as a new plant association is encountered or with any significant change in the environmental parameters (slope, aspect, elevation), structural condition, seral status, or ecological condition. Ecological condition ranks are described in Appendix 1.

Composition and structure data were be collected on 0.1 acre plots using the methods of Bourgeron et al. (1991) and USDA Forest Service (1992). Multivariate analytical techniques (Hill 1979a; Hill 1979b; Ter Braak 1991) are employed in the description of plant community composition and structure and the assessment of environmental factors and ecological processes.

Ecological descriptions of sagebrush shrub and grassland natural plant community occurrences are identified through observations drawn from visits to designated reference areas (RNA/ACEC's) on Cascade Resource Area which encompass vegetation similar to that in the conservation easement area, as well as observations drawn from the conservation easement area itself.

Vegetation mapping units are delineated and described within the study area on the basis of potential natural vegetation, current vegetative cover, and ecological condition. Vegetation mapping units were identified through a combination of aerial photography interpretation and ecological land unit modeling (Anderson et al. 1998). Stands were delineated and digitized in IDF&G geographical information system (GIS) at a scale of 1:24,000. Raster data analyses were conducted with 30 x 30 meter pixels.

RESULTS

Plant associations and cover types identified in the study area are summarized in Table 1. A crosswalk from these communities to Natural Resources Conservation Service range sites observed in the area by Gibbs and Franzen (1999) is provided in Table 2. The vegetation of the Rocking M Ranch Wildlife Conservation Easement Area is mapped using 25 potential natural and 30 existing vegetation mapping units. Figures 3, 4, and 5 display potential natural vegetation, existing vegetation, and ecological condition, respectively. The area of each plant association occurring within the study area is summarized by current covertype and ecological condition in Appendix 2. Detailed descriptions of the most abundant plant associations follow in the next section. Detailed environmental and composition data is summarized in Appendix 3. The synthesis tables located in Appendix 3 are a primary source for much of the discussion that follows in the next section. The tables will not, however, be repeated referenced.

Plant species observed in the study area are listed in Appendix 4.

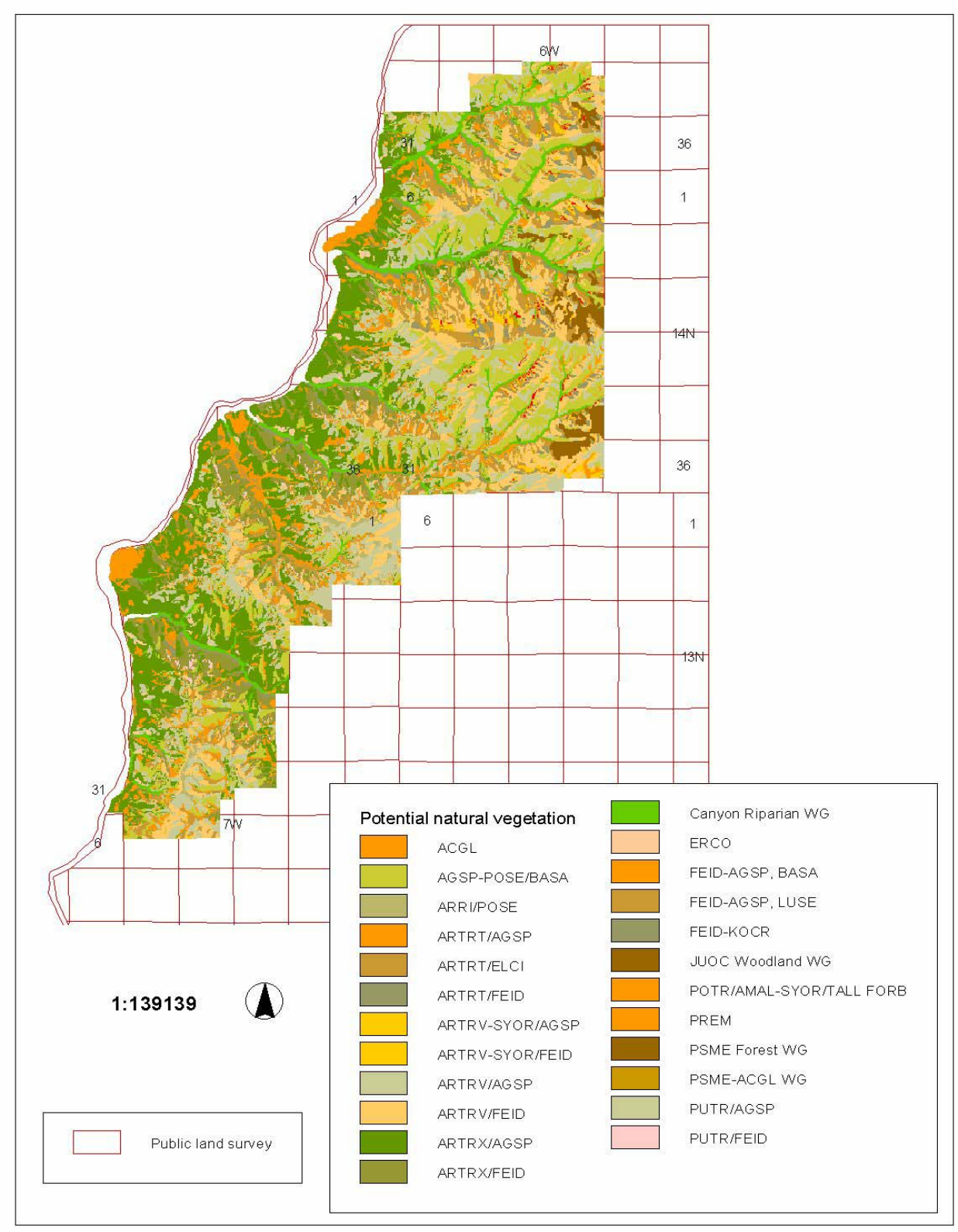

Figure 3. Potential natural vegetation of the Rocking M Ranch Wildlife Conservation Easement Area. Codes for the vegetation mapping units are defined in Table 1.

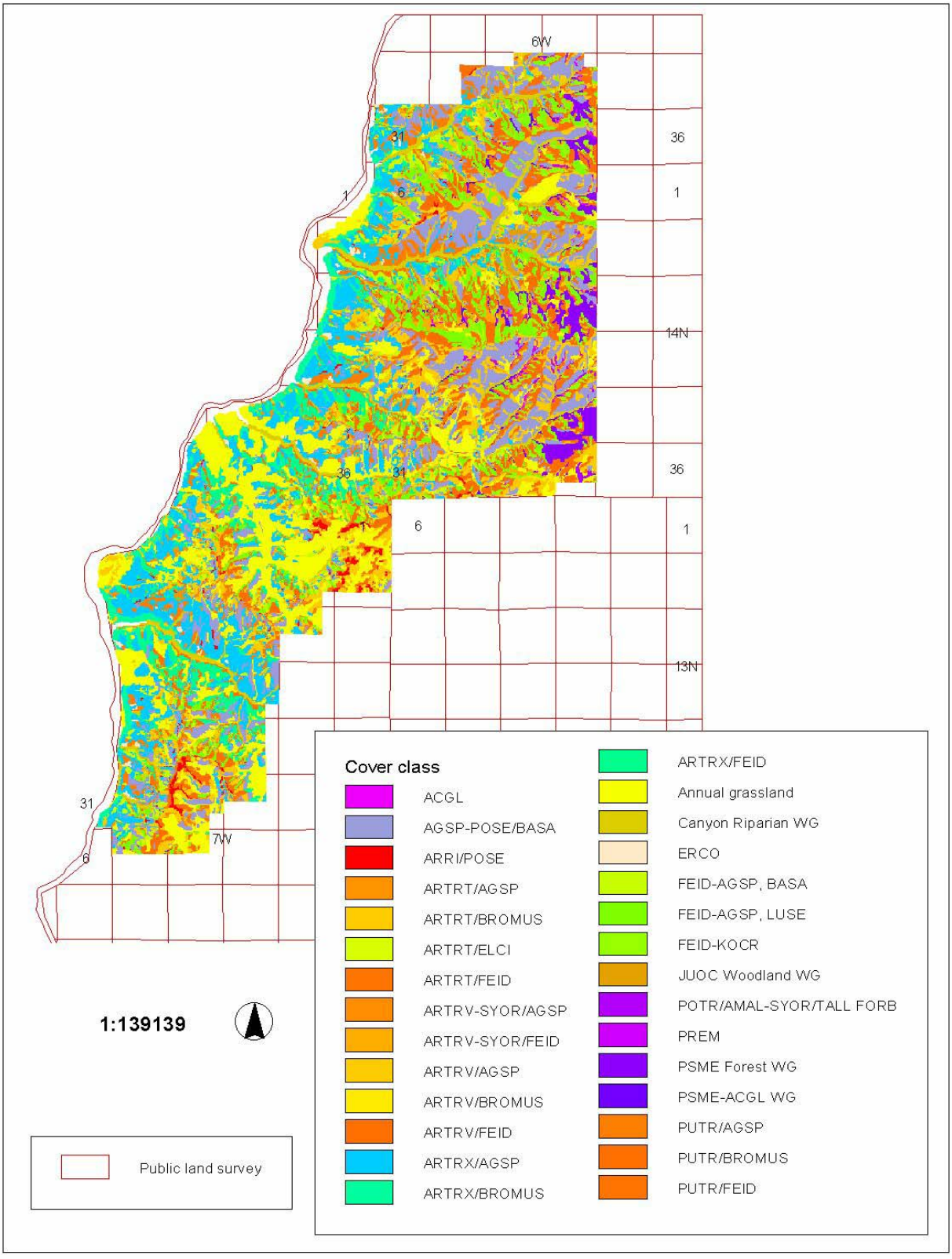

Figure 4. Existing vegetative cover of Rocking M Ranch Wildlife Conservation Easement Area.

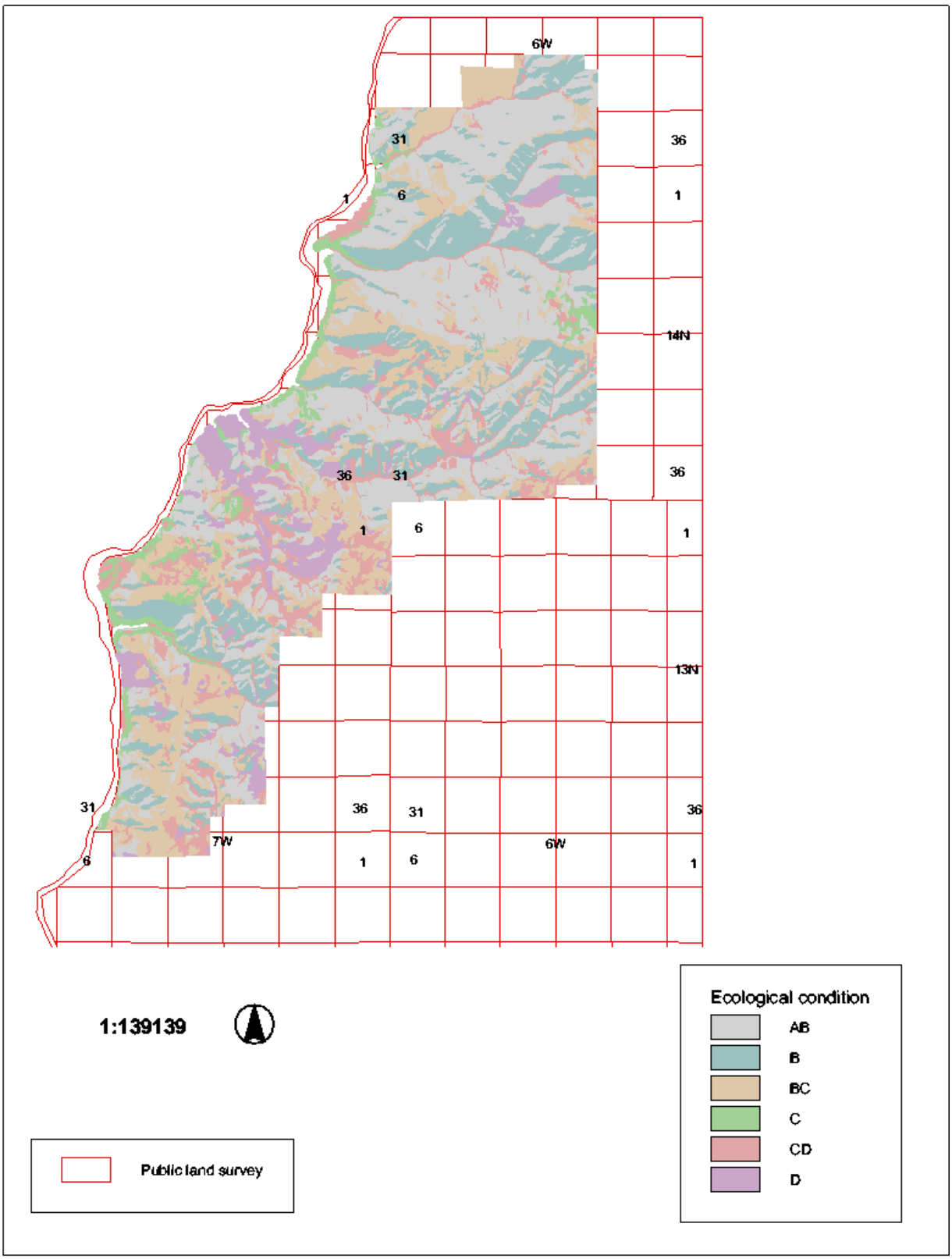

Figure 5. Ecological condition of vegetation within the Rocking M Wildlife Conservaton Easement Area. Condition ranks are defined in Table x.

Table 1. Plant associations and plant association groups identified in the Rocking M Ranch Wildlife Conservation Area. a) Plant association map codes (as they appear in Figures 1 - 3) are list with the plant association name and primary reference. b) Plant association group map codes are listed with the plant association group name, the included plant associations, and the association primary references.

a)

Plant Association Code	Plant Association Name	Primary Reference
ACGL	*Acer glabrum*	none
AGSP-POSE/BASA	*Agropyron spicatum-Poa secunda/Balsamorhiza sagittata*	Johnson and Simon 1987
ARRI/POSE	*Artemisia rigida/Poa secunda*	Johnson and Simon 1987
ARTRT/AGSP	*Artemisia tridentata tridentata/Agropyron spicatum*	Hironaka et al. 1983
ARTRT/ELCI	*Artemisia tridentata tridentata/Elymus cinereus*	Hironaka et al. 1983
ARTRT/FEID	*Artemisia tridentata tridentata/Festuca idahoensis*	Hironaka et al. 1983
ARTRV-SYOR/AGSP	*Artemisia tridentata vaseyana-Symphoricarpos oreophilus/Agropyron spicatum*	Hironaka et al. 1983
ARTRV-SYOR/FEID	*Artemisia tridentata vaseyana-Symphoricarpos oreophilus/Festuca idahoensis*	Hironaka et al. 1983
ARTRV/AGSP	*Artemisia tridentata vaseyana/Agropyron spicatum*	Hironaka et al. 1983
ARTRV/FEID	*Artemisia tridentata vaseyana/Festuca idahoensis*	Hironaka et al. 1983
ARTRX/AGSP	*Artemisia tridentata xericensis/Agropyron spicatum*	Hironaka et al. 1983
ARTRX/FEID	*Artemisia tridentata xericensis/Festuca idahoensis*	Hironaka et al. 1983
ERCO	*Eriogonum compositum*	
FEID-AGSP, BASA	*Festuca idahoensis-Agropyron spicatum, Balsamhoriza sagittatum*	Johnson and Simon 1987
FEID-AGSP, LUSE	*Festuca idahoensis-Agropyron spicatum, Lupinus sericeus*	Johnson and Simon 1987
FEID-KOCR	*Festuca idahoensis-Koleria cristata*	Johnson and Simon 1987
POTR/AMAL-SYOR/TALL FORB	*Populus tremuloides/Amelanchier alnifolia-Symphoricarpos oreophilus/Tall Forb*	Mueggler 1988
PREM	*Prunus emarginata*	none
PUTR/AGSP	*Purshia tridentata/Agropyron spicatum*	Johnson and Simon 1987
PUTR/FEID	*Purshia tridentata/Festuca idahoensis*	Johnson and Simon 1987

Table 1 (continued)
b)

Plant Association Group Code	Plant Association Group Name	Included Plant Communities and Plant Associations	Primary Reference
Canyon Riparian WG	Canyon Riparian WG	*Alnus rhombifolia/Philadelphus lewisii*	Miller 1976
		Betula occidentalis/Mesic forb	Padgett et al. 1989
		Crataegus douglasii/Rosa woodsii	Kovalchik 1987
		Populus trichocarpa/Rosa woodsii	Asherin and Orme 1978
		Salix lasiolepis/Barren	Padgett et al. 1989
		Salix lasiolepis/Mesic forb	Moseley 1999
		Salix lutea/Poa pratensis	Moseley 1999
JUOC Woodland WG	*Juniperus occidentalis* Woodland WG	*Juniperus occidentalis/Agropyron spicatum*	Dealy 1975
		Juniperus occidentalis/Festuca idahoensis	Dealy 1975
PSME Forest WG	*Pseudotsuga menziesii* Forest WG	*Pseudotsuga menziesii/Physocarpus malvaceus*	Steele et al. 1981
		Pseudotsuga menziesii/ Symphoricarpos oreophilus	Steele et al. 1981
PSME-ACGL WG	*Pseudotsuga menziesii-Acer glabrum* WG	*Acer glabrum*	none
		Pseudotsuga menziesii/Physocarpus malvaceus	Steele et al. 1981
		Pseudotsuga menziesii/ Symphoricarpos oreophilus	Steele et al. 1981

Table 2. Crosswalk between range sites identified as occurring within the study area and plant associations reported for the area. The *map number*, *range site*, and *range site code* identified for the study area by Gibbs and Franzen (1999) are listed with the comparable potential natural vegetation plant association and the associated primary reference.

Map number	Range site	Range site code	Plant Association	Primary Reference
1	North slope loamy 12-16", FEID/KOCR	B9-5-I	FEID-KOCR, low	Johnson and Simon 1987
2	North slope 16-22", SYAL/FEID/AGSP	B9-2-I	SYAL-ROSA	Johnson and Simon 1987
3	Shrubby north 15 +", PHMA/SYAL	009XY060OR	PHMA-SYAL	Johnson and Simon 1987
4	South slope loamy 12-16", AGSP/POSE	B9-12-I	AGSP-POSE	Johnson and Simon 1987
5	High mountain south 16-20", ARTRV/ERIOG/AGSP/STIPA	010XC050OR	ARTRV-SYOR/AGSP	Hironaka et al. 1983
6	Loamy 12-16", ARTRX/AGSP	010XY007ID	ARTRX/AGSP	Hironaka et al. 1983
7	Loamy 16-20", PUTR2/FEID	010XY003ID	PUTR/FEID	Johnson and Simon 1987
8	Loamy bottom, ELCI2	010XY005OR	ARTRT/ELCI	Hironaka et al. 1983
9	North slope loamy 12-16", ARTRX/AGSP	010XY010ID	ARTRX/FEID	Hironaka et al. 1983
10	North slope loamy 16-22", ARVA2/FEID	010XY005ID	ARTRV/FEID	Hironaka et al. 1983
11	Shallow south stony 12-16", ARTRX/AGSP	B10-16-I	ARTRX/AGSP	Hironaka et al. 1983
12	Shallow south schist 9-12", FONE2/AGSP	010XC052OR	GLNE/AGSP	Johnson and Simon 1987
13	Shrubby mountain north 16-20", AMAL/ARTRV/FEID	010XC067OR	ARTRV-SYOR/FEID	Hironaka et al. 1983
14	South slope loamy 12-16", ARTRX/AGSP	010XY019ID	ARTRX/AGSP	Hironaka et al. 1983
15	Very shallow 12-20", ARRI2/POSE	010XY002ID	ARRI/POSE	Johnson and Simon 1987
16	Douglas fir/mountain snowberry, PSME/SYOR	E43A-1-I	PSME/SYOR	Steele et al. 1981
17	Rock outcrop		none	none
18	Aspen		*Populus tremuloides/Amelanchier alnifolia-Symphoricarpos oreophilus/Tall Forb*	Mueggler 1988

Map number	Range site	Range site code	Plant Association	Primary Reference
19	Shallow stony loam 12-16", ARAR8/AGSP	010XY015ID	ARAR/AGSP	Hironaka et al. 1983
20	Semi-wet meadow		rangesite is general, likely crosswalks to numerous associations	none
21	Loamy 12-16", AGSP/POSE	B9-6-I	AGSP-POSE	Johnson and Simon 1987
22	Loamy 16-22", FEID/AGSP	B9-3-I	FEID-AGSP	Johnson and Simon 1987
23	SR Mountain shallow north 12-16", ARTRV/FEID/POSE	010XC075OR	ARTRV/FEID	Hironaka et al. 1983
24	South slope loamy 16-22", AGSP/FEID	B9-13-I	FEID-AGSP/BASA	Johnson and Simon 1987
25	South schist 9-12", FONE2/AGSP	010XC044OR	GLNE/AGSP	Johnson and Simon 1987
26	Shallow south slope 12-16", AGSP/OPPO	B9-7-I	AGSP-POSE/OPPO	Johnson and Simon 1987
27	JD Shallow south 12-16", JUOC/PSSPS/STTH2/POSE4	010XB047OR	JUOC/AGSP	Dealy 1975

VEGETATION DESCRIPTION

Grassland Vegetation

Agropyron spicatum-Poa secunda Plant Assocations

Distribution--*Agropyron spicatum-Poa secunda* plant assocations are described from sites located in the Hells Canyon, Wallowa and Blue mountains, Columbia River Basin, and western Montana (Johnson and Simon 1987; Johnson and Clausnitzer 1991; Tisdale 1986; Meuggler and Stewart 1980; Daubenmire 1970; Mueggler and Harris 1969). Johnson and Simon (1987) describe numerous *Agropyron spicatum-Poa secunda* communities for the Hells Canyon region. Tisdale (1986), in comparison, discribes only one for his Hells Canyon study area. In an effort the reconcile this classification conundrum, Rust (1997) proposed two associations with six variants (or phases). This trend appears to characterize data from this study as well. Two major associations, *Agropyron spicatum-Poa secunda* (AGSP-POSE) and *Agropyron spicatum-Poa secunda/Balsamorhiza sagittata* (AGSP-POSE/BASA), appear to characterize the compositional loci of high variability in composition along an environmental gradient of moisture availability associated with elevation, aspect, slope gradient, and soil texture. *Agropyron spicatum-Poa secunda* plant associations occur throughout the easement area. Stands were sampled at Upper Rock Creek, Upper Wolf Creek, Perkins Creek, Thorn Spring Creek, Trail Creek, McCord Butte, Rocky Comfort Flat, West/Middle Ridge, Upper Flat Creek, Spring Creek, Cuddy Mountain, Emery Creek, Summer Creek, and Kleinschmidt Grade. Though distinct *Agropyron spicatum-Poa secunda* plant associations appear to occur within the study area, all stands are mapped as *Agropyron spicatum-Poa secunda/Balsamorhiza sagitatta* and are not treated as a plant association group (Table 1).

Vegetation--*Agropyron spicatum-Poa secunda* communities are characterized by a relatively open, tall bunchgrass canopy dominated by *Agropyron spicatum. Agropyron spicatum* is abundant, occurring with 40 - 60 and 20 - 30 percent cover in stands grouped as AGSP-POSE/BASA and AGSP-POSE, respectively. *Poa secunda* is consistently present but typically is only common to well represented. Annual bromes (*Bromus brizaeformis, Bromus japonicus,* and *Bromus tectorum*) and *Poa bulbosa* are often present and may occur with abundance in degraded stands. In AGSP-POSE/BASA associated herbaceous species include *Balsamorhiza sagittata, Lupinus* spp., *Crepis accuminata, Allium acuminatum, Achillea millefolium,* and *Epilobium paniculatum*. Common herbaceous species associated with AGSP-POSE are *Balsamorhiza sagittata, Penstemon deustus,* and *Collomia grandiflora*.

Environment--The AGSP-POSE/BASA and AGSP-POSE associations occur in upper-slope to ridgetop positions on major ridge systems within the study area. Soils on these steep, hot, dry sites are very gravelly, cobbly colluvium which is often raveling. The associations are weakly differentiated on the basis of elevation, slope configuration, and parent material. AGSP-POSE/BASA tends to occur onbasalt parent materials, at higher elevation (3700 - 5100 feet) compared to AGSP/POSE, and with straight slope configuration. AGSP-POSE tends to occur on metamorphic parent material, at lower elevation (2900 - 4500 feet), and with convex slope configurations. *Festuca idahaoensis* plant associations are adjacent on adjacent and opposing north-facing slopes.

Conservation and management considerations--*Agropyron spicatum* is considered one of the most important forage species for wildlife and livestock, though it is not the most highly preferred species (Sours 1983; Zlatnik 1999). *Agropyron spicatum* is moderately grazing tolerant only during seasonal periods when it is not growing. It is extremely sensitive to defoliation (by herbivory or fire) during the active growing season (Blaisdell and Pechanec 1949; Britton et al. 1990; McLean and Wikeem 1985). *Agropyron spicatum* is considered a grazing decreaser. Heavy grazing results in stand degradation and mortality of individual bunchgrass plants.

AGSP-POSE/BASA and AGSP-POSE are relatively resistant to fire. Seasonal timing, however, largely determines the affect of fire. *Agropyron spicatum* has coarse stems and little leafy material. In the

dormant period dry leaf material and stems burn rapidly and little heat is transferred down toward the leaf meristem located at the soil surface. *Agropyron spicatum* plant associations are most severely affected by fire that occurs during the growing season, prior to dormancy (Zamora 1989).

Cummulative effects of fire and livestock grazing are significant. Stands of *Agropyron spicatum* exposed to fire and subsequent grazing show higher bunchgrass mortality and lower productivity and reproduction than stands that are exposed only to fire. Cattle often congregate on recently burned stands as *Agropyron spicatum* regrowth is highly palatable and preferred forage (Bunting et al. 1998; Moomaw 1956; Strang 1989).

The response of AGSP-POSE/BASA and AGSP-POSE to disturbance is influenced by the presence of annual grass species. The early spring growth phenology of *Bromus tectorum* and *Elymus caput-medusea* confers these species a competitive advantage over *Agropyron spicatum* in seedling establishment. These exotic annual grass species are able to germinate and initiate root growth at cooler soil temperatures and continue to grow throughout winter. In spring the annual species are able to competitively capture soil surface moisture before initiation of significant root growth has occurred in *Agropyron spicatum* (Harris 1967). Increased abundance of annual grass species leads to the accumulation of fine fuels, which results in more frequent fire and the subsequent reduction in abundance of *Agropyron spicatum* (Peters and Bunting 1994; Whisenant 1990). This spiraling decline related to the invasion of annual grass species has contributed to widespread loss of the quality and distribution of *Agropyron spicatum* plant associations.

Festuca idahoensis-Agropyron spicatum, Balsamhoriza sagittata (FEID-AGSP, BASA) and ***Festuca idahoensis-Agropyron spicatum, Lupinus*** (FEID-AGSP, LUPINUS)

Distribution--The *Festuca idahoensis-Agropyron spicatum* plant association is described from sites located in the northern portion of the Blue Mountains, the northeastern portion of the Wallowa Mountains, Hells Canyon and southwestern Montana (Johnson and Simon 1987; Johnson and Clausnitzer 1991; Tisdale 1986; Meuggler and Stewart 1980). Johnson and Simon (1987) differentiate FEID-AGSP/BASA and FEID-AGSP/LUSE from sites within the northeastern portion of the Wallowa Mountains and Hells Canyon. The associations are among the most abundant bunchgrass associations within the Wallowa Mountains and Hells Canyon. This differentiation is also apparent in our data from the upper Hells Canyon region except the *Lupinus* species is not always *Lupinus sericea*. For the purposes of this discussion, the communities are tentatively differentiated here as phases rather then plant associations.

The association occurs throughout the easement area. Stands of the association were sampled at Benton Creek, Cuddy Mountain, Emery Creek, Lower Wolf Creek, Rocky Comfort Flat, Spring Creek, Summer Creek, Trail Creek, Upper Flat Creek, and West/Middle Ridge.

Vegetation--The grassland vegetation is co-dominated by *Festuca idahoensis* and *Agropyron spicatum*. These species form a relatively dense bunchgrass canopy (32 - 62 percent cover). *Poa secunda* is consistently present in the understory. *Festuca idahoensis* is typically more abundant in the *Lupinus* phase. Important forbs of the *Balsamorhiza sagittata* phase are *Sedum stenopetalum, Eriophyllum lanatum, Castilleja* spp., *Allium acuminatum, Calochortus* spp., *Achillea millefolium, Balsamorhiza sagittata, Crepis accuminatum,* and *Lupinus* species. *Achillea millefolium, Balsamorhiza sagittata, Crepis acuminata, Arabis* spp., *Arnica sororia, Astragalus purshii, Collinsia parviflora, Eriogonum heracleoides, Lithospermum ruderale, Lupinus sericeus,* and *Senecio integerrimus* are important herbaceous associates of the *Lupinus* phase (Appendix 3).

Bromus tectorum and *Bromus brizaeformis* are present in both communities with degraded conditions. *Bromus japonicus* appears to have a greater affinity for the *Lupinus* phase. *Sedum stenopetalum, Eriophyllum lanatum, Castilleja* spp. decrease with degradation in the *Balsamorhiza* phase while *Tragopogon dubius, Epilobium paniculatum, Collomia grandiflora,* and *Lactuca serriola* increase (Appendix

3). In the *Lupinus* phase *Arabis* spp., *Arnica sororia, Eriogonum heracleoides*, and *Senecio integerrimus* are decreasers while *Tragopogon dubius, Epilobium paniculatum, Clarkia pulchella,* and *Lomatium triternatum* increase in abundance with poorer condition (Table x).

Factors that contribute to the increased abundance of exotic plant species appear to be confounded with basic environmental factors. Lower elevation FEID-AGSP stands tend to occur on steeper slopes. The apparent correlation between increased number and abundance of exotic species with the increased abundance of *Festuca idahoensis* and *Agropyron spicatum* suggests that lower elevation, more steeply sloped, and perhaps more productive, sites are more susceptible to invasion by exotic species. These low elevation sites are also more heavily utilized by livestock as they occur in closer proximity to water.

Environment--The association occurs on steep to moderately steep, west-southwest- to east-southeast-facing, well drained slopes on mid- to upper-slope positions of upper breakland and lower mountain ridges. The association most frequently occurs on convex topographical surfaces at elevations ranging from 2700 to 6200 feet. Higher elevation stands tend to occur on more gentle slopes. The *Balsamorhiza* phase typically occurs on northeast- to east-facing slopes while the *Lupinus* phase occurs on northwest- to west-facing slopes. *Purshia tridentata/Agropyron spicatum, Artemisia rigida,* and *Agropyron spicatum* lithosolic communities are often adjacent in upslope positions. *Pseudotsuga meziesii/Physocarpus malvaceus, Artemisia tridentata vaseyana, Physocarpus malvaceus*, or *Agropyron spicatum-Poa secunda* associations are often adjacent downslope.

Conservation and management considerations--Native grasslands such as FEID-AGSP are apparently highly stable, as is evidenced by abrupt and well-defined ecotones with forest and shrublands (Tisdale 1986). The dominant bunchgrasses within the association, however, show differing levels of tolerance to fire disturbance. *Agropyron spicatum* is considered tolerant of fire. In the dormant period dry leaf material and stems burn rapidly and little heat is transferred downward into the leaf meristem located at the soil surface. *Agropyron spicatum* is sensitive to burns that occur during the growing season prior to the onset of dormancy (Zamora 1989; Zlatnik 1999). *Festuca idahoensis*, however, is generally considered fire-sensitive. Dried foliage arranged in a dense, fine-leaved tuft may continue to smolder for a considerable period after the initial fire front has passed (Bradley 1986; Wright and Klemmedson 1965). *Festuca idahoensis* can be severely damaged by summer and fall fires; recovery may require several decades (Antos et al. 1983; Conrad and Poulton 1966; Harniss and Murray 1973). *Festuca idahoensis* appears to be least damaged by fires that occur in early spring. In spring cool, moist soil may provide protection from fire damage and promote regrowth (Bradley 1986).

Tisdale (1986) argues that current composition or distribution of FEID-AGSP stands are not significantly affected by fire. Johnson and Simon (1987), however, found that native perennial forbs and both exotic and native annuals (such as *Balsamorhiza sagittata*, *Lupinus* spp., *Achillea millefolium*, and *Lactuca serriola*) increase after fire.

Festuca idahoensis and *Agropyron spicatum* are highly palatable and important forage species for livestock and wildlife. Excessive utilization of FEID-AGSP stands results in a decline in abundance of these highly vulnerable and palatable native perennials and an increase in exotic annual species, especially *Bromus* species (Tisdale 1986). With moderate grazing impact *Festuca idahoensis* declines in cover and constancy while *Agropyron spicatum* and *Poa secunda* increase. High grazing intensity results in decreased *Agropyron spicatum* abundance, increased bare ground and gravel exposure, and subsequent invasion by annual *Bromus* species (Johnson and Simon 1987). Native perennial forbs (especially *Lupinus*, *Balsamorhiza sagittata*, and other unpalatable species) respond to livestock grazing with initial increases, followed by decreases in abundance on degraded sites dominated by annual exotic grass species (Johnson and Simon 1987; Tisdale 1986). Overgrazing, especially on ridgetops, will increase wind and water caused soil erosion due to lack of vegetative and microbiotic crust cover. As a result, spring soil moisture decreases. In these conditions *Festuca idahoensis* often will not persist leading to a droughtier site and greater abundance of *Agropyron spicatum* (Johnson and Simon 1987).

Early season livestock grazing may damage FEID-AGSP associations for several reasons. Trampling by livestock is most severe during early season with saturated soil conditions. Early season livestock use often results in soil compaction and uprooting of bunchgrasses and other native perennial plants. Early grazing *Festuca idahoensis* and *Agropyron spicatum* reduces seed formation and plant vigor. Repeated early season grazing eventual results in perennial bunchgrass mortality (Johnson and Simon 1987).

The distribution of grazing is typically uneven in the steep terrain characteristic of the canyon grasslands. Livestock often concentrate on more gradual slopes, flats, and on areas closer to water. This often results in over-utilization in late spring and early summer during peak growth periods (Tisdale 1986). The impacts of livestock grazing may be compounded by wild ungulate use. Deer and elk use of FEID-AGSP is high and, when combined with cattle grazing, can lead to over utilization, especially during simultaneous use in winter (Johnson and Simon 1987).

Festuca idahoensis, and to a lesser extent *Agropyron spicatum*, require maintenance of the surface area between individual bunchgrasses, especially with sufficient cover of microbiotic crust to help maintain soil moisture (Johnson and Simon 1987). *Festuca idahoensis* and *Agropyron spicatum* are sensitive to defoliation (by herbivory or fire) during the active growing season. Prescribed fire may increase diversity and grass production though it should occur in spring when soil moisture is higher or in late fall of dry years (Bradley 1986). Livestock grazing during flowering and seed forming periods of native perennial grasses should be avoided. Proper management of spring sheep grazing on degraded sites can help control weeds, reduce *Balsamorhiza sagittata*, and reduce annual *Bromus* species. On steeper slopes sheep may cause less damage than cattle, however, sheep grazing during early spring is damaging to *Festuca idahoensis* because it is the preferred forage (Johnson and Simon 1987).

Festuca idahoensis-Koleria cristata (FEID-KOCR) Plant Associations

Distribution--This regional endemic plant association is known only from the Wallowa, Seven Devils, and western Salmon River mountains and Hells Canyon (a range of less than 10,000 square miles). The association is described by Johnson and Simon (1987), Tisdale (1986), Campbell (1962), Mueggler and Harris (1969) and Poulton (1955) from sites on canyon and mountain slopes of the lower Snake River drainage. Johnson and Simon (1987) recognize four *Festuca idahoensis-Koleria cristata* plant associations from sites in the northeast Wallowa Mountains and Hells Canyon. Our data support recognition of three of these four plant associations (FEID-KOCR, Ridgetop; FEID-KOCR, High; and FEID-KOCR, Low) within the upper Hells Canyon area. Stands within the Rocking M Ranch are all considered FEID-KOCR, High, though they are identified simply as FEID-KOCR in Figures 3 and 4, Table 1, and Appendix 2.

Vegetation--FEID-KOCR plant associations are characterized by a dense sward of bunchgrass and a rich assemblage of forbs. Total perennial grass cover typically ranges for 60 to 70 percent. *Festuca idahoensis* is usually abundant. *Agropyron spicatum* is often the co-dominant bunch grass, though the presence of *Koleria cristata* on these sites is indicative of more mesic environments, compared to adjacent *Festuca idahoensis/Agropyron spicatum* stands. Consistent associated forbs include *Brodiaea douglasii, Frasera albicaulis, Castilleja hispida, Hieracium albertinum,* and *Arnica sororia* (Johnson and Simon 1987).

FEID-KOCR, Ridgetop; FEID-KOCR, High; and FEID-KOCR, Low stands observed in the upper Hells Canyon region appear similar to those described by Johnson and Simon (1987) primarily on the basis of patterns in environmental distribution. There are, however, significant differences in the species composition of these associations. This may be due to the differences in seral status or the distribution and relative abundance of key species within the range of the associations. Common forbs of upper Hells Canyon FEID-KOCR, High stands are: *Achillea millefolium, Crepis acuminata, Senecio integerrimus, Calochortus eurycarpus, Clarkia pulchella, Crepis modocensis, Eriogonum heracleoides*, and *Lupinus laxiflorus*. Herbaceous species characteristic of the more xeric FEID-KOCR, Low stands include:

Balsamorhiza sagittata, Castilleja spp., Collomia grandiflora, Epilobium paniculatum, Lithospermum ruderale, Myosotis micrantha, and *Polygonum douglasii*. *Arnica sororia, Eriogonum heracleoides*, and *Brodiaea douglasii* are common herbaceous associates of FEID-KOCR, Ridgetop stands observed in the upper Hells Canyon region.

Environment--FEID-KOCR associations occur on relatively deep loessal soils that overlay a range of different rock types. The association includes the most productive grassland stands in the Blue Mountains ecoregional section. Stands of FEID-KOCR, Ridgetop occur on gentle to moderately steep, west- to northeast-facing slopes in ridgetop and upper-slope positions. The microtopographical configuration is usually convex, but may also be straight or concave. The elevation of stands ranges from 4500 to 6300 feet. The FEID-KOCR, High association occurs on moderately steep to steep west- to north-facing slopes in mid- to upper-slope positions at 4500 to 5600 feet elevation. Stands of FEID-KOCR, Low occur on steep northeast- to northwest-facing slopes in lower- to upper-slope positions at 2960 to 5000 feet elevation. Factors of slope aspect and elevation interact in a compensatory manner. Higher elevation stands of FEID-KOCR, Low occur on more southwesterly aspects; the lowest elevation stands occur on northerly aspects.

Conservation and management considerations--*Koelaria cristata* often shows little affect or increases with fire disturbance. Similar to *Agropyron spicatum*, the dried coarse foliage of the low-growing bunchgrass species burns rapidly with little heat transfer down toward leaf meristem tissues located at or just below the soil surface (Tirmenstein 1987). The effect of fire on *Koelaria cristata* is related to the season of the fire. The species is least effected by early spring and fall burns. It is most effected by late spring and summer fire events (Britton et al. 1990; Volland and Dell 1981; Wright and Bailey 1980). *Festuca idahoensis*, however, is generally considered fire-sensitive. Dried foliage arranged in a dense, fine-leaved tuft may continue to smolder for a considerable period after an initial fire front has passed (Bradley 1986; Wright and Klemmedson 1965). *Festuca idahoensis* can be severely damaged by summer and fall fires; recovery may require several decades (Antos et al. 1983; Conrad and Poulton 1966; Harniss and Murray 1973). *Festuca idahoensis* appears to be least damaged by fires that occur in early spring. In spring cool, moist soil may provide protection from fire damage and promote regrowth (Bradley 1986). Fire disturbance in FEID-KOCR plant associations may result in increased abundance of *Koelaria cristata* and decreased abundance of *Festuca idahoensis*. The lengthy recovery period of *Festuca idahoensis* may also contribute to increased abundance of *Poa pratensis* and *Balsamorhiza sagittata* following fire disturbance (Johnson and Simon 1987; Tisdale 1986). Higher moisture levels characteristic of north-facing slopes, especially at higher elevations, has probably limited the occurrence of fire on many FEID-KOCR sites.

The greatest concerns regarding the maintenance of quality FEID-KOCR habitats are the intensity and timing of grazing by livestock. With excessive grazing (at all elevations) *Festuca idahoensis* and (eventually) *Koelaria cristata* are eliminated and replaced by exotic annual *Bromus* species, annual and perennial forbs, *Poa secunda*, and *Poa pratensis* (Johnson and Simon 1987). On shallow ridgetop soils less palatable native perennial species (such as *Poa secunda*, *Danthonia unispicata*, and various forbs) may increase with excessive utilization (Johnson and Simon 1987). Grazing disturbance of sites with deep soil, benches, and gentle ground (at all elevations) results in the initial increase of native forbs, *Koelaria cristata*, *Poa pratensis*, *Poa bulbosa*, and annual *Bromus* species while *Festuca idahoensis* and often *Agropyron spicatum* decline. On lower elevation sites *Agropyron spicatum* may increase with degradation as competition is reduced and sites become droughtier due to loss of vegetative and microbiotic crust cover (Johnson and Simon 1987).

Stands of FEID-KOCR located on steep slopes are very unstable and often slump. Occurrences on gentle slopes and ridgetops are most heavily utilized and impacted by both livestock and elk. While sheep show preference for *Festuca idahoensis*, cattle and elk prefer *Agropyron spicatum*. Trampling impacts (trailing, soil compaction, erosion, and plant uprooting) can be high (especially on steep slopes) throughout the spring and early summer because soil moisture lingers later on *Festuca idahoensis-Koelaria cristata* sites. Noxious weeds, usually *Hypericum perforatum*, can become dominant on degraded sites at all elevations

and difficult to eradicate (Johnson and Simon 1987).

Most grassland vegetation benefits from natural levels of disturbance. Periodic grazing or fire can contribute to the maintenance of plant vigor. Maintenance of healthy FEID-KOCR occurrences requires that livestock grazing not occur until perennial bunchgrass species have produced mature seeds (Johnson and Simon 1987). The seasonal timing of the occurrence of fire is also critical.

Festuca idahoensis-dominated plant associations are susceptible to invasion by more fire resistant species such as *Poa pratensis*. Fires that occur during the wet, dormant season (November through March) result in the least impact as plant moisture is high enough to protect sensitive root crowns. Prescribed fire has been used effectively to increase vegetative diversity for wildlife and decrease the abundance of undesirable perennial forbs such as *Grindelia* species (Johnson and Simon 1987).

Shrubland Vegetation

Artemisia rigida/Poa secunda (ARRI/POSE)

Distribution--The association is described by Johnson and Clausnitzer (1991), Johnson and Simon (1987), Hall (1973), Tisdale (1986), Hironaka et al. (1983), and Daubenmire (1970) from stands located in the Blue and Wallowa mountains, Hells Canyon, and the Columbia River plateau. The moderately abundant association occurs in relatively small stands on dispersed basalt ridgetops and lithosolic sites. Many ARRI/POSE stands may represent degraded FEID-KOCR or FEID-AGSP sites.

Vegetation--The sparse, dwarf-shrub vegetation is dominated by *Artemisia rigida*. *Poa secunda* and *Danthonia unispicata* are the principal understory grass species. *Sitanion hystrix* is a consistent associate in stands of the upper Hells Canyon region. *Agropyron spicatum* may also be present, but is usually not common. *Sedum stenopetalum, Polygonum douglasii, Balsamorhiza incana, Allium acuminatum, Lomatium macrocarpum, Trifolium macrocephalum, Lomatium triternatum*, and *Sisyrinchium inflatum* are commonly associated herbaceous species.

Environment--The association is restricted to shallow, basalt lithosolic soils. ARRI/POSE stands occur on exposed, gently sloped ridgetops and dissected plateaus with convex or straight microtopographic configuration at 3500 to 5500 feet elevation.

Conservation and management considerations--*Artemisia rigida* is highly palatable to wildlife and livestock. The shrub is heavily utilized by deer and elk in winter. Shallow soils on rocky ARRI/POSE sites are subject to frost heaving and boiling. When soil moisture is high, trampling damage is often severe. Due to low abundance and discontinuous nature of fuels fire usually does not carry through ARRI/POSE stands ((Hironaka et al. 1983; Hickerson 1986; Johnson and Simon 1987).

Artemisia tridentata tridentata/Agropyron spicatum (ARTRT/AGSP) and ***Artemisia tridentata tridentata/Festuca idahoensis*** (ARTRT/FEID)

Distribution--The plant associations are described from sites in the mountains of northern Nevada and the Snake River Plain of Idaho (Nelson and Jensen 1987; Hironaka et al. 1983). *Artemisia tridentata* stands sampled by Daubenmire (1970) are now considered to be dominated by *Artemisia tridentata wyomingensis*. The extent of *Artemisia tridentata tridentata* associations has severely declined due to the conversion of deep, fertile floodplain soils to cultivation. Relatively few high quality stands of the associations are currently known.

Vegetation--The decline in the extent and quality of these associations pre-dated descriptive work on the sagebrush ecosystems (Hironaka et al. 1983). There is little to no documentation of pristine stand

composition and structure. Hironaka et al. (1983) report that the composition and structure of these stands was nearly identical to that of *Artemisia tridentata wyomingensis/Agropyron spicatum*. In *Artemisia tridentata/Agropyron* stands observed by (now considered primarily ssp. *wyomingensis*) Daubenmire (1970), the shrub canopy is open, ranging from 9 to 26 percent cover. Perennial grass cover is abundant with *Agropyron spicatum* and *Poa secunda* co-dominant. *Stipa commata* is often also present. Principal herbaceous associates include *Antenaria dimorpha, Brodiaea douglasii, Calochortus macrocarpus, Lithofragma bulbifera*, and *Lomatium triternatum*. Plant interspaces are occupied by a continuous cryptogamic crust.

Late-seral, high quality *Artemisia tridentata tridentata/Festuca idahoensis* stands are open. The *Artemisia tridentata tridentata* ranges from 8 to 25 percent cover. Understory bunchgrasses are very abundant. The combined cover of the co-dominant species, *Agropyron spicatum, Festuca idahoensis* and *Poa secunda*, ranges from 75 to (greater than) 100 percent. Important forbs include *Achillea millefolium, Erigeron pumilus, Lithospermum ruderale, Lomatium macrocarpum,* and *Lomatium triternatum*.

Environment--*Artemisia tridentata tridentata/Agropyron spicatum* is indicative of relatively deep, fertile floodplain and colluvial soils. Stands occur on lower to mid-slope positions on moderately steep to gentle slopes on all slope aspects, at 2200 to 3800 feet elevation.

Stands of *Artemisia tridentata tridentata/Festuca idahoensis* occur on moderately steep to steep north-facing convex or concave slopes in mid- to lower-slope positions at 2500 to 3200 feet elevation. In the southern portion of the range the association is reported from 5000 to 7000 feet elevation. Soils are deep gravelly silt loam.

Conservation and management considerations--*Artemisia tridentata tridentata* provides important hiding and thermal cover and nesting habitat for wildlife. *Artemisia tridentata tridentata* plant associations provide important winter range for mule deer. The species is typically killed by fire. *Artemisia tridentata tridentata* can, however, quickly become re-established by seed from adjacent stands. With the occurrence of repeated and extensive fire events, and the invasion of exotic grass species, natural regeneration of *Artemisia tridentata tridentata* is significantly inhibited (Britton and Clark 1985; Bunting et al. 1987; Humphrey 1984; Rosentreter and Jorgensen 1986; Tirmenstein 1999).

Extensive areas of ARTRT/AGSP potential natural vegetation on Rocking M Ranch are currently annual grassland. These areas require aggressive management for the re-establishment of *Artemisia tridentata tridentata* and associated native perennial bunchgrasses. *Artemisia tridentata tridentata* is successfully re-established by broadcast seed, drilling, or with the use of transplant stock (Shaw and Monsen 1990). The use of regional indigenous plant materials from similar site conditions appears important (Meyer and Monsen 1992). Successful re-establishment of *Artemisia tridentata tridentata* is also dependent on the availability of mycorrhizal fungal associates, which may be absent on sites that have been converted to annual grassland for prolonged periods (Rosentreter and Jorgensen 1986).

Stands of ARTRT/AGSP and ARTRT/FEID are typically restricted to draws that are often subjected to concentrated excessive utilization by livestock for grazing, loafing, and trailing. Exotic annual grass species are often well represented to abundant in the understory. These stands are highly vulnerable to conversion to annual grassland following fire (Pechanec et al. 1954; West and Hassan 1985).

Artemisia tridentata tridentata/Elymus cinereus (ARTRT/ELCI)

Distribution--The plant association is reported as occurring is Colorado, Wyoming, Nevada, Idaho, Oregon, and possibly Wyoming (Hironaka et al. 1983; Bourgeron and Engelking 1994; Weixelman et al. 1996). The association is thought to have been widespread prior to European settlement. Currently stands are small and fragmented and typically encompass less than five acres. A few stands are reported that are up to 40 acres (Jankovsky-Jones 1998).

Vegetation--*Artemisia tridentata tridentata* dominates the shrub layer and a mixture of graminoids and forbs dominate the herbaceous layer in stands of high ecological condition. *Elymus cinereus* is usually the most abundant understory species, sometimes reaching near 100 percent cover. *Artemisia tridentata tridentata* typically occurs with an open canopy, ranging from 10-50 percent cover. *Crysothamnus* spp. usually occurs with low abundance in high quality stands. Graminoid species are usually abundant; total cover can be as high as 70 percent. *Elymus cinereus* often contributes to most of the graminoid cover. The total cover of forb is generally between 5 and 20 percent (Weixelman et al. 1996 as cited by Moseley 1998).

Environment--The plant association is often the zone of transition between drier upland associations and the wetter riparian associations. The association is most often found in areas of deep alluvial deposition on gentle to moderately steep valley bottoms, stream terraces, and toeslopes at 2500 to 4500 feet elevation. Seasonal flooding on these sites is rare.

Conservation and management considerations--Much of the discussion regarding the conservation and management of ARTRT/AGSP and ARTRT/FEID (above) also applies to ARTRT/ELCI sites. In contrast to *Artemisia tridentata tridentata*, *Elymus cinereus* is considered highly resistant to fire. Dry coarse leaves and stems burn rapidly and insulate basal leaf meristems from prolonged heating (Bunting 1985; McMurray 1987; Wright 1985). *Elymus cinereus* is an important seral component is stands disturbed by fire (Humphrey 1984). In remnant ARTRT/ELCI stands subjected to intensive livestock grazing residual *Elymus cinereus* is often restricted to the protective cover of *Artemisia tridentata tridentata*. Following fire distrubance these plants are susceptible to over utilization by livestock (Perry and Chapman 1975).

Elymus cinereus provides excellent cover, nesting, and bedding habitats for upland birds, small mammals, and big game (Sours 1983). The perennial grass is attractive as forage for cattle, deer, and elk in spring and fall (Wasser 1982). *Elymus cinereus*, however, is highly susceptible to damage from spring grazing and heavy utilization during the growing season (Krall et al. 1971; Perry and Chapman 1975; Roundy et al. 1983). Krall et al. (1971) and Roundy et al. (1983) recommend restricting livestock use in *Elymus cinereus* to fall and winter.

Elymus cinereus is recognized for its value in riparian restoration. The species is strongly competitive and may effectively suppress undesirable, exotic species such as *Onopordum acanthium* (Scotch thistle) (McMurray 1987; Monsen 1983).

Artemisia tridentata vaseyana-Symphoricarpos oreophylus/Agropyron spicatum
(ARTRV-SYOR/AGSP)

Distribution--The plant association is described by Hironaka et al. (1983), Tueller and Eckert (1987), and Nelson and Jensen (1987) for stands located in southern Idaho and northern Nevada. The association occurs with moderate to low abundance in dispersed patches within the Northwest Basin and Range, east into the Overthrust Mountains, and north into the Idaho Batholith and Beaverhead Mountains ecoregional sections. Few stands of the association were identified within the study area.

Vegetation--The plant association is characterized by a dense shrub canopy of *Artemisia tridentata vaseyana* and *Symphoricarpos oreophilus*. A suite of other mountain shrub species such as *Prunus virginiana, Amelanchier alnifolia*, or *Ribes cereum* are often also present. *Purshia tridentata* is often abundant. In upper Hells Canyon *Artemisia tridentata vaseyana* and *Symphoricarpos oreophilus* are abundant; only trace amounts of *Prunus emarginata* and *Rosa nutkana* are present. *Agropyron spicatum, Bromus carinatus, Melica bulbosa,* and *Stipa occidentalis* are the principal grass species (occurring with a total cover of 25 percent). Herbaceous associates include: *Eriogonum heracleoides, Lupinus sericeus, Achillea millefolium,* and *Balsamorhiza sagittata*.

Environment--The association typically occurs near the upper elevational limit of *Artemisia tridentata vaseyana*. Stands occur on steep, southwest- to northwest-facing slopes in mid-slope positions at 4400 to 8500 feet elevation.

Artemisia tridentata vaseyana-Symphoricarpos oreophylus/Festuca idahoensis (ARTRV-SYOR/FEID)

Distribution--The plant association is described by Hironaka et al. (1983) and Tueller and Eckert (1987) for sites located in southern Idaho and northern Nevada. The association is moderately abundant in dispersed patches within the Northwest Basin and Range, Overthrust Mountains, Idaho Batholith, and Beaverhead Mountains ecoregional sections.

Vegetation--The plant association is characterized by an open shrub canopy of *Artemisia tridentata vaseyana* and *Symphoricarpos oreophylus*. Understory grass and forb species are abundant and contribute greater vegetative cover then the shrub overstory. Principal grass species are *Festuca idahoensis, Agropyron spicatum, Koeleria cristata,* and *Poa secunda*. *Eriogonum heracleoides, Achillea millefolium, Calochortus eurycarpus, Crepis acuminata, Lupinus laxiflorus,* and *Balsamorhiza sagittata* are associated herbaceous species.

Environment--The association occurs on moderate to steep west- to north-facing slopes in mid-slope to ridgetop positions at 3700 to 5300 feet elevation. Stands frequently occupy convex sites.

Artemisia tridentata vaseyana/Agropyron spicatum (ARTRV/AGSP) and ***Artemisia tridentata vaseyana/Festuca idahoensis*** (ARTRV/FEID)

Distribution--These widespread plant associations occur in numerous relatively small stands in the foothills and lower mountain slopes of the Rocky Mountains, northern Great Basin, and upper Hells Canyon. The associations are described from sites in Colorado, Montana, Nevada, and Idaho (Mueggler and Stuart 1980; Cooper et al. 1995; Hironaka et al. 1983; Lewis 1975; Jensen et al. 1988; Baker and Kennedy 1985).

Vegetation--The shrubland ARTRV/AGSP vegetation is dominated by *Artemisia tridentata vaseyana*. *Purshia tridentata* is often well represented to abundant. Associated forbs include *Eriogonum heracleoides, Balsamorhiza sagittata, Lupinus caudatus, Lithosperma ruderale,* and *Achillea millifolium*.

Artemisia tridentata vaseyana forms relatively open canopy in ARTRV/FEID stands (approximately 42 percent cover). *Festuca idahoensis* is the dominant understory grass species and occurs with a mean abundance of 40 percent cover. *Agropyron spicatum* and *Poa secunda* are commonly associated. *Koeleria cristata* and *Sitanion hystrix* may also be present. The mean total abundance of grass species in stands that are in excellent condition is approximately 50 percent cover. Commonly associated forbs include *Arenaria aculeata, Crepis acuminata, Erysimum asperum, Phlox hoodii, Antennaria microphylla, Eriogonum heracleoides, Lupinus* spp., and *Achillea millefolium*. Herbaceous species typically occur with relatively moderate abundance, contributing approximately 20 percent total cover.

Environment--The ARTRV/AGSP plant association occurs in the warmest and driest sites occupied by *Artemisia tridentata vaseyana*. Stands occur on middle and upper canyon slopes with convex microtopography on steep southwest- to northwest-facing slopes in mid- to upper-slope positions at 2600 to 4750 feet elevation. Stands with a more southerly aspect tend to occur with convex microtopography on more gentle slopes. Over the entire range, the association occurs on a variety of different parent materials. Within the upper Hells Canyon area stands occur principally on undifferentiated Columbia River basalts.

The ARTRV/FEID plant association occurs on more cool and mesic sites than ARTRV/AGSP. In the upper Hells Canyon region stands occur on middle and upper canyon slopes with both convex and concave microtopography on moderate to steep west-northwest- to east-northeast-facing slopes in mid- to upper-slope positions at 3000 to 6000 feet elevation. Higher elevation stands (6000 to 8000 feet) tend to occur on gentle, south-facing slopes. The association occurs on a variety of different parent materials. Within the upper Hells Canyon area stands occur principally on undifferentiated Columbia River basalts.

Conservation and management considerations--*Artemisa tridentata vaseyana* provides important winter forage of relatively high nutritive value for both wild ungulates and livestock. Dense stands of ARTRV/AGSP and ARTRV/FEID provide important summer, winter, and spring-fall habitat for mule deer (Hironaka et al. 1983; Bradley 1986). The south-facing slopes of ARTRV/AGSP provide important winter range for deer and elk. Spring grazing of these sites by livestock does not allow *Agropyron spicatum* sufficient recovery prior to the growing season and may contribute to its decline. Steep sloped ARTRV/AGSP and ARTRV/FEID sites are vulnerable to soil displacement and livestock trampling impacts.

Artemisa tridentata vaseyana is highly susceptible to fire mortality. The response of stands of ARTRV/AGSP or ARTRV/FEID is reflective of the response of dominant understory perennial bunchgrass species and dependent on the timing of the fire event, the abundance and vigor of these species, and the abundance of exotic annual grass species. Re-establishment of *Artemisia tridentata vaseyana* occurs through the introduction of seed from adjacent stands and germination of seed stored in the soil surface horizons. *Artemisia tridentata vaseyana* germination is apparently stimulated by heat (Mueggler 1956; Hironaka et al. 1983; Bradley 1986; Johnson and Simon 1987).

Artemisia tridentata xericensis/Agropyron spicatum (ARTRX/AGSP) and ***Artemisia tridentata xericensis/Festuca idahoensis*** (ARTRX/FEID)

Distribution--The plant associations are described by Hironaka et al. (1983) for sites within central southwest Idaho (Elmore, Ada, Boise, Gem, Payette, and Washington counties). The associations occur with low to moderate abundance.

Vegetation--*Artemisia tridentata xericensis* dominates the shrubland canopy. Most stands possess a relatively open shrub canopy. *Purshia tridenata, Chrysothamnus nauseosus,* and *Chrysothamnus viscidiflorus* are commonly associated. *Agropyron spicatum* is the principal grass species in ARTRX/AGSP stands. In ARTRX/FEID *Festuca idahoensis* is present. In the one ARTRX/FEID stand sampled, perennial bunchgrass abundance was 90 percent cover. *Agropyron spicatum* and *Festuca idahoensis* contributed 50 and 40 percent cover respectively. Associated herbaceous species include *Achillea millefolium, Balsamorhiza sagittata, Brodiaea douglasii, Crepis acuminata, Epilobium paniculatum, Erigeron corymbosus, Hieracium albertinum, Lomatium triternatum,* and *Lupinus* spp.

Environment--The associations occur in a relatively narrow environmental zone including sites below 4500 feet elevation that receive 12 inches or greater precipitation per year and with relatively warm summer air temperatures. ARTRX/AGSP stands observed in the study area occur on gentle to steep northeast- to east-facing and west- to northwest-facing slopes at 2500 to 4500 feet elevation. ARTRX/FEID stands were observed at 2500 to 3500 feet elevation on gentle to steep northwest- to northeast-facing slopes with concave microtopography. Both plant associations typically occur on lower to middle canyon slopes in mid- to upper-slope positions.

Purshia tridentata/Agropyron spicatum (PUTR/AGSP)

Distribution--*Purshia tridentata/Agropyron spicatum* is described for sites on the eastern foothills of the Cascade Range, southern portions of the Ochoco, Blue and Wallowa mountains, and the foothills of

the Bitterroot Valley (Daubenmire 1970; Hall 1973; Johnson and Simon 1987; Hironaka et al. 1983; Mueggler and Stewart 1980). The widespread plant association occurs in relatively small, dispersed stands.

Vegetation--In the upper Hells Canyon stands *Purshia tridentata* forms an open (9 percent cover), medium to tall shrub canopy. Other shrub species are usually not abundant; *Glossopetalon nevadense* is frquently present. *Agropyron spicatum* is well represented to abundant in the understory. *Poa secunda* is usually present; *Stipa comata* and *Stipa thurberiana* may also be present. Total grass cover is approximately 16 percent. Typically associated forbs include *Achillea millefolium, Balsamorhiza sagittata, Eriophyllum lanatum, Penstemon deustus, Chaenactis douglasii, Descurainia richardsonii, Epilobium paniculatum, Galium multiflorum, Lactuca serriola, Lomatium dissectum, Phacelia hastata, Phacelia linearis,* and *Tonella floribunda*. Total forb cover is approximately 13 percent.

Environment--In the upper Hells Canyon region the plant association occurs on steep south- to southwest-facing slopes at 2750 to 4000 feet elevation. These convex sites occur on middle and upper canyon slopes in mid-slope positions. Stands occur primarily on basalt parent materials.

Conservation and management considerations--Fire, excessive utilization by livestock and wild ungulates, and the compounding affects of exotic annual grass species are concerns for the maintenance of quality stands of the PUTR/AGSP association. *Purshia tridentata* is very susceptible to fire mortality; little sprouting after fire is observed in the region (Blaisdell 1950; Clark et al. 1982; Scholten 1983; Noste and Bushey 1987; Zlatnik 1999). *Agropyron spicatum* usually recovers from all but the hottest burns (Johnson and Simon 1987). *Agropyron spicatum* will decline in abundance with overgrazing by livestock while less desirable native perennials (*Poa secunda*, *Balsamorhiza sagittata*, and *Lomatium* species), annual *Bromus* species, bare ground, rock, and gravel increase in abundance (Johnson and Simon 1987).

Mule deer and elk rely heavily on the availability of *Purshia tridentata* for fall and winter forage. Cattle and sheep prefer *Purshia tridentata* in summer and fall when it is most vulnerable (Johnson and Simon 1987; Hironaka et al. 1983; Shaw and Monson 1983). Under heavy browsing pressure *Purshia tridentata* acts as a decreaser (Zacek et al. 1977; Monsen1987). Repeated browsing in excess of 60 percent foliar removal by mule deer and elk may result in reduced *Purshia tridentata* cover (Hironaka et al. 1983). Mule deer and cattle compete for *Purshia tridentata* in late summer, fall, and winter (Clements and Young 1997). Trampling by livestock on steep slopes can be damaging to both *Purshia tridentata* seedling survival and understory species due to physical displacement of plants and soil.

Purshia tridentata/Festuca idahoensis (PUTR/FEID)

Distribution--*Purshia tridentata/Festuca idahoensis* is described for sites on the eastern foothills of the Cascade Range, portions of the Ochoco, Blue and Wallowa mountains, and the foothills of the Bitterroot Valley (Daubenmire 1970; Hall 1973; Johnson and Simon 1987; Johnson and Clausnitzer 1991; Hironaka et al. 1983; Mueggler and Stewart 1980). The wide-ranging plant association occurs in relatively small, dispersed stands. The PUTR/FEID-AGSP plant association identified by Johnson and Simon (1987) and Johnson and Clausnitzer (1991) is considered synonymous to PUTR/FEID. The *Purshia tridentata-Agropyron-Festuca* association described by Hall (1973) is assumed to contain PUTR/FEID.

Vegetation--*Purshia tridentata* forms an open canopy. The average shrub canopy cover is approximately 27 percent. Understory bunch grass species are abundant; the sum cover is approximately 50 percent. While *Agropyron spicatum* is often most abundant, the plant association is destinguished by the presence of *Festuca idahoensis* which is usually common to well represented. *Poa secunda* is common to well represented. Herbaceous associates include *Balsamorhiza sagittata, Achillea millefolium, Lupinus* spp*., Penstemon glandulosus, Calochortus eurycarpus, Comandra umbellata, Lithospermum ruderale,* and *Lomatium dissectum*.

Environment--In the upper Hells Canyon region stands occur on steep northwest- to northeast-facing slopes in mid- to upper-slope positions on lower canyon side slopes at 3100 to 3800 feet elevation. Sites are typically convex to straight. Stands occur primarily on meta-sedimentary wackes. *Artemisia tridentata*- and *Physocarpus malvaceous*-dominated plant associations are often adjacent in downslope positions. PUTR/AGSP may be adjacent on more southerly aspects.

Conservation and management considerations--Fire, poorly timed livestock grazing, and excessive use by both livestock and wild ungulates are management issues regarding the PUTR/FEID association. *Purshia tridentata* is usually killed by fire and *Festuca idahoensis* is susceptible to damage from late summer or fall burns when plant and soil moisture conditions are low (Johnson and Simon 1987; Tisdale 1986). When the PUTR/FEID association is overgrazed, *Festuca idahoensis* is eliminated and *Bromus tectorum* eventually dominates the understory (Daubenmire 1970). As degradation occurs, *Purshia tridentata, Festuca idahoensis, Agropyron spicatum*, and moss cover decrease while *Poa secunda, Stipa occidentalis*, native perennial forbs (e.g. *Balsamorhiza sagittata, Penstemon deustus,* and *Lomatium dissectum*), *Bromus* species, native annuals (e.g. *Clarkia pulchella, Galium aparine, Collinsia parviflora,* and *Epilobium paniculatum*), gravel, and bare ground increase (Johnson and Simon 1987; Daubenmire 1970). Heavy use by elk and deer, especially on winter range, will result in reduced *Purshia tridentata* cover, poor seedling survival, and an older age class stand. In addition, cattle and sheep will also browse it, especially in late summer and fall when it is most vulnerable (Johnson and Simon 1987; Hironaka et al. 1983). Repeated browsing of 60 percent foliar removal during winter may cause a decrease in *Purshia tridentata*, though early grazing will allow for it to recover during the growing season (Hironaka et al. 1983).

Trampling caused by early season livestock grazing on steep slopes can impact both *Purshia tridentata* and *Festuca idahoensis*. Damage is most severe during early season with saturated soil conditions and results in compaction and uprooting of bunchgrasses, *Purshia tridentata* seedlings, and other native perennial plants. Early grazing also reduces *Festuca idahoensis* seed formation and, with continued grazing over several years, contributes to losses in plant viability (Johnson and Simon 1987).

Other plant communities

A number of important plant communities that occur within the study area are not discussed in detail here. Plant communities grouped as the Canyon Riparian Working Group (Table 1) are described by Moseley (1999) and will be treated in a forthcoming guide to the riparian vegetation of southwestern Idaho. The *Acer glabrum* and *Prunus emarginata* plant communities (or dominance types) are frequently observed (often from a distance) in the upper portion of drainages within the study area. The communities were not sampled and no references concerning their classification were located in the literature.

Juniperus occidentalis and *Pseudotsuga menziesii* associations within the area are described by Dealy (1975) and Steele et al. (1981). Work reported here did not focus on these forest and woodland communites as they are relatively minor or occur on private land (within the perimeter of the area) that is excluded from conservation easement management.

One stand of the community identified as *Eriogonum compositum* was sampled in the study area. Data are summarized in Appendix 3. This distinctive plant association is restricted to steep, south-facing phyllite scree slopes common on lower-slope breaklands within the study area.

Three stands tentatively classified as *Artemisia rigida/Festuca idahoensis* were sampled. Stands occur in ridgetop and upper-slope positions on steep west- to north-facing slopes. Shallow, gravelly colluvium may occur with bedrock outcrops; cobbles and stones are abundant. Open *Artemisia rigida* occurs with trace amounts of *Artemisia tridentata xericensis* or *Purshia tridentata*. *Festuca idahoensis* and *Poa secunda* are well represented; *Agropyron spicatum* is common. A number of herbaceous species are observed in these stands (Appendix 3), particularly, *Sedum stenopetalum, Eriogonum umbellatum, Eriogonum*

strictum, Penstemon gairdneri, Erigeron bloomeri, and *Allium accuminatum*. Stands observed are both highly stabilized (with abundant biotic crust cover) and naturally prone to soil erosion. Elk and deer sign is common. Livestock access is typically restricted by steep, rocky terrain. Johnson and Simon (1987) suggest relic cover of *Festuca idahoensis* or *Agropyron spicatum* with *Artemisia rigida* indicate a degraded condition. This did not appear to be the case for two stands sampled; elk use is relatively intense on the third.

CONCLUSIONS AND MANAGEMENT RECOMMENDATIONS

The objectives of this study are to develop a comprehensive vegetation map for the conservation easement area, to assist in the classification and description of the vegetation within the area, and provide recommendations for the conservation of wildlife habitats within the easement area. The potential natural vegetation, existing vegetative cover, and ecological condition of the vegetation within the study area is mapped at the scale of 1:24,000. The distribution, composition, physical environment, and conservation and management concerns of major components of the vegetation are described.

Primary management objectives for the area are to maintain and restore the availability and quality of wildlife habitats. Habitats located on steep, upper-slope positions within the conservation easement are largely in a high quality, representative condition. Important components of the vegetation are, however, susceptible to degradation based on the seasonal timing and intensity of fire disturbance and livestock use. Critical lower-slope, valley bottom, and stream side wildlife habitats within the study area have been heavily impacted by the cumulative effects of livestock grazing, exotic species introductions, and fire disturbance. Conservation management strategies need to focus on (1) significant reduction of the number of livestock, and the seasons of livestock use, within the area, (2) fire prevention, (3) direct mitigation and restoration of degraded habitats, and (4) a monitoring and evaluation system.

Livestock use is the principle ecological mechanism to begin downward trends in vegetative condition and the quality of wildlife habitats. The number and season of livestock use within the conservation easement area must be reduced from customary levels in order to simultaneously maintain existing high quality habitat conditions while also restoring those habitats that are degraded.

Native perennial bunchgrass species, *Elymus cinereus, Festuca idahoensis, Poa secunda, Koleria cristata*, and *Agropyron spicatum*, are key components of the shrubland and grassland ecosystems of the area. These species provide important wildlife habitat and commercial resource values. The long lived, deep rooted perennial bunchgrass species native to the area also serve a keystone role in the maintenance of ecosystem stability and resilience to disturbance events and environmental change. Lose of the abundance and vigor of bunchgrass triggers the raveling (perhaps eventually irreversible) decay of ecosystem integrity, and the capability of these sites to produce wildlife habitat and commercial resource values. In order to maintain and enhance quality wildlife habitats and commercial resource values management must result in significant and prolonged gains in the distribution and abundance of bunchgrass. The priority may be restoration of the frequency and cover of *Elymus cinereus* within the historic distribution of *Artemisia tridentata tridentata/Elymus cinereus*.

Adoptive management is an approach that involves the ordered steps of planning, implementing, monitoring, and evaluating. In this cyclical approach monitoring and evaluation are key links to the achievement of management objectives. A monitoring system should be established within the conservation easement that allows the referential power, for example, of paired sampling designs. The capability to identify critical causal relationships between patterns in resource utilization and vegetation composition and structure, the quality of wildlife habitats, and the maintenance of biological diversity will require access to strictly controlled reference conditions. A well planned system of fenced livestock exclosures of sufficient number and size to represent long-term reference ecological conditions of the major plant associations on the Rocking M Ranch Wildlife Conservation Easement Area should be identified and constructed.

LITERATURE CITED

Anderson, M. G., M. D. Merrill, and F. B. Biasi. 1998. Connecticut River watershed. Ecological communities and neotropical migrant birds. Eastern Conservation Science, Boston Satellite Office, The Nature Conservancy, Boston. 56 pp.

Antos, J. A., B. McCune, and C. Bara. 1983. The effect of fire on an ungrazed western Montana grassland. American Midland Naturalist 110(2): 354-364.

Asherin, D. A., and M. L. Orme. Inventory of riparian habitats and associated wildlife along Dworshak Reservoir and lower Clearwater River. Idaho Cooperative Wildlife Research Unit; College of Forestry, Wildlife and Range Sciences; University of Idaho, Moscow. 477 pp.

Baker, W. L. and S. C. Kennedy. 1985. Presettlement vegetation of part of northwestern Moffat County, Colorado, described from remnants. Great Basin Naturalist 45:747-777.

Blaisdell, J. P. 1950. Effects of controlled burning on bitterbrush on the upper Snake River plain. Res. Pap. No. 20. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden. 3 pp.

Blaisdell, J. P. and J. F. Pechanec. 1949. Effects of herbage removal at various dates on vigor of bluebunch wheatgrass and arrowleaf balsamroot. Ecology 30(3): 298-305.

Bourgeron, P. S., R. L. DeVelice, L. D. Engelking, G. Jones and E. Muldavin. 1991. WHTF site and community survey manual. Version 92B. Western Heritage Task Force, Boulder. 24 p.

Bourgeron, P. S., and L. D. Engelking, editors. 1994. A preliminary vegetation classification of the Western United States. Unpublished report prepared by the Western Heritage Task Force for The Nature Conservancy, Boulder, CO. Not paged.

Bradley, A. 1986. Artemisia tridentata ssp. vaseyana. In: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2000, July). Fire Effects Information System, [Online]. Available: http://www.fs.fed.us/database/feis/

Bradley, A. 1986. Festuca idahoensis. In: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2000, July). Fire Effects Information System, [Online]. Available: http://www.fs.fed.us/database/feis/

Britton, C. M. and R. G. Clark. 1985. Effects of fire on sagebrush and bitterbrush. In: Sanders, K. and J. Durham, eds. Rangeland fire effects: a symposium: Proceedings of the symposium; 1984 November 27-29; Boise, ID. U.S. Department of the Interior, Bureau of Land Management, Idaho State Office, Boise.

Britton, C. M., G. R. McPherson, and F. A. Sneva. 1990. Effects of burning and clipping on five bunchgrasses in eastern Oregon. The Great Basin Naturalist 50(2): 115-120.

Bunting, S. C., R. Robberecht, and G. E. Defosse. 1998. Length and timing of grazing on postburn productivity of two bunchgrasses in an Idaho experimental range. International Journal of Wildland Fire 8(1): 15-20.

Bunting, S. C., B. M. Kilgore, and C. L. Bushey. 1987. Guidelines for prescribed burning sagebrush-grass rangelands in the northern Great Basin. Gen. Tech. Rep. INT-231. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden. 33 pp.

Bunting, S. C. 1985. Fire in sagebrush-grass ecosystems: successional changes. In: Sanders, K. and J. Durham, eds. Rangeland fire effects: a symposium: Proceedings of the symposium; 1984 November 27-29; Boise, ID. U.S. Department of the Interior, Bureau of Land Management, Idaho State Office, Boise.

Bureau of Land Management. 1995. Unpublished weather data on file at: Bureau of Land Management, Lower Snake District Office, Boise, ID.

Caicco, S. L., and C. A. Wellner. 1983. Research Natural Area recommendation for Lost Basin Grassland, BLM, Boise District ID. Idaho Natural Areas Coordinating Committee mimeo rept. 11 pp.

Campbell, J. 1962. Grasslands of the Snake River drainage in northern Idaho and adjacent Washington. M.S. Thesis, University of Idaho, Moscow. 86 p.

Clark, R. J., C. M. Britton, and F. A. Sneva. 1982. Mortality of bitterbrush after burning and clipping in eastern Oregon. Journal of Range Management 35(6): 711-714.

Conrad, C. E. and C. E. Poulton. 1966. Effect of a wildfire on Idaho fescue and bluebunch wheatgrass. Journal of Range Management 19(3): 138-141.

Cooper, S. V., P. Lesica, R. L. DeVelice, and J. T. McGarvey. 1995. Classification of southwestern Montana plant communities with emphasis on those of Dillon Resource Area, Bureau of Land Management. Montana Natural Heritage Program, Helena, Montana. 152 pp.

Daubenmire, R. 1970. Steppe vegetation of Washington. Technical Bulletin 62. Pullman, WA: Washington Agricultural Experiment Station. 131 p.

Dealy, J. E. 1975. Ecology of curl-leaf mahogany (*Cercocarpus ledifolius* Nutt.) in Oregon and adjacent areas. Unpublished dissertation, Oregon State University, Corvallis. 168 pp.

Ertter, B., and B. Moseley. 1992. Floristic regions of Idaho. Journal of the Idaho Academy of Science 28(2):57-70.

Gibbs, J. and D. Franzen. 1999. Range site map and associated data for Rocking M Conservation Easement Area. Unpublished document prepared for USDI Bureau of Land Management, Lower Snake River District.

Hall, F.C. 1973. Plant communities of the Blue Mountains of Oregon. R6-ECOL-79-001. USDA, Forest Service, Pacific Northwest Region, Portland OR.

Harniss, R. O. and R. B. Murray. 1973. 30 years of vegetal change following burning of sagebrush-grass range. Journal of Range Management 26(5): 322-325.

Harris, G. A. 1967. Some competitive relationships between Agropyron spicatum and Bromus tectorum. Ecological Monographs 37(2): 89-111.

Henricksen, T.A. 1975. Geology and mineral deposits of the Mineral-Iron Mountain District, Washington County, Idaho, and of a metallized zone in western Idaho and eastern Oregon. Ph.D. dissertation, Oregon State University, Corvallis. 202 p., plus appendices.

Hickerson, Jody. 1986. Artemisia rigida. In: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2000, July). Fire Effects Information System, [Online]. Available: http://www.fs.fed.us/database/feis/

Hill, M. O. 1979a. DECORANA - a FORTRAN program for detrended correspondence analysis and reciprocal averaging. Ecology and Systematics, Cornell University, Ithaca.

Hill, M. O. 1979a. TWINSPAN - a FORTRAN program for arranging multivariate data in an ordered two-way table by classification of individuals and attributes. Ecology and Systematics, Cornell University, Ithaca.

Hironaka, M., M.A. Fosberg, and A.H. Winward. 1983. Sagebrush-grass habitat types of southern Idaho. Bulletin No. 35. Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow. 44 p.

Hitchcock, C.L., and A. Cronquist. 1973. Flora of the Pacific Northwest. University of Washington Press, Seattle, WA. 730 p.

Humphrey, L. D. 1984. Patterns and mechanisms of plant succession after fire on Artemisia-grass sites in southeastern Idaho. Vegetatio 57: 91-101.

Jankovsky-Jones, M. 1998. Conservation strategy for wetlands in east-central Idaho. Unpublished report prepared with funding from the United States Environmental Protection Agency through Section 104(b) (3) of the Clean Water Act. 26 pp. plus appendices.

Jensen, M.E., L.S. Peck, and M.V. Wilson. 1988. A sagebrush community type classification for mountainous northeastern Nevada rangelands. Great Basin Naturalist 48(4):422-433.

Johnson, C.G., and S.A. Simon. 1987. Plant associations of the Wallowa-Snake Province. R6-ECOL-TP-255A-86. USDA, Forest Service, Pacific Northwest Region,Wallowa-Whitman National Forest, Baker City, OR. 399 p., plus appendices.

Johnson, C.G., and R.R. Clausnitzer. 1992. Plant associations of the Blue and Ochoco Mountains. R6-ECOL-TP-036-92. USDA, Forest Service, Pacific Northwest Region. 164 p., plus appendices.

Johnson, F.D. 1981. Idaho: climate/vegetation life zone data. Forestry, Wildlife and Range Science Experiment Station, Univ. of Idaho, Moscow.

Kovalchik, B. L. 1987. Riparian Zone Associations: Deschutes, Ochoco, Fremont, and Winema National Forests. USDA Forest Service, Region 6 Ecology Technical Paper 279-87. Pacific Northwest Region, Portland, OR. 171 pp.

Krall, J. L., J. R. Stroh, C. S. Cooper, and S. R. Chapman. 1971. Effect of time and extent of harvesting basin wildrye. Journal of Range Management 24(6): 414-418.

Lewis, M. E. 1975. Plant communities of the Jarbidge Mountain Complex, Humboldt National Forest. Unpublished report compiled

for the USDA Forest Service, Intermountain Region. 22 pp.

Lichthardt, J., and S. Rust. 1994a. Establishment record for Emery Creek Research Natural Area within Payette National Forest, Adams County, Idaho. Unpublished report prepared for the U.S. Forest Service Intermountain Research Station, Ogden, UT. 17 pp. plus appendices and maps.

Lichthardt, J., and S. Rust. 1994b. Establishment record for Lost Basin Grassland Research Natural Area within Payette National Forest, Adams County, Idaho. Unpublished report prepared for the U.S. Forest Service Intermountain Research Station, Ogden, UT. 16 pp. plus appendices and maps.

Lichthardt, J., and S. Rust. 1994c. Establishment record for Cuddy Mountain Research Natural Area within Payette National Forest, Washington County, Idaho. Unpublished report prepared for the U.S. Forest Service Intermountain Research Station, Ogden, UT. 18 pp. plus appendices and maps.

Mancuso, M. 1995. A vegetation map of the Rocking M Ranch, Upper Dennett Creek/Raft Creek Wildlife Conservation Easement Area, Washington, County, Idaho. Conservation Data Center, Idaho Department of Fish and Game. 38 pp. plus appendices.

Mancuso, M. 1997. A vegetation map of the Rocking M Ranch, Lower Raft Creek, Black Canyon-Tartar Gulch, and Upper Wolf Creek Wildlife Conservation Easement Areas, Washington County, Idaho. Conservation Data Center, Idaho Department of Fish and Game.

Mancuso, M., and R. Moseley. 1995. A vegetation map for Brownlee Wildlife Management Area, Washington County, Idaho. Unpublished report on file at: Idaho Department of Fish and Game, Boise, ID. 72 p., plus appendices.

McLean, A. and S. Wikeem. 1985. Influence of season and intensity of defoliation on bluebunch wheatgrass survival and vigor in southern British Columbia. Journal of Range Management 38(1): 21-26.

McMurray, N. E. 1987. Leymus cinereus. In: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2000, July). Fire Effects Information System, [Online]. Available: http://www.fs.fed.us/database/feis/

McNab, W.H., and P.E. Avers. 1994, compilers. Ecological subregions of the United States: Section descriptions. Administrative Publication WO-WSA-5. U.S.D.A., Forest Service, Ecosystem Management, Washington, DC. 267 p.

Meyer, S. E. and S. B. Monsen. 1992. Big sagebrush germination patterns: Subspecies and population differences. Journal of Range Management 45(1): 87-93.

Miller, T. B. 1976. Ecology of riparian communities dominated by white alder in western Idaho. Unpublished thesis, University of Idaho, Moscow. 154 pp.

Mitchell, V.E., and E.H. Bennett, compilers. 1979. Geologic map of the Baker quadrangle, Idaho (scale 1:250,000). Idaho Bureau of Mines and Geology, Moscow.

Monsen, S. B. 1983. Plants for revegetation of riparian sites within the Intermountain region. In: Monsen, S. B. and N. Shaw, compilers. Managing Intermountain rangelands--improvement of range and wildlife habitats: Proceedings of symposia; 1981 September 15-17; Twin Falls, ID; 1982 June 22-24; Elko, NV. Gen. Tech. Rep. INT-157. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden.

Moomaw, J. C. 1956. Some effects of grazing and fire on vegetation in the Columbia Basin region, Washington. Unpublished dissertation. State College of Washington, Pullman. 87 pp.

Moseley, R. K. 1998. Riparian and wetland community inventory of 14 reference areas in southwestern Idaho. Conservation Data Center, Idaho Department of Fish and Game, Technical bulletin no. 98-5, prepared for Lower Snake River District, Bureau of Land Management. Order no. 1422-D010-P97-0116. 52 pp. plus appendices.

Moseley, R. K. 1999. Riparian inventory and proper functioning condition assessment of the Rocking M Wildlife Conservation Easement Area. Idaho Department of Fish and Game, unpublished report prepared for the Lower Snake River District, Bureau of Land Management. Order No. 1422D910A50202 (Task Order No. 17). 10 pp. plus tables and appendices.

Mueggler, W.F. 1988. Aspen community types of the Intermountain Region. Gen. Tech. Rep. INT-250. USDA, Forest Service, Intermountain Research Station, Ogden, UT. 135 p.

Mueggler, W. F., and C. A. Harris. 1969. Some vegetation and soil characteristics of mountain grasslands in central Idaho. Ecology 50(4): 671-678.

Mueggler, W.F. and W. L. Stewart. 1980. Grassland and shrubland habitat types of western Montana. Gen. Tech. Rep. INT-66. USDA, Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT. 154 p.

Natural Resources Conservation Service. 1995. Soil survey for Adams and Washington counties, Idaho. Weiser, ID. Draft 1995.

Nelson, L., and M. Jensen. 1987. Sagebrush-grass community types of the Humbolt National Forest. USDA Forest Service, Humbolt National Forest, Elko, NV. 54 p., plus appendices.

Noste, N. V. and C. L. Bushey. 1987. Fire response of shrubs of dry forest habitat types in Montana and Idaho. Gen. Tech. Rep. INT-239. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden. 22 pp.

Padgett, W. G., A. P. Youngblood, and A. H. Winward. 1989. Riparian community type classification of Utah and southeastern Idaho. USDA Forest Service R4-Ecol-89-01. Intermountain Region, Ogden, UT. 191 pp.

Pechanec, J. F., G. Stewart, and J. P. Blaisdell. 1954. Sagebrush burning good and bad. Farmers' Bulletin No. 1948. U.S. Department of Agriculture, Washington, DC . 34 pp.

Perry, L. J. and S. R. Chapman. 1975. Effects of clipping on dry matter yields of basin wildrye. Journal of Range Management 28(4): 271-274.

Peters, E. F. and S. C. Bunting. 1994. Fire conditions pre- and postoccurrence of annual grasses on the Snake River Plain. In: Monsen, S. B. and S. G. Kitchen, compilers. Proceedings--ecology and management of annual rangelands; 1992 May 18-22; Boise, ID. Gen. Tech. Rep. INT-GTR-313. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden.

Poulton, C.E. 1955. Ecology of the non-forested vegetation in Umatilla and Morrow counties, Oregon. Unpublished dissertation, State College of Washington, Pullman. 166 pp.

Rosentreter, R. and R. Jorgensen. 1986. Restoring winter game ranges in southern Idaho. Tech. Bull. 86-3. U.S. Department of the Interior, Bureau of Land Management, Idaho State Office, Boise. 26 p.

Ross, S.H., and C.N. Savage. 1967. Idaho earth science: geology, fossils, climate, water, and soils. Idaho Bureau of Mines and Geology, Earth Science Series No. 1, Moscow, ID. 271 p.

Roundy, B. A., G. J. Cluff, J. A. Young, and R. A. Evans. 1983. Treatment of inland saltgrass and greasewood sites to improve forage production. In: Monsen, S. B. and N. Shaw, compilers. Managing Intermountain rangelands--improvement of range and wildlife habitats: Proceedings of symposia; 1981 September 15-17; Twin Falls, ID; 1982 June 22-24; Elko, NV. Gen. Tech. Rep. INT-157. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden.

Rust, S. K. 1997. Community concepts and applications for conservation. Unpublished report prepared for USDA Forest Service Northern Region, Intermountain Region and Intermountain Research Station. Conservation Data Center, Idaho Department of Fish and Game, Boise. 67 pp.

Scholten, G. C. 1983. Bitterbrush management on the Boise Wildlife Management Area. In: Tiedemann, A. R. and K. L. Johnson, compilers. Proceedings--research and management of bitterbrush and cliffrose in western North America; 1982 April 13-15; Salt Lake City, UT. Gen. Tech. Rep. INT-152. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden.

Shaw, N. L. and S. B. Monsen. 1983. Phenology and growth habits of nine antelope bitterbrush, desert bitterbrush, Stansbury cliffrose, and Apache-plume accessions. In: Tiedemann, A. R. and K. L. Johnson, compilers. Proceedings--research and management of bitterbrush and cliffrose in western North America; 1982 April 13-15; Salt Lake City, UT. Gen. Tech. Rep. INT-152. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden.

Shaw, N. L. and S. B. Monsen. 1990. Use of sagebrush for improvement of wildlife habitat. In: Fisser, H. G., ed. Wyoming shrublands: Aspen, sagebrush and wildlife management: Proceedings, 17th Wyoming shrub ecology workshop; 1988 June 21-22; Jackson, WY. Wyoming Shrub Ecology Workshop, University of Wyoming, Department of Range Management, Laramie.

Sours, J. M. 1983. Characteristics and uses of important grasses for arid western rangelands. In: Monsen, S. B., N. Shaw, compilers. Managing Intermountain rangelands--improvement of range and wildlife habitats: Proceedings of a symposia; 1981 September 15-17; Twin Falls, ID; 1982 June 22-24; Elko, NV. Gen. Tech. Rep. INT-157. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station Ogden, UT.

Steele, R., R.D. Pfister, R.A. Ryker, and J.A. Kittams. 1981. Forest habitat types of central Idaho. Gen. Tech. Rep. INT-114. USDA, Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT. 138 p.

Strang, Roy M. 1989. Impacts of fire on herbaceous vegetation. In: Baumgartner, D. M., D. W. Breuer, B. A. Zamora, and others, compilers. Prescribed fire in the Intermountain region: Symposium proceedings; 1986 March 3-5; Spokane, WA. Washington State University, Cooperative Extension, Pullman.

Ter Braak, C. J. F. 1991. CANOCO - a FORTRAN program for canonical correspondence analysis, principal components analysis, and redundancy analysis (version 3.12). IWIS-TNA, Wageningen, The Netherlands.

Tirmenstein, D. 1987. Koeleria macrantha. In: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2000, July). Fire Effects Information System, [Online]. Available: http://www.fs.fed.us/database/feis/

Tirmenstein, D. 1999. Artemisia tridentata spp. tridentata (revised from McMurray, Nancy E. March 1989 and Bradley, Anne, 1986). In: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2000, July). Fire Effects Information System, [Online]. Available: http://www.fs.fed.us/database/feis/

Tisdale, E.W. 1986. Canyon grasslands and associated shrublands of west-central Idaho and adjacent areas. Bulletin No. 40. Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow. 42 p.

Tueller, P. T., and R. E. Eckert, Jr. 1987. Big sagebrush (Artemisia tridentata vaseyana) and longleaf snowberry (Symphoricarpos oreophilus) plant associations in northeastern Nevada. Great Basin Naturalist 47(1): 117-131.

USDA Forest Service. 1992. Ecosystem Inventory and Analysis Guide (7/92). Northern Region, Missoula, MT.

Volland, L. A. and J. D. Dell. 1981. Fire effects on Pacific Northwest forest and range vegetation. U.S. Department of Agriculture, Forest Service, Pacific Northwest Region, Range Management and Aviation and Fire Management, Portland. 23 p.

Wasser, C. H. 1982. Ecology and culture of selected species useful in revegetating disturbed lands in the West. FWS/OBS-82/56. U.S. Department of the Interior, Fish and Wildlife Service, Office of Biological Services, Western Energy and Land Use Team, Washington, DC. 347 pp.

Weixelman, D. A., D. C. Zamudio, and K. A. Zamudio. 1996. Central Nevada Riparian Field Guide. USDA Forest Service, Intermountain Region, R4-ECOL-96-01. 90 pp. plus appendices.

Wellner, C. A., and R. K. Moseley. 1992. Establishment record for Rocky Comfort Flat Research Natural Area within Payette National Forest, Adams County, Idaho. USDA Forest Service. 20 pp. plus appendices.

West, N. E. and M. A. Hassan. 1985. Recovery of sagebrush-grass vegetation following wildfire. Journal of Range Management 38(2): 131-134.

Whisenant, S. G. 1990. Changing fire frequencies on Idaho's Snake River Plains: ecological and management implications. In: Mcarthur, E. D., E. M. Romney, S. D. Smith, and P. T. Tueller, compilers. Proceedings--symposium on cheatgrass invasion, shrub die-off, and other aspects of shrub biology and management; 1989 April 5-7; Las Vegas, NV. Gen. Tech. Rep. INT-276. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden.

Wright, H. A. 1985. Effects of fire on grasses and forbs in sagebrush-grass communities. In: Sanders, K. and J. Durham, eds. Rangeland fire effects: a symposium: Proceedings of the symposium; 1984 November 27-29; Boise, ID. U.S. Department of the Interior, Bureau of Land Management, Idaho State Office, Boise.

Wright, H. A. and A. W. Bailey. 1980. Fire ecology and prescribed burning in the Great Plains--a research review. Gen. Tech. Rep. INT-77. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden. 60 p.

Wright, H. A. and J. O. Klemmedson. 1965. Effect of fire on bunchgrasses of the sagebrush-grass region in southern Idaho. Ecology. 46(5): 680-688.

Zamora, B. A. 1989. Tiller characteristics of bluebunch wheatgrass during the first growing season after fall burning. In: Baumgartner, D. M., D. W. Breuer, B. A. Zamora, and others, compilers. Prescribed fire in the Intermountain region: Symposium proceedings; 1986 March 3-5; Spokane, WA. Washington State University, Cooperative Extension, Pullman.

Zlatnik, E. 1999. Pseudoroegneria spicata (revised from Bradley, Anne. August 1986). In: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2000, July). Fire Effects Information System, [Online]. Available: http://www.fs.fed.us/database/feis/

Zlatnik, E. 1999. Purshia tridentata (revised from Bradley, Anne. 1987). In: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2000, July). Fire Effects Information System, [Online]. Available: http://www.fs.fed.us/database/feis/

APPENDIX 1. Ecological condition classes.

A Pristine condition. Evidence of post-industrial human-caused disturbance is absent. Exotic species are absent.

B Little evidence of post-industrial human-caused disturbance is present. Stand composition and structure is predominantly natural. Exotic species are only common (≤ one percent cover).

C Post-industrial human-caused disturbance is apparent. Stand composition and structure is altered. Exotic species are well represented to abundant (5 - 25 percent cover).

D Evidence of post-industrial human-caused disturbance is prevalent. Stand composition and structure is altered. Native species are present, but are in peril of loss. Increasers dominate the stand. Invader species are a significant compositional component.

F Native stand composition, structure, and function are significantly altered. Re-establishment of native stand composition, structure, and function will require large energy inputs.

APPENDIX 2. Vegetation summary. The area of each plant association with the Rocking M Ranch Wildlife Conservation Easement area is summarized by covertype and ecological condition.

Association	Covertype	Condition class	Acres
ACGL	ACGL	AB	103.6
		B	1.5
		BC	0.2
		CD	1.5
AGSP-POSE/BASA	AGSP-POSE/BASA	AB	1239.3
		B	3056.5
		BC	954.0
		C	28.2
		CD	10.0
	Annual grassland	CD	92.5
		D	336.4
ARRI/POSE	ARRI/POSE	AB	69.3
		B	3.3
		BC	287.7
		C	1.1
		CD	4.0
	Annual grassland	CD	38.6
		D	42.6
ARTRT/AGSP	ARTRT/AGSP	AB	138.3
		B	18.6
		BC	195.2
		C	44.9
	ARTRT/BROMUS	C	151.6
		CD	6.4
	Annual grassland	CD	1121.2
		D	400.5
ARTRT/ELCI	ARTRT/BROMUS	CD	1.7
	ARTRT/ELCI	AB	57.8
		B	26.9
		BC	24.0
		C	0.4
	Annual grassland	CD	236.6
		D	87.3
ARTRT/FEID	ARTRT/BROMUS	C	40.4
	ARTRT/FEID	AB	496.1
		B	0.2
		BC	52.7
	Annual grassland	CD	3.3

Association	Covertype	Condition class	Acres
		D	41.8
ARTRV-SYOR/AGSP	ARTRV-SYOR/AGSP	AB	62.2
		B	0.2
		BC	4.4
	Annual grassland	CD	28.6
ARTRV-SYOR/FEID	ARTRV-SYOR/FEID	AB	279.0
		B	9.5
		BC	6.0
		CD	0.8
	Annual grassland	CD	40.2
ARTRV/AGSP	ARTRV/AGSP	AB	1329.6
		B	908.6
		BC	1635.9
		C	58.4
	ARTRV/BROMUS	CD	12.6
	Annual grassland	CD	651.8
		D	212.3
ARTRV/FEID	ARTRV/BROMUS	CD	26.2
	ARTRV/FEID	AB	2578.6
		B	64.7
		BC	1497.5
		C	0.2
	Annual grassland	CD	360.7
		D	48.9
ARTRX/AGSP	ARTRX/AGSP	AB	1612.9
		B	1859.8
		BC	1574.0
		C	90.9
	ARTRX/BROMUS	C	747.6
		CD	8.0
	Annual grassland	CD	446.7
		D	909.3
ARTRX/FEID	ARTRX/BROMUS	C	48.9
		CD	18.4
	ARTRX/FEID	AB	883.1
		B	8.0
		BC	907.3
		C	137.2
	Annual grassland	CD	389.6
		D	197.7

Association	Covertype	Condition class	Acres
Canyon Riparian WG	Canyon Riparian WG	AB	557.7
		B	400.0
		BC	97.8
		C	144.1
		CD	571.7
		D	84.2
ERCO	Annual grassland	D	28.9
	ERCO	AB	4.6
		B	138.1
		BC	7.3
		C	0.4
FEID-AGSP, BASA	Annual grassland	CD	9.3
		D	24.0
	FEID-AGSP, BASA	AB	934.0
		B	5.1
		BC	226.8
		C	6.0
FEID-AGSP, LUSE	Annual grassland	CD	70.5
		D	13.6
	FEID-AGSP, LUSE	AB	2233.9
		B	13.3
		BC	418.0
		C	4.0
		CD	1.3
FEID-KOCR	Annual grassland	CD	7.3
	FEID-KOCR	AB	535.0
		B	1.7
		BC	90.7
JUOC Woodland WG	JUOC Woodland WG	AB	31.5
		B	46.0
		BC	0.2
POTR/AMAL-SYOR/TALL FORB	POTR/AMAL-SYOR/TALL FORB	AB	12.0
		B	1.5
		BC	0.2
		CD	46.9
PREM	Annual grassland	CD	22.2
	PREM	AB	15.3
		B	73.3
		BC	0.4

Association	Covertype	Condition class	Acres
PSME Forest WG	PSME Forest WG	AB	257.3
		B	30.9
		BC	185.9
		C	198.5
		CD	75.3
PSME-ACGL WG	PSME-ACGL WG	AB	218.8
		BC	2.0
		CD	1.1
PUTR/AGSP	Annual grassland	CD	86.2
		D	79.8
	PUTR/AGSP	AB	107.4
		B	858.6
		BC	316.0
		C	2.8
	PUTR/BROMUS	CD	1.7
PUTR/FEID	Annual grassland	D	4.2
	PUTR/FEID	AB	108.3
		B	1.3
		BC	40.4
		C	2.0

APPENDIX 3. Stand synthesis tables for associations. Mean values (and standard deviation, “S.D.”) for environmental (range is given for aspect) and substrate attributes and plant species constancy (percent frequency, abbreviated “CON”) and characteristic cover (the mean cover of occurrences, abbreviated “CHAR”) are listed for major plant associations within the Rocking M Ranch study area. Capital letters following the plant association code refer to the ecological condition of the stands sampled. Mosses and lichens were consistently identified on a subset of plots, thus constancy values are not shown. The absence of composition data for moss and lichen species does not indicate the no species were observed.

Page Locations

	AGSP-POSE B		AGSP-POSE/BASA B		AGSP-POSE/BASA C	
	2 Plots		8 Plots		4 Plots	
Environment	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
Slope	59.0	5.7	64.4	3.0	46.3	13.0
Aspect	S - W		SW - W		SW - W	
Elevation	3810.0	975.8	3741.3	636.1	4735.0	471.8
N horizon	15.0	14.1	11.6	16.6	11.5	8.2
E horizon	23.0	1.4	30.1	13.7	15.8	9.0
S horizon	1.0	1.4	12.0	8.8	4.8	4.5
W horizon	1.5	2.1	1.4	1.5	7.5	7.6
Substrate (cover)						
Bedrock	0.0	0.0	0.5	1.1	0.0	0.0
Boulder	0.1	0.1	1.1	1.7	0.0	0.1
Cobble	5.0	0.0	8.9	7.3	19.3	21.2
Stone	0.1	0.1	2.3	2.4	1.0	2.0
Gravel	25.0	21.2	23.4	13.7	8.8	4.8
Soil	17.5	10.6	16.5	10.8	20.0	15.8
Litter	42.0	31.1	30.0	16.3	34.3	19.1
Moss	0.6	0.6	1.4	1.7	2.0	2.3
Lichen	0.1	0.0	0.1	0.1	0.0	0.0
Species	CON	CHAR	CON	CHAR	CON	CHAR
Grasses, sedges and rushes						
Agropyron spicatum	100.0	27.5	100.0	42.5	100.0	33.8
Bromus brizaeformis	.	.	75.0	0.3	75.0	3.3
Bromus japonicus	.	.	62.5	0.8	25.0	5.0
Bromus tectorum	50.0	2.0	75.0	0.7	75.0	0.7
Festuca idahoensis	.	.	12.5	1.0	75.0	0.1
Festuca octoflora	50.0	1.0	.	.	.	.
Poa bulbosa	100.0	1.0	12.5	1.0	25.0	4.0
Poa secunda	100.0	3.5	100.0	5.1	100.0	6.8
Stipa thurberiana	.	.	.	.	25.0	0.5
Herbs						
Achillea millefolium	50.0	0.1	50.0	0.5	75.0	0.4
Agoseris glauca	50.0	0.1	.	.	.	.
Agoseris grandiflora	.	.	37.5	0.1	.	.
Agoseris spp.	.	.	12.5	0.1	.	.
Allium acuminatum	50.0	0.1	62.5	0.7	50.0	0.1
Alyssum desertorum	.	.	12.5	0.1	.	.
Amsinckia spp.	.	.	25.0	0.1	.	.
Apocynum androsaemifolium	50.0	25.0	.	.	.	.
Arenaria serpyllifolia	.	.	12.5	0.1	.	.
Arabis sparsiflora	.	.	12.5	0.1	.	.
Astragalus conjunctus	.	.	12.5	0.1	.	.
Astragalus cusickii	50.0	0.5	.	.	.	.
Astragalus inflexus	.	.	12.5	0.1	.	.
Astragalus purshii	.	.	.	.	75.0	0.7
Astragalus vallaris	50.0	0.1	25.0	0.1	25.0	0.1
Balsamorhiza sagittata	50.0	1.0	100.0	8.1	100.0	11.3
Blepharipappus scaber	.	.	37.5	0.1	.	.
Brodiaea douglasii	.	.	12.5	0.1	.	.
Castilleja spp.	.	.	.	.	25.0	0.1
Chaenactis douglasii	100.0	0.1	12.5	0.1	25.0	0.1
Cirsium canovirens	100.0	0.1	.	.	25.0	0.1
Cirsium utahense	.	.	12.5	0.1	.	.
Clarkia pulchella	.	.	50.0	0.3	25.0	0.1
Collomia grandiflora	50.0	0.1	50.0	0.1	100.0	0.1
Collinsia parviflora	.	.	50.0	0.3	25.0	0.1
Crepis acuminata	.	.	25.0	4.5	50.0	1.5
Crepis spp.	.	.	37.5	0.1	25.0	0.1
Cruciferae spp.	.	.	.	.	50.0	1.0
Cryptantha spp.	.	.	12.5	0.1	25.0	0.1
Descurainia richardsonii	.	.	12.5	0.1	.	.
Draba verna	.	.	12.5	0.1	.	.
Epilobium paniculatum	50.0	0.1	62.5	0.3	50.0	0.1
Erigeron chrysopsidis	.	.	.	.	50.0	1.5
Eriophyllum lanatum	.	.	50.0	0.6	25.0	0.1

Eremocarpus setigerus	.	.	12.5	0.1	.	.
Eriastrum sparsiflorum	.	.	.	.	25.0	2.0
Eriogonum umbellatum	.	.	12.5	0.1	25.0	0.1
Euphorbia glyptosperma	.	.	12.5	0.1	.	.
Galium spp.	.	.	12.5	0.1	.	.
Galium multiflorum	.	.	37.5	0.4	.	.
Haplopappus radiatus	.	.	12.5	0.1	.	.
Holosteum umbellatum	.	.	25.0	0.1	.	.
Lactuca serriola	.	.	62.5	0.1	25.0	0.1
Lewisia rediviva	.	.	.	.	25.0	0.1
Lithophragma parviflora	.	.	12.5	0.1	.	.
Lithospermum ruderale	.	.	37.5	0.4	50.0	0.1
Lomatium dissectum	50.0	0.1	50.0	0.5	25.0	0.1
Lomatium grayi	.	.	37.5	1.4	75.0	0.1
Lomatium macrocarpum	.	.	12.5	0.1	.	.
Lomatium spp.	50.0	3.0	37.5	0.7	.	.
Lomatium triternatum	50.0	0.1	.	.	50.0	0.1
Lupinus laxiflorus	.	.	12.5	1.0	.	.
Lupinus spp.	.	.	75.0	1.4	100.0	2.0
Lupinus sericeus	50.0	0.1	.	.	.	.
Mentzelia albicaulis	.	.	12.5	0.1	.	.
Mimulus cusickii	.	.	25.0	0.1	.	.
Microsteris gracilis	.	.	25.0	0.1	.	.
Myosotis micrantha	.	.	25.0	0.1	.	.
Penstemon deustus	.	.	62.5	2.0	75.0	5.7
Penstemon gairdneri	.	.	.	.	50.0	0.1
Penstemon venustus	.	.	.	.	25.0	0.1
Phlox aculeata	50.0	0.1	.	.	.	.
Phacelia hastata	50.0	0.5	50.0	0.1	25.0	0.1
Phlox hoodii	.	.	.	.	50.0	4.5
Phacelia linearis	.	.	25.0	0.1	25.0	1.0
Phlox longifolia	50.0	0.1	.	.	.	.
Phlox viscida	.	.	12.5	0.1	.	.
Plectritis macrocera	.	.	12.5	0.1	.	.
Plagiobothrys tenellus	.	.	12.5	0.1	.	.
Polygonum douglasii	.	.	.	.	25.0	0.1
Scutellaria angustifolia	.	.	12.5	1.0	.	.
Sedum stenopetalum	.	.	12.5	0.1	.	.
Sisymbrium altissimum	.	.	12.5	0.1	.	.
Tonella floribunda	.	.	25.0	2.0	.	.
Tragopogon dubius	50.0	0.1	50.0	1.1	100.0	0.3
Vaccaria segetalis	.	.	25.0	0.1	.	.
Verbascum blattaria	.	.	12.5	0.1	.	.
Viola spp.	.	.	12.5	0.1	.	.
Zigadenus venenosus	50.0	5.0	37.5	0.4	50.0	0.1
Mosses						
Tortula spp.	.	.		3.0	.	.
Shrubs						
Artemisia tridentata vaseyana	50.0	0.1	12.5	0.1	.	.
Artemisia tridentata xericensis	50.0	0.1	.	.	.	.
Chrysothamnus nauseosus	.	.	12.5	0.1	.	.
Chrysothamnus viscidiflorus	50.0	0.1	.	.	50.0	0.1
Prunus virginiana	.	.	12.5	2.0	.	.

Environment	ARRI/FEID B 3 Plots MEAN	S.D.	ARRI/POSE A 2 Plots MEAN	S.D.	ERCO C 1 Plots MEAN	S.D.
Slope	40.3	27.8	4.0	0.0	54.0	0.0
Aspect	W - NW		SW - NW		SW	
Elevation	3880.0	541.5	4490.0	0.0	2300.0	0.0
N horizon	4.3	2.5	1.0	0.0	26.0	0.0
E horizon	14.0	9.8	3.0	0.0	20.0	0.0
S horizon	14.0	9.6	2.5	0.7	19.0	0.0
W horizon	3.0	2.6	0.0	0.0	8.0	0.0
Substrate (cover)						
Bedrock	0.7	0.6	0.0	0.0	0.0	0.0
Boulder	2.4	2.5	0.0	0.0	0.0	0.0
Cobble	26.7	20.8	18.0	11.3	4.0	0.0
Stone	14.3	14.0	0.5	0.7	0.0	0.0
Gravel	10.7	9.0	13.0	2.8	70.0	0.0
Soil	11.7	7.6	14.0	8.5	5.0	0.0
Litter	13.3	8.1	3.0	1.4	19.0	0.0
Moss	5.3	5.9	22.5	3.5	0.0	0.0
Lichen	3.7	4.0	25.0	0.0	0.0	0.0
Species	CON	CHAR	CON	CHAR	CON	CHAR
Ferns and fern allies						
Cystopteris fragilis	33.3	0.1	.	.	.	.
Selaginella wallacei	33.3	15.0	.	.	.	.
Grasses, sedges and rushes						
Agropyron spicatum	100.0	3.4	.	.	.	.
Bromus brizaeformis	66.7	1.0	.	.	.	.
Bromus tectorum	33.3	0.1	.	.	100.0	5.0
Danthonia unispicata	33.3	20.0	.	.	.	.
Festuca idahoensis	100.0	11.7	.	.	.	.
Poa bulbosa	33.3	0.1	.	.	100.0	0.1
Poa secunda	100.0	13.3	100.0	20.0	.	.
Sitanion hystrix	66.7	0.1	100.0	2.5	.	.
Herbs						
Achillea millefolium	66.7	0.1	.	.	100.0	0.1
Agoseris spp.	.	.	100.0	0.6	.	.
Allium acuminatum	66.7	0.1	100.0	2.5	.	.
Allium brandegei	.	.	50.0	0.1	.	.
Antennaria dimorpha	33.3	0.1	.	.	.	.
Antennaria flagellaris	.	.	50.0	0.3	.	.
Arabis spp.	.	.	.	.	100.0	0.1
Arabis microphylla	33.3	0.1	.	.	.	.
Asclepias cryptoceras	.	.	.	.	100.0	0.1
Astragalus inflexus	33.3	0.1	.	.	.	.
Balsamorhiza incana	.	.	100.0	2.3	.	.
Balsamorhiza sagittata	66.7	0.6	.	.	.	.
Brodiaea douglasii	33.3	0.1	.	.	.	.
Calochortus eurycarpus	33.3	3.0	.	.	.	.
Camassia quamash	33.3	0.1	.	.	.	.
Castilleja rustica	33.3	0.1	100.0	1.0	.	.
Chaenactis douglasii	.	.	.	.	100.0	2.0
Clarkia pulchella	66.7	0.1	.	.	.	.
Collomia grandiflora	33.3	0.1	.	.	100.0	0.1
Collinsia parviflora	33.3	0.1	.	.	.	.
Crepis modocensis	.	.	50.0	0.1	.	.
Cryptantha spp.	33.3	0.1	.	.	.	.
Delphinium spp.	33.3	0.1	.	.	100.0	0.1
Draba verna	33.3	0.1	.	.	100.0	0.5
Epilobium paniculatum	66.7	0.1	.	.	100.0	0.1
Erigeron bloomeri	66.7	2.0	.	.	.	.
Erigeron chrysopsidis	33.3	8.0	.	.	.	.
Eriogonum compositum	.	.	.	.	100.0	15.0
Eriophyllum lanatum	33.3	0.1	.	.	.	.
Eriogonum sphaerocephalum	.	.	50.0	0.1	.	.
Eriogonum strictum	66.7	0.1	.	.	.	.

Eriogonum thymoides	.	.	50.0	0.1	.	.
Eriogonum umbellatum	66.7	0.1	.	.	.	.
Eriogonum vimineum	.	.	.	.	100.0	0.1
Galium multiflorum	66.7	0.1	.	.	.	.
Holosteum umbellatum	66.7	0.1	.	.	.	.
Lactuca serriola	33.3	0.1	.	.	.	.
Lomatium dissectum	66.7	0.1	.	.	100.0	0.5
Lomatium grayi	33.3	1.0	.	.	.	.
Lomatium leptocarpum	66.7	0.6	.	.	.	.
Lomatium macrocarpum	66.7	0.6	100.0	12.5	.	.
Lomatium spp.	33.3	4.0	.	.	.	.
Lomatium nudicaule	33.3	4.0	.	.	.	.
Lomatium triternatum	.	.	100.0	2.5	.	.
Microsteris gracilis	66.7	0.1	.	.	.	.
Microseris troximoides	33.3	0.1	.	.	.	.
Myosotis micrantha	66.7	0.1	.	.	.	.
Orobanche fasciculata	33.3	0.1	.	.	.	.
Penstemon deustus	33.3	2.0	.	.	100.0	0.8
Penstemon gairdneri	66.7	0.1	50.0	0.3	.	.
Phacelia hastata	.	.	.	.	100.0	0.1
Phlox viscida	33.3	1.0	.	.	.	.
Polygonum douglasii	33.3	0.1	100.0	5.0	.	.
Scutellaria angustifolia	33.3	0.1	.	.	100.0	0.1
Sedum lanceolatum	33.3	0.1	.	.	.	.
Sedum stenopetalum	100.0	4.4	100.0	10.0	.	.
Silene antirrhina	33.3	0.1	.	.	.	.
Sisyrinchium inflatum	33.3	1.0	100.0	0.6	.	.
Tonella floribunda	33.3	0.1	.	.	.	.
Tragopogon dubius	66.7	0.1	.	.	100.0	0.1
Trifolium macrocephalum	.	.	50.0	5.0	.	.
Vaccaria segetalis	.	.	.	.	100.0	0.1
Zigadenus venenosus	33.3	1.0	.	.	.	.
Lichens						
Cladonia spp.		2.0		11.0		.
Collema spp.		0.1		3.5		.
Dermatocarpon miniatum		.		6.0		.
Peltigera canina		.		3.0		.
Peltigera spp.		1.0		4.0		.
Psora spp.		0.1		.		.
Psora tuckermanii		.		2.0		.
Mosses						
Bryum caespiticium		.		1.0		.
Encalypta spp.		.		3.0		.
Encalypta vulgaris		0.1		.		.
Homulothecium nevadensa		.		0.1		.
Pteridium spp.		0.1		.		.
Tortula ruralis		2.0		19.0		.
Shrubs						
Artemisia rigida	100.0	11.3	100.0	27.5	.	.
Artemisia tridentata xericensis	33.3	0.1	.	.	.	.
Purshia tridentata	33.3	0.1	.	.	100.0	1.0

	ARTRV/FEID A		ARTRV/FEID B	
	2 Plots		3 Plots	
Environment	MEAN	S.D.	MEAN	S.D.
Slope	47.5	3.5	30.7	23.4
Aspect	ALL		ALL	
Elevation	5460.0	198.0	4403.3	317.9
N horizon	0.5	0.7	1.3	1.2
E horizon	10.5	10.6	2.7	1.2
S horizon	15.0	7.1	11.3	9.0
W horizon	0.5	0.7	1.0	1.7
Substrate (cover)				
Bedrock	0.0	0.0	0.0	0.0
Boulder	0.0	0.0	0.3	0.6
Cobble	0.1	0.1	0.7	1.1
Stone	0.0	0.0	0.7	1.2
Gravel	2.0	1.4	0.4	0.6
Soil	1.5	0.7	5.0	4.4
Litter	59.0	5.7	59.0	2.6
Moss	12.5	10.6	3.3	2.1
Lichen	5.0	7.1	0.7	1.1
Species	CON	CHAR	CON	CHAR
Grasses, sedges and rushes				
Agropyron spicatum	50.0	7.0	100.0	24.7
Bromus brizaeformis	.	.	33.3	0.1
Bromus carinatus	.	.	33.3	5.0
Bromus japonicus	.	.	33.3	2.0
Bromus tectorum	.	.	33.3	0.1
Festuca idahoensis	100.0	52.5	100.0	41.7
Koeleria cristata	100.0	0.6	100.0	5.0
Poa secunda	50.0	4.0	.	.
Stipa occidentalis	.	.	33.3	0.1
Herbs				
Achillea millefolium	100.0	1.5	100.0	2.3
Agoseris glauca	50.0	0.1	33.3	0.1
Agoseris spp.	50.0	0.1	33.3	0.1
Anaphalis margaritacea	.	.	33.3	0.1
Antennaria microphylla	100.0	3.0	.	.
Arabis spp.	50.0	0.1	33.3	0.2
Artemisia ludoviciana	50.0	0.1	.	.
Arnica sororia	100.0	1.5	33.3	8.0
Astragalus purshii	50.0	0.1	.	.
Balsamorhiza sagittata	50.0	0.1	.	.
Besseya rubra	.	.	66.7	0.6
Brodiaea douglasii	50.0	0.1	33.3	0.1
Castilleja applegatei	.	.	33.3	4.0
Calochortus elegans	50.0	0.1	.	.
Calochortus eurycarpus	50.0	0.1	100.0	1.5
Castilleja oresbia	.	.	66.7	0.1
Castilleja spp.	100.0	4.5	100.0	2.4
Clarkia pulchella	.	.	33.3	0.1
Collomia grandiflora	.	.	66.7	0.6
Collomia linearis	.	.	33.3	0.1
Collinsia parviflora	.	.	66.7	0.1
Crepis acuminata	100.0	1.3	100.0	0.7
Crepis modocensis	.	.	33.3	1.0
Cryptantha spp.	.	.	33.3	0.2
Epilobium paniculatum	.	.	66.7	0.6
Erysimum asperum	100.0	0.1	33.3	0.1
Erigeron chrysopsidis	50.0	0.5	.	.
Eriogonum heracleoides	100.0	5.0	66.7	2.3
Erigeron pumilus	.	.	66.7	0.1
Eriogonum umbellatum	50.0	0.1	.	.
Galium boreale	50.0	0.1	.	.
Galium triflorum	.	.	33.3	1.0
Geum triflorum	.	.	33.3	5.0
Helianthella uniflora	.	.	33.3	20.0

Hieracium albertinum	50.0	0.1	100.0	2.0
Lactuca serriola	.	.	33.3	0.1
Lithospermum arvense	.	.	33.3	0.1
Lithospermum ruderale	.	.	33.3	0.1
Lomatium foeniculaceum	50.0	0.1	.	.
Lomatium spp.	.	.	33.3	2.0
Lomatium nudicaule	.	.	33.3	4.0
Lupinus laxiflorus	.	.	33.3	12.0
Lupinus spp.	50.0	7.0	66.7	0.6
Lupinus sericeus	50.0	3.0	.	.
Montia perfoliata	.	.	33.3	0.1
Penstemon spp.	.	.	66.7	0.3
Phlox aculeata	50.0	1.0	.	.
Phacelia hastata	.	.	33.3	0.1
Phacelia linearis	50.0	0.1	.	.
Phlox longifolia	50.0	0.1	.	.
Polygonum douglasii	.	.	33.3	0.1
Potentilla gracilis	.	.	33.3	0.1
Polygonum polygaloides	.	.	33.3	0.1
Senecio integerrimus	.	.	33.3	0.1
Sedum lanceolatum	50.0	2.0	.	.
Silene douglasii	50.0	0.1	.	.
Silene oregana	.	.	33.3	4.0
Taraxacum officinale	.	.	33.3	0.1
Tragopogon dubius	100.0	0.1	100.0	0.1
Viola spp.	.	.	33.3	0.1
Wyethia amplexicaulis	.	.	33.3	2.0
Lichens				
Cladonia spp.		.		0.1
Peltigera spp.		.		0.1
Mosses				
Bryum spp.		.		0.1
Encalypta spp.		.		0.1
Tortula spp.		.		4.0
Shrubs				
Artemisia tridentata vaseyana	100.0	47.5	100.0	21.7
Chrysothamnus nauseosus	100.0	0.1	33.3	0.1
Chrysothamnus viscidiflorus	100.0	2.0	66.7	0.5
Prunus virginiana	.	.	33.3	0.1
Tetradymia spp.	50.0	0.1	.	.

Environment	FEID-AGSP, BASA A 2 Plots MEAN	S.D.	FEID-AGSP, BASA B 12 Plots MEAN	S.D.	FEID-AGSP, BASA C 7 Plots MEAN	S.D.
Slope	42.5	3.5	60.4	12.0	67.4	7.2
Aspect	W - NE		W - NE		W - NE	
Elevation	3884.0	719.8	4559.6	923.6	4275.7	1120.9
N horizon	2.0	0.0	5.4	8.2	9.6	9.6
E horizon	3.0	1.4	16.7	12.2	11.0	7.0
S horizon	12.5	2.1	11.3	11.6	12.3	8.7
W horizon	11.5	9.2	6.4	8.4	19.7	12.6
Substrate (cover)						
Bedrock	0.0	0.0	0.1	0.3	0.3	0.5
Boulder	0.0	0.0	0.1	0.3	0.2	0.4
Cobble	5.5	6.4	5.8	7.0	14.0	13.8
Stone	3.0	2.8	0.9	1.1	1.7	1.7
Gravel	2.5	3.5	12.0	9.9	9.1	8.6
Soil	12.5	3.5	14.5	6.6	11.0	7.2
Litter	47.5	17.7	34.2	13.2	25.6	13.5
Moss	4.5	0.7	9.5	6.7	9.0	8.5
Lichen	1.6	2.1	1.9	3.2	5.3	7.7
Species	CON	CHAR	CON	CHAR	CON	CHAR
Ferns and fern allies						
Cystopteris fragilis	.	.	8.3	0.1	.	.
Selaginella wallacei	.	.	16.7	1.0	.	.
Grasses, sedges and rushes						
Agropyron spicatum	100.0	25.0	100.0	24.1	100.0	32.9
Bromus brizaeformis	.	.	66.7	0.3	71.4	2.0
Bromus japonicus	.	.	41.7	1.1	28.6	1.0
Bromus tectorum	.	.	25.0	1.0	57.1	1.0
Elymus caput-medusae	.	.	8.3	0.1	.	.
Festuca idahoensis	100.0	32.5	100.0	32.3	100.0	27.9
Koeleria cristata	.	.	16.7	0.1	14.3	0.1
Melica bulbosa	.	.	16.7	0.1	.	.
Poa bulbosa	.	.	25.0	2.0	42.9	4.3
Poa secunda	100.0	2.5	100.0	4.1	85.7	6.0
Stipa occidentalis	.	.	.	.	14.3	0.1
Herbs						
Achillea millefolium	100.0	0.6	66.7	0.8	85.7	0.5
Agoseris grandiflora	.	.	8.3	0.1	14.3	1.0
Agoseris spp.	.	.	.	.	14.3	0.1
Agoseris retrorsa	50.0	0.1	.	.	14.3	0.1
Allium acuminatum	50.0	1.0	33.3	0.5	42.9	0.4
Alyssum desertorum	.	.	8.3	3.0	.	.
Allium tolmiei	.	.	8.3	0.1	.	.
Amsinckia spp.	.	.	8.3	0.1	.	.
Antennaria dimorpha	.	.	16.7	0.1	.	.
Antennaria microphylla	50.0	2.0	.	.	.	.
Arabis spp.	50.0	0.1	8.3	0.1	14.3	0.1
Arenaria aculeata	.	.	8.3	0.1	.	.
Arabis holboellii	.	.	8.3	0.1	.	.
Arnica sororia	.	.	25.0	0.1	14.3	0.1
Arabis sparsiflora	.	.	8.3	0.1	14.3	0.1
Arabis suffrutescens	.	.	16.7	0.1	14.3	0.1
Astragalus conjunctus	.	.	8.3	2.0	.	.
Astragalus inflexus	.	.	16.7	0.1	.	.
Astragalus purshii	.	.	16.7	0.1	.	.
Astragalus vallaris	.	.	8.3	0.1	.	.
Balsamorhiza incana	50.0	1.0	8.3	0.1	.	.
Balsamorhiza sagittata	100.0	11.0	100.0	9.1	100.0	6.6
Blepharipappus scaber	.	.	25.0	0.4	14.3	1.0
Brodiaea douglasii	.	.	8.3	0.1	14.3	0.1
Calochortus eurycarpus	100.0	1.0	16.7	0.1	14.3	0.1
Calochortus spp.	.	.	8.3	0.1	28.6	0.1
Calochortus macrocarpus	.	.	8.3	0.1	14.3	0.1
Camelina microcarpa	.	.	8.3	0.1	.	.

Castilleja rustica	50.0	0.1	.	.	.	.
Castilleja spp.	.	.	33.3	2.3	14.3	0.1
Chaenactis douglasii	.	.	8.3	0.1	28.6	0.1
Cirsium canovirens	.	.	8.3	0.1	14.3	0.1
Clarkia pulchella	.	.	50.0	0.7	57.1	2.0
Collomia grandiflora	50.0	0.1	91.7	0.2	57.1	0.1
Collinsia parviflora	.	.	41.7	0.1	57.1	0.3
Comandra umbellata	.	.	.	.	14.3	0.1
Crepis acuminata	50.0	1.0	50.0	0.3	57.1	0.5
Crepis spp.	.	.	50.0	0.1	28.6	0.1
Cruciferae spp.	.	.	8.3	0.1	.	.
Cryptantha spp. (annual)	.	.	.	.	14.3	1.0
Cryptantha spp.	.	.	25.0	0.1	28.6	0.1
Delphinium spp.	.	.	16.7	0.1	.	.
Descurainia richardsonii	.	.	8.3	0.1	14.3	0.1
Draba verna	.	.	8.3	0.1	.	.
Epilobium paniculatum	.	.	66.7	0.1	57.1	0.3
Erigeron bloomeri	.	.	8.3	0.1	.	.
Erigeron chrysopsidis	.	.	16.7	0.6	.	.
Eriogonum heracleoides	50.0	0.1	41.7	1.6	.	.
Eriophyllum lanatum	50.0	0.1	25.0	0.4	14.3	0.1
Erigeron linearis	.	.	8.3	0.1	14.3	0.1
Eriastrum sparsiflorum	.	.	8.3	0.1	.	.
Eriogonum strictum	.	.	8.3	0.1	.	.
Eriogonum umbellatum	50.0	1.0	41.7	0.5	.	.
Galium aparine	.	.	8.3	0.1	.	.
Galium multiflorum	.	.	8.3	0.1	42.9	0.1
Gayophytum spp.	50.0	3.0	.	.	.	.
Haplopappus spp. (herbaceous)	.	.	8.3	0.1	.	.
Haplopappus radiatus	.	.	16.7	0.1	.	.
Helianthella uniflora	.	.	16.7	0.1	.	.
Hieracium albertinum	.	.	.	.	14.3	0.1
Holosteum umbellatum	.	.	8.3	0.1	14.3	0.1
Lathyrus pauciflorus	.	.	8.3	2.0	.	.
Lactuca serriola	.	.	41.7	0.1	71.4	0.1
Lithospermum arvense	.	.	25.0	0.4	14.3	0.1
Lithophragma parviflora	.	.	.	.	28.6	0.6
Lithospermum ruderale	.	.	16.7	0.1	42.9	0.1
Lomatium ambiguum	.	.	8.3	0.1	.	.
Lomatium dissectum	.	.	41.7	0.7	57.1	6.0
Lomatium grayi	.	.	50.0	0.1	14.3	1.0
Lomatium leptocarpum	.	.	8.3	0.1	.	.
Lomatium macrocarpum	.	.	8.3	0.1	.	.
Lomatium spp.	50.0	1.0	25.0	0.4	.	.
Lomatium nudicaule	50.0	0.1	.	.	.	.
Lomatium triternatum	50.0	0.1	33.3	0.1	28.6	0.1
Lupinus spp.	50.0	4.0	91.7	1.4	85.7	1.7
Lupinus sericeus	50.0	0.1	8.3	4.0	14.3	4.0
Madia gracilis	.	.	.	.	14.3	1.0
Mentzelia albicaulis	.	.	.	.	14.3	0.1
Mimulus cusickii	.	.	8.3	0.1	.	.
Microsteris gracilis	.	.	41.7	0.1	28.6	0.1
Myosotis micrantha	.	.	8.3	0.1	14.3	0.1
Nemophila kirtleyi	.	.	.	.	14.3	0.1
Orobanche uniflora purpurea	50.0	0.1	.	.	.	.
Penstemon deustus	.	.	33.3	2.3	71.4	1.5
Penstemon fruticosus serratus	.	.	8.3	0.1	.	.
Penstemon gairdneri	.	.	25.0	1.1	14.3	0.1
Penstemon glandulosus	.	.	16.7	0.6	28.6	0.1
Penstemon spp.	.	.	8.3	0.1	14.3	0.1
Perideridia spp.	50.0	1.0	.	.	.	.
Phoenicaulis cheiranthoides	.	.	8.3	0.1	.	.
Phacelia hastata	.	.	8.3	0.1	14.3	0.1
Phacelia heterophylla	.	.	8.3	0.1	.	.
Phlox hoodii	50.0	10.0	25.0	2.7	.	.
Phacelia linearis	.	.	33.3	0.1	42.9	0.4
Polygonum douglasii	50.0	3.0	16.7	0.1	.	.
Sedum lanceolatum	.	.	.	.	14.3	0.1
Sedum stenopetalum	50.0	2.0	25.0	0.1	.	.
Silene douglasii	.	.	.	.	14.3	0.1
Sisyrinchium inflatum	50.0	0.1	.	.	.	.
Solidago missouriensis	.	.	.	.	14.3	1.0
Stellaria nitens	.	.	.	.	14.3	0.1

Tonella floribunda	.	.	25.0	0.1	42.9	0.1
Tragopogon dubius	50.0	0.1	83.3	0.3	71.4	3.6
Trifolium macrocephalum	50.0	3.0	.	.	.	.
Zigadenus venenosus	.	.	16.7	0.6	.	.
Lichens						
Cladonia spp.		1.0		.		.
Collema spp.		1.0		.		.
Peltigera spp.		1.0		.		.
Mosses						
Encalypta vulgaris		2.0		.		.
Tortula ruralis		0.1		.		.
Shrubs						
Artemisia rigida	50.0	1.0	16.7	0.1	.	.
Artemisia tridentata vaseyana	.	.	.	.	14.3	0.1
Artemisia tridentata wyomingensis	.	.	8.3	0.1	.	.
Chrysothamnus nauseosus	.	.	8.3	2.0	42.9	0.2
Chrysothamnus viscidiflorus	.	.	25.0	0.4	.	.
Glossopetalon nevadense	.	.	8.3	0.1	14.3	1.0
Prunus virginiana	.	.	8.3	1.0	.	.
Rosa woodsii	.	.	8.3	0.1	.	.
Sambucus cerulea	.	.	8.3	1.0	.	.
Symphoricarpos albus	.	.	16.7	0.1	.	.
Symphoricarpos oreophilus	.	.	8.3	0.1	.	.

	FEID-AGSP, LUPINUS A		FEID-AGSP, LUPINUS B	
	3 Plots		7 Plots	
Environment	MEAN	S.D.	MEAN	S.D.
Slope	50.7	19.0	51.9	18.2
Aspect	W - E		W - E	
Elevation	4885.0	1539.3	3960.7	542.0
N horizon	1.0	1.0	2.0	4.0
E horizon	7.0	3.5	10.4	7.1
S horizon	17.0	17.6	11.9	7.5
W horizon	11.7	10.1	9.0	12.8
Substrate (cover)				
Bedrock	0.0	0.0	0.0	0.0
Boulder	0.0	0.0	0.0	0.0
Cobble	0.0	0.1	5.7	8.7
Stone	0.0	0.0	5.2	9.5
Gravel	14.7	15.0	4.6	2.9
Soil	10.3	9.5	10.6	7.9
Litter	37.0	6.9	35.7	15.2
Moss	15.3	21.5	10.7	7.6
Lichen	2.7	3.8	6.6	10.5
Species	CON	CHAR	CON	CHAR
Grasses, sedges and rushes				
Agropyron spicatum	100.0	19.0	100.0	24.3
Bromus brizaeformis	.	.	57.1	0.6
Bromus japonicus	33.3	0.1	57.1	0.3
Bromus tectorum	.	.	42.9	0.1
Elymus caput-medusae	.	.	14.3	0.1
Festuca idahoensis	100.0	38.3	100.0	37.9
Festuca microstachys	.	.	14.3	0.1
Poa bulbosa	33.3	0.1	.	.
Poa secunda	66.7	2.8	100.0	2.7
Herbs				
Achillea millefolium	100.0	2.0	85.7	0.6
Agoseris glauca	33.3	0.1	.	.
Agoseris grandiflora	.	.	14.3	0.1
Agoseris spp.	33.3	0.1	.	.
Allium acuminatum	33.3	0.1	14.3	0.1
Antennaria dimorpha	33.3	0.1	.	.
Arabis spp.	33.3	0.1	14.3	0.1
Arnica sororia	33.3	0.5	14.3	0.1
Astragalus purshii	66.7	0.1	28.6	0.1
Aster spp.	.	.	14.3	0.1
Balsamorhiza incana	.	.	42.9	7.0
Balsamorhiza sagittata	100.0	7.3	71.4	1.6
Besseya rubra	.	.	14.3	0.1
Blepharipappus scaber	.	.	14.3	0.1
Calochortus eurycarpus	.	.	28.6	0.1
Calochortus spp.	.	.	14.3	0.1
Castilleja rustica	.	.	14.3	0.1
Castilleja spp.	.	.	14.3	0.1
Cirsium canovirens	.	.	14.3	0.1
Clarkia pulchella	33.3	0.1	57.1	0.6
Collomia grandiflora	33.3	0.1	28.6	0.1
Collinsia parviflora	66.7	0.1	57.1	0.1
Crepis acuminata	100.0	1.7	57.1	1.0
Crepis spp.	.	.	14.3	1.0
Epilobium paniculatum	.	.	57.1	0.1
Erigeron chrysopsidis	33.3	0.1	.	.
Erigeron corymbosus	33.3	0.1	.	.
Eriogonum heracleoides	66.7	1.5	.	.
Eriophyllum lanatum	33.3	0.1	.	.
Galium multiflorum	.	.	14.3	2.0
Galium triflorum	33.3	0.1	.	.
Gayophytum spp.	.	.	14.3	0.1
Haplopappus radiatus	33.3	2.0	.	.
Habenaria unalascensis	.	.	14.3	0.1

Hieracium albertinum	.	.	14.3	0.1
Holosteum umbellatum	.	.	42.9	0.4
Lactuca serriola	.	.	28.6	0.1
Lesquerella spp.	33.3	0.1	.	.
Lithophragma parviflora	.	.	14.3	0.1
Lithospermum ruderale	66.7	0.1	28.6	0.1
Lomatium dissectum	.	.	85.7	0.3
Lomatium foeniculaceum	33.3	0.1	.	.
Lomatium grayi	.	.	42.9	0.1
Lomatium macrocarpum	.	.	14.3	0.1
Lomatium spp.	33.3	0.1	.	.
Lomatium triternatum	33.3	0.1	57.1	1.0
Lupinus spp.	33.3	5.0	100.0	6.4
Lupinus sericeus	66.7	5.5	.	.
Microsteris gracilis	.	.	28.6	0.1
Myosotis micrantha	.	.	42.9	0.7
Penstemon deustus	33.3	0.1	14.3	0.1
Penstemon gairdneri	.	.	14.3	0.1
Penstemon glandulosus	33.3	1.0	.	.
Penstemon spp.	.	.	14.3	0.1
Phlox aculeata	33.3	0.1	.	.
Phlox hoodii	.	.	28.6	0.6
Phacelia linearis	.	.	28.6	0.6
Phlox longifolia	33.3	0.1	.	.
Plectritis macrocera	.	.	14.3	0.1
Senecio integerrimus	66.7	0.1	.	.
Sedum lanceolatum	.	.	14.3	0.1
Stellaria nitens	.	.	28.6	0.1
Tonella floribunda	.	.	14.3	0.1
Tragopogon dubius	33.3	0.1	85.7	0.4
Shrubs				
Amelanchier alnifolia	33.3	0.5	.	.
Artemisia rigida	.	.	28.6	0.1
Artemisia tridentata vaseyana	33.3	0.1	.	.
Chrysothamnus nauseosus	33.3	3.0	14.3	0.1
Chrysothamnus viscidiflorus	66.7	0.3	28.6	0.1
Tetradymia spp.	33.3	0.1	14.3	0.5

Environment	FEID-KOCR, High A 1 Plots MEAN	S.D.	FEID-KOCR, High B 2 Plots MEAN	S.D.	FEID-KOCR, High C 1 Plots MEAN	S.D.
Slope	60.0	0.0	19.0	15.6	8.0	0.0
Aspect	W - N		W - N		W - N	
Elevation	5440.0	0.0	5075.0	742.5	4460.0	0.0
N horizon	0.0	0.0	1.0	0.0	2.0	0.0
E horizon	12.0	0.0	3.5	2.1	4.0	0.0
S horizon	26.0	0.0	9.5	6.4	4.0	0.0
W horizon	0.0	0.0	1.5	0.7	3.0	0.0
Substrate (cover)						
Bedrock	1.0	0.0	0.0	0.0	0.0	0.0
Boulder	0.0	0.0	0.0	0.0	0.0	0.0
Cobble	0.1	0.0	0.1	0.1	5.0	0.0
Stone	0.0	0.0	0.0	0.0	1.0	0.0
Gravel	5.0	0.0	7.6	10.5	5.0	0.0
Soil	3.0	0.0	2.8	3.2	10.0	0.0
Litter	76.0	0.0	63.0	17.0	39.0	0.0
Moss	0.1	0.0	1.0	1.3	6.0	0.0
Lichen	0.1	0.0	1.0	1.3	4.0	0.0
Species	CON	CHAR	CON	CHAR	CON	CHAR
Grasses, sedges and rushes						
Agropyron spicatum	100.0	10.0	100.0	20.0	100.0	40.0
Bromus mollis	.	.	50.0	2.0	.	.
Carex hoodii	100.0	2.0	.	.	.	.
Festuca idahoensis	100.0	3.0	100.0	42.5	100.0	40.0
Koeleria cristata	100.0	3.0	100.0	1.0	100.0	10.0
Melica bulbosa	100.0	20.0	50.0	10.0	.	.
Poa bulbosa	100.0	0.1	50.0	0.1	.	.
Poa secunda	100.0	1.0	50.0	4.0	.	.
Herbs						
Achillea millefolium	100.0	1.0	100.0	5.0	100.0	2.0
Agoseris glauca	100.0	0.1	.	.	.	.
Agoseris spp.	.	.	.	.	100.0	0.1
Allium acuminatum	.	.	.	.	100.0	0.1
Antennaria dimorpha	.	.	50.0	0.1	.	.
Antennaria microphylla	100.0	1.0	.	.	100.0	1.0
Arabis spp.	.	.	50.0	0.1	.	.
Arnica sororia	.	.	100.0	2.8	100.0	4.0
Astragalus purshii	.	.	50.0	0.5	.	.
Balsamorhiza sagittata	.	.	50.0	1.0	.	.
Besseya rubra	.	.	50.0	5.0	100.0	1.0
Brodiaea douglasii	.	.	50.0	0.1	100.0	0.1
Calochortus elegans	100.0	0.1	.	.	.	.
Calochortus eurycarpus	100.0	1.0	50.0	0.1	100.0	1.0
Castilleja oresbia	.	.	.	.	100.0	0.1
Castilleja spp.	.	.	50.0	5.0	.	.
Castilleja miniata	.	.	.	.	100.0	0.1
Clarkia pulchella	.	.	50.0	0.1	.	.
Collomia grandiflora	100.0	0.1	50.0	0.1	.	.
Collomia linearis	.	.	50.0	0.1	.	.
Crepis acuminata	100.0	0.1	50.0	0.5	100.0	1.0
Crepis modocensis	.	.	50.0	0.1	100.0	0.1
Erigeron chrysopsidis	.	.	50.0	1.0	.	.
Erigeron corymbosus	100.0	0.1	.	.	.	.
Eriogonum heracleoides	100.0	4.0	100.0	2.0	100.0	2.0
Frasera albicaulis	.	.	.	.	100.0	5.0
Geum triflorum	100.0	0.1	50.0	1.0	.	.
Helianthella uniflora	100.0	20.0	.	.	.	.
Hieracium albertinum	100.0	3.0	.	.	.	.
Lomatium dissectum	.	.	.	.	100.0	0.5
Lomatium foeniculaceum	.	.	50.0	0.1	.	.
Lomatium triternatum	100.0	0.1	50.0	0.5	.	.
Lupinus laxiflorus	.	.	50.0	15.0	.	.
Lupinus sericeus	100.0	10.0	50.0	7.0	100.0	2.0
Navarretia breweri	.	.	50.0	0.1	.	.

Orthocarpus tenuifolius	.	.	.	.	100.0	0.1
Penstemon gairdneri	.	.	.	.	100.0	1.0
Phlox aculeata	.	.	50.0	4.0	.	.
Phacelia linearis	.	.	50.0	0.1	.	.
Phlox longifolia	.	.	50.0	0.1	.	.
Phlox viscida	.	.	.	.	100.0	0.1
Polygonum douglasii	.	.	50.0	0.1	.	.
Polygonum polygaloides	100.0	0.1	.	.	.	.
Potentilla spp.	100.0	2.0	50.0	4.0	.	.
Senecio integerrimus	100.0	0.5	50.0	0.1	.	.
Sedum stenopetalum	.	.	50.0	0.1	.	.
Silene douglasii	100.0	0.1	.	.	.	.
Sidalcea oregana	.	.	50.0	1.0	100.0	0.1
Solidago missouriensis	.	.	.	.	100.0	1.0
Tragopogon dubius	.	.	100.0	0.1	100.0	0.1
Viola purpurea	100.0	0.1	.	.	.	.
Zigadenus venenosus	.	.	.	.	100.0	0.1
Lichens						
Cladonia spp.		.		0.1		3.0
Collema spp.		.		.		1.0
Peltigera spp.		.		.		2.0
Psora tuckermanii		.		.		0.1
Mosses						
Bryum spp.		.		0.1		1.0
Homulothecium nevadensa		.		0.1		.
Tortula spp.		.		0.1		5.0
Shrubs						
Artemisia rigida	.	.	50.0	0.1	.	.
Artemisia tridentata vaseyana	100.0	0.1	.	.	100.0	0.1
Chrysothamnus nauseosus	100.0	0.1	50.0	1.0	.	.
Chrysothamnus viscidiflorus	.	.	50.0	3.0	.	.
Rosa nutkana	100.0	0.1	.	.	.	.
Tetradymia spp.	.	.	50.0	0.1	.	.

Environment	FEID-KOCR, Low A 1 Plots MEAN	S.D.	FEID-KOCR, Low B 4 Plots MEAN	S.D.	FEID-KOCR, Low C 1 Plots MEAN	S.D.
Slope	26.0	0.0	47.3	18.3	19.0	0.0
Aspect	N - E		N - E		N - E	
Elevation	6430.0	0.0	3827.5	688.0	5560.0	0.0
N horizon	0.0	0.0	4.8	3.1	2.0	0.0
E horizon	16.0	0.0	14.5	8.9	10.0	0.0
S horizon	5.0	0.0	14.3	9.2	4.0	0.0
W horizon	0.0	0.0	7.0	8.2	11.0	0.0
Substrate (cover)						
Bedrock	0.1	0.0	0.0	0.1	0.1	0.0
Boulder	0.1	0.0	0.1	0.1	0.1	0.0
Cobble	5.0	0.0	1.5	1.3	2.0	0.0
Stone	8.0	0.0	0.5	0.6	5.0	0.0
Gravel	8.0	0.0	7.5	8.4	15.0	0.0
Soil	4.0	0.0	9.3	1.5	12.0	0.0
Litter	40.0	0.0	31.5	13.6	5.0	0.0
Moss	10.0	0.0	14.5	5.3	30.0	0.0
Lichen	5.0	0.0	10.0	7.1	0.0	0.0
Species	CON	CHAR	CON	CHAR	CON	CHAR
Ferns and fern allies						
Cystopteris fragilis	.	.	50.0	0.6	.	.
Grasses, sedges and rushes						
Agropyron spicatum	100.0	10.0	100.0	17.5	100.0	2.0
Bromus brizaeformis	.	.	100.0	0.6	.	.
Bromus japonicus	.	.	75.0	0.1	.	.
Bromus tectorum	.	.	50.0	0.1	100.0	0.1
Carex geyeri	.	.	25.0	0.1	.	.
Festuca idahoensis	100.0	50.0	100.0	42.5	100.0	60.0
Koeleria cristata	100.0	5.0	100.0	7.3	100.0	0.1
Poa bulbosa	.	.	25.0	0.1	.	.
Poa secunda	100.0	2.0	100.0	3.5	100.0	2.0
Herbs						
Achillea millefolium	100.0	1.0	100.0	0.5	100.0	0.1
Agoseris grandiflora	.	.	.	.	100.0	0.1
Agastache urticifolia	.	.	50.0	0.1	.	.
Allium acuminatum	100.0	0.1	25.0	0.1	100.0	0.1
Alyssum desertorum	.	.	25.0	0.1	100.0	0.1
Antennaria luzuloides	.	.	25.0	1.0	.	.
Arabis spp.	100.0	0.1	.	.	.	.
Arabis divaricarpa	.	.	25.0	1.0	.	.
Arabis glabra	.	.	25.0	0.1	.	.
Arabis holboellii	.	.	.	.	100.0	0.1
Arenaria serpyllifolia	.	.	50.0	1.0	.	.
Arnica sororia	100.0	0.5	25.0	0.1	.	.
Arabis sparsiflora	.	.	25.0	0.1	.	.
Astragalus inflexus	.	.	.	.	100.0	0.1
Aster spp.	100.0	0.5	.	.	.	.
Balsamorhiza sagittata	100.0	7.0	100.0	9.8	100.0	4.0
Besseya rubra	.	.	25.0	0.1	.	.
Brodiaea douglasii	100.0	0.1	25.0	0.1	.	.
Calochortus eurycarpus	.	.	25.0	0.1	.	.
Castilleja spp.	100.0	0.1	100.0	0.8	.	.
Clarkia pulchella	.	.	50.0	0.1	.	.
Collomia grandiflora	100.0	0.1	75.0	0.1	100.0	0.1
Collomia linearis	.	.	25.0	0.1	.	.
Collinsia parviflora	.	.	50.0	0.1	100.0	0.1
Crepis acuminata	100.0	0.1	25.0	1.0	.	.
Crepis spp.	.	.	50.0	0.1	100.0	0.1
Cruciferae spp.	.	.	25.0	0.1	.	.
Draba verna	.	.	25.0	0.1	.	.
Epilobium paniculatum	.	.	100.0	0.1	.	.
Erigeron chrysopsidis	100.0	0.1	.	.	.	.
Erythronium grandiflorum	.	.	25.0	0.1	.	.

Eriogonum heracleoides	100.0	2.0	50.0	2.5	100.0	0.1
Eriogonum strictum strictum	.	.	.	.	100.0	0.1
Galium multiflorum	.	.	25.0	0.1	.	.
Geum triflorum	.	.	50.0	0.6	.	.
Haplopappus lanuginosus	.	.	.	.	100.0	1.0
Haplopappus radiatus	.	.	.	.	100.0	0.1
Helianthella uniflora	100.0	0.1	50.0	1.0	.	.
Hieracium albertinum	.	.	75.0	0.1	.	.
Lathyrus pauciflorus	.	.	25.0	0.1	.	.
Lactuca serriola	.	.	50.0	0.1	.	.
Lithospermum ruderale	100.0	0.1	75.0	1.7	.	.
Lomatium grayi	.	.	.	.	100.0	0.1
Lomatium leptocarpum	.	.	.	.	100.0	0.1
Lomatium macrocarpum	.	.	.	.	100.0	0.1
Lomatium spp.	100.0	0.1	25.0	0.1	.	.
Lomatium triternatum	.	.	50.0	0.1	100.0	0.1
Lupinus spp.	100.0	1.0	75.0	0.1	100.0	2.0
Lupinus sericeus	.	.	.	.	100.0	0.1
Microsteris gracilis	.	.	50.0	0.1	100.0	0.1
Myosotis micrantha	.	.	75.0	0.4	100.0	0.1
Penstemon deustus	.	.	25.0	0.1	.	.
Penstemon glandulosus	.	.	50.0	0.6	.	.
Phoenicaulis cheiranthoides	.	.	.	.	100.0	0.1
Phlox hoodii	.	.	.	.	100.0	7.0
Phacelia linearis	.	.	.	.	100.0	0.1
Plagiobothrys tenellus	.	.	25.0	0.1	.	.
Polygonum douglasii	.	.	75.0	0.1	100.0	0.1
Senecio canus	.	.	50.0	0.1	.	.
Sedum stenopetalum	.	.	50.0	0.6	.	.
Silene antirrhina	.	.	50.0	0.1	.	.
Silene douglasii	100.0	0.1	25.0	0.1	.	.
Silene oregana	.	.	25.0	1.0	.	.
Stellaria nitens	.	.	25.0	0.1	.	.
Taraxacum officinale	.	.	25.0	0.1	.	.
Tragopogon dubius	100.0	0.1	75.0	0.4	100.0	6.0
Shrubs						
Artemisia rigida	.	.	25.0	0.1	100.0	0.1
Chrysothamnus nauseosus	.	.	.	.	100.0	0.1
Chrysothamnus viscidiflorus	.	.	25.0	0.1	100.0	0.1
Physocarpus malvaceus	.	.	50.0	1.0	.	.
Prunus virginiana	100.0	0.1	.	.	.	.
Spiraea betulifolia	.	.	75.0	4.4	.	.
Symphoricarpos albus	.	.	50.0	1.5	.	.

	FEID-KOCR, Ridgetop A		FEID-KOCR, Ridgetop B	
	4 Plots		2 Plots	
Environment	MEAN	S.D.	MEAN	S.D.
Slope	29.0	16.9	42.5	6.4
Aspect	W - NW		W - NW	
Elevation	5810.0	853.6	5050.0	636.4
N horizon	2.5	4.4	2.0	1.4
E horizon	12.8	8.4	13.5	4.9
S horizon	2.8	1.7	17.5	2.1
W horizon	0.3	0.5	1.0	1.4
Substrate (cover)				
Bedrock	0.0	0.0	0.5	0.7
Boulder	0.0	0.0	0.5	0.7
Cobble	0.0	0.0	2.5	3.5
Stone	0.0	0.0	3.5	4.9
Gravel	3.0	2.4	1.5	2.1
Soil	5.5	3.3	5.0	0.0
Litter	59.3	7.4	25.0	14.1
Moss	4.3	4.3	26.0	1.4
Lichen	2.5	3.7	3.0	2.8
Species	CON	CHAR	CON	CHAR
Grasses, sedges and rushes				
Agropyron dasystachyum	.	.	50.0	0.1
Agropyron spicatum	100.0	14.8	100.0	5.5
Bromus brizaeformis	.	.	50.0	0.1
Bromus carinatus	50.0	0.6	.	.
Bromus inermis	.	.	50.0	1.0
Bromus japonicus	.	.	100.0	0.1
Carex geyeri	.	.	50.0	1.0
Carex spp.	.	.	50.0	0.1
Festuca idahoensis	100.0	38.8	100.0	57.5
Koeleria cristata	100.0	15.0	100.0	6.5
Poa bulbosa	.	.	50.0	1.0
Poa pratensis	.	.	50.0	0.1
Poa secunda	50.0	2.0	100.0	0.1
Stipa occidentalis	.	.	50.0	0.1
Herbs				
Achillea millefolium	100.0	1.1	100.0	1.0
Agastache urticifolia	50.0	1.3	.	.
Allium acuminatum	.	.	100.0	0.1
Antennaria luzuloides	.	.	50.0	1.0
Antennaria microphylla	50.0	1.5	50.0	1.0
Arabis spp.	25.0	0.1	50.0	0.1
Arnica sororia	100.0	2.1	100.0	2.5
Arabis sparsiflora	.	.	50.0	0.1
Aster perelegans	.	.	50.0	1.0
Balsamorhiza sagittata	50.0	0.6	100.0	0.6
Besseya rubra	.	.	50.0	0.1
Brodiaea douglasii	100.0	1.5	50.0	0.1
Calochortus eurycarpus	25.0	1.0	50.0	1.0
Castilleja rustica	25.0	0.1	.	.
Castilleja spp.	25.0	1.0	100.0	0.1
Clarkia pulchella	50.0	0.1	50.0	2.0
Collomia grandiflora	50.0	0.1	100.0	0.6
Collinsia parviflora	50.0	0.1	50.0	0.1
Crepis acuminata	100.0	0.3	.	.
Crepis spp.	.	.	100.0	0.6
Crepis modocensis	25.0	0.3	.	.
Cuscuta spp.	.	.	50.0	0.1
Erigeron chrysopsidis	25.0	1.0	.	.
Eriogonum heracleoides	100.0	10.3	100.0	9.0
Eriogonum strictum strictum	.	.	50.0	0.1
Galium multiflorum	.	.	50.0	0.1
Galium triflorum	50.0	0.1	.	.
Geum triflorum	25.0	1.0	100.0	0.1
Haplopappus lanuginosus	.	.	50.0	1.0

Hackelia micrantha	25.0	2.0	.	.
Heuchera cylindrica	.	.	50.0	0.1
Helianthella uniflora	25.0	0.1	50.0	1.0
Hieracium albertinum	25.0	0.1	100.0	0.1
Lepidium perfoliatum	25.0	0.1	.	.
Lomatium macrocarpum	.	.	50.0	0.1
Lomatium spp.	25.0	2.0	50.0	0.1
Lomatium nudicaule	25.0	0.5	.	.
Lomatium triternatum	.	.	50.0	0.1
Lupinus spp.	75.0	2.2	50.0	1.0
Madia gracilis	25.0	0.1	.	.
Microsteris gracilis	.	.	50.0	0.1
Myosotis micrantha	.	.	100.0	0.1
Orthocarpus tenuifolius	.	.	50.0	2.0
Phoenicaulis cheiranthoides	.	.	50.0	0.1
Phacelia hastata	25.0	1.0	.	.
Phacelia heterophylla	25.0	0.1	.	.
Phlox hoodii	.	.	50.0	5.0
Polygonum douglasii	50.0	0.6	50.0	0.1
Potentilla glandulosa	.	.	50.0	0.1
Senecio integerrimus	25.0	0.1	.	.
Sedum lanceolatum	.	.	50.0	0.1
Sedum stenopetalum	25.0	0.1	100.0	1.5
Silene antirrhina	.	.	50.0	0.1
Silene douglasii	25.0	2.0	100.0	1.0
Sidalcea oregana	25.0	1.0	.	.
Stellaria nitens	.	.	50.0	0.1
Tragopogon dubius	100.0	0.1	100.0	0.6
Lichens				
Cladonia fimbriata		5.0		.
Collema spp.		1.0		.
Peltigera rufescens		2.0		.
Mosses				
Bryum caespiticium		0.8		.
Tortula ruralis		0.3		.
Shrubs				
Artemisia rigida	25.0	0.1	50.0	0.1
Artemisia tridentata vaseyana	.	.	50.0	0.1
Chrysothamnus nauseosus	.	.	50.0	0.1
Chrysothamnus viscidiflorus	.	.	50.0	0.1
Prunus virginiana	25.0	0.5	.	.

Environment	PUTR/AGSP B 3 Plots MEAN	S.D.	PUTR/AGSP C 3 Plots MEAN	S.D.	PUTR/FEID B 4 Plots MEAN	S.D.
Slope	68.7	9.0	62.0	5.6	58.0	5.4
Aspect	SW		SW		NE	
Elevation	3776.7	522.7	3823.3	307.3	3373.8	316.6
N horizon	16.0	3.5	14.7	10.6	3.3	1.7
E horizon	29.0	6.2	20.7	4.9	16.3	15.1
S horizon	13.0	9.0	15.7	5.0	28.0	19.9
W horizon	4.7	7.2	8.7	15.0	17.3	8.8
Substrate (cover)						
Bedrock	5.3	4.5	4.3	4.9	0.3	0.5
Boulder	1.0	0.0	1.7	2.1	0.4	0.5
Cobble	5.0	4.6	9.0	9.6	3.5	2.3
Stone	3.7	3.8	4.7	6.4	2.8	2.6
Gravel	33.3	20.8	25.0	8.7	10.0	10.8
Soil	24.0	10.4	24.0	14.4	10.0	5.8
Litter	10.3	9.5	15.0	5.0	49.3	17.3
Moss	7.7	10.7	1.7	0.6	6.0	3.9
Lichen	0.1	0.1	0.1	0.0	0.6	0.9
Species	CON	CHAR	CON	CHAR	CON	CHAR
Ferns and fern allies						
Cystopteris fragilis	33.3	0.1	.	.	25.0	0.1
Selaginella wallacei	33.3	2.0	.	.	25.0	0.1
Grasses, sedges and rushes						
Agropyron spicatum	100.0	23.0	100.0	20.7	100.0	31.8
Bromus brizaeformis	100.0	0.1	100.0	7.3	25.0	1.0
Bromus japonicus	33.3	0.1	33.3	0.1	100.0	0.3
Bromus tectorum	100.0	0.7	100.0	3.0	25.0	2.0
Danthonia unispicata	33.3	0.1	.	.	.	.
Festuca idahoensis	33.3	1.0	.	.	100.0	15.8
Koeleria cristata	.	.	.	.	25.0	0.1
Poa bulbosa	.	.	.	.	50.0	2.0
Poa secunda	100.0	1.0	100.0	3.0	100.0	2.8
Stipa comata	.	.	33.3	0.1	.	.
Stipa thurberiana	33.3	0.1	.	.	.	.
Herbs						
Achillea millefolium	66.7	0.1	100.0	0.4	100.0	0.5
Agoseris spp.	33.3	0.1	.	.	.	.
Agoseris retrorsa	.	.	.	.	25.0	0.1
Allium acuminatum	.	.	33.3	0.1	.	.
Amsinckia retrorsa	.	.	33.3	0.1	.	.
Amsinckia spp.	33.3	0.1	.	.	.	.
Arabis microphylla	33.3	0.1	.	.	.	.
Arabis sparsiflora	33.3	0.1	66.7	0.1	.	.
Arabis suffrutescens	33.3	0.1	33.3	0.1	.	.
Astragalus inflexus	.	.	33.3	0.1	.	.
Astragalus purshii	.	.	.	.	25.0	0.1
Balsamorhiza incana	33.3	0.1	.	.	.	.
Balsamorhiza sagittata	100.0	4.0	100.0	4.0	100.0	10.8
Calochortus eurycarpus	.	.	.	.	50.0	0.1
Calochortus macrocarpus	33.3	0.1	.	.	.	.
Camelina microcarpa	33.3	0.1	33.3	0.1	.	.
Chaenactis douglasii	66.7	0.1	66.7	0.1	.	.
Cirsium canovirens	33.3	0.1	33.3	0.1	.	.
Cirsium utahense	33.3	0.1	33.3	0.1	.	.
Clarkia pulchella	66.7	1.5	66.7	0.1	25.0	1.0
Collomia grandiflora	.	.	66.7	0.1	25.0	0.1
Collinsia parviflora	33.3	0.1	66.7	0.6	25.0	0.1
Comandra umbellata	.	.	.	.	50.0	0.1
Crepis acuminata	33.3	1.0	.	.	25.0	1.0
Crepis spp.	33.3	0.1	33.3	0.1	.	.
Cryptantha spp. (annual)	33.3	0.1	33.3	0.1	.	.
Cryptantha spp. (perennial)	33.3	1.0	33.3	0.1	.	.
Cryptantha spp.	33.3	0.1	33.3	1.0	.	.

Delphinium spp.	66.7	0.1	.	.	25.0	0.1
Descurainia richardsonii	66.7	0.1	66.7	0.1	.	.
Draba verna	.	.	33.3	0.1	25.0	0.1
Epilobium paniculatum	33.3	0.1	100.0	0.4	25.0	0.1
Erigeron bloomeri	33.3	0.1	.	.	.	.
Eriogonum compositum	33.3	0.1	66.7	2.5	.	.
Eriogonum heracleoides	33.3	0.1	.	.	25.0	4.0
Eriophyllum lanatum	100.0	1.4	100.0	0.7	25.0	0.1
Eriogonum strictum proliferum	.	.	.	.	25.0	0.1
Eriogonum strictum strictum	33.3	0.1	.	.	.	.
Eriogonum umbellatum	.	.	33.3	0.1	25.0	0.1
Galium aparine	33.3	0.1	33.3	0.1	25.0	0.1
Galium spp.	.	.	.	.	25.0	0.1
Galium multiflorum	66.7	0.6	66.7	0.1	25.0	0.1
Galium triflorum	33.3	0.1	.	.	.	.
Gayophytum spp.	33.3	0.1	.	.	.	.
Haplopappus radiatus	.	.	.	.	25.0	0.1
Holosteum umbellatum	33.3	0.1	33.3	0.1	25.0	0.1
Lactuca serriola	33.3	0.1	100.0	0.1	.	.
Lithophragma bulbifera	.	.	.	.	25.0	0.1
Lithospermum ruderale	.	.	.	.	50.0	0.1
Lomatium dissectum	66.7	3.0	100.0	1.1	50.0	0.1
Lomatium grayi	66.7	0.6	33.3	5.0	.	.
Lomatium triternatum	.	.	.	.	25.0	0.1
Lupinus spp.	33.3	1.0	.	.	75.0	0.7
Mentzelia albicaulis	.	.	66.7	0.1	.	.
Mimulus cusickii	33.3	0.1	66.7	0.1	.	.
Microsteris gracilis	33.3	0.1	33.3	0.1	25.0	0.1
Mimulus nanus	.	.	33.3	0.1	.	.
Myosotis micrantha	.	.	33.3	0.1	25.0	0.1
Onopordum acanthium	.	.	33.3	0.1	.	.
Orobanche fasciculata	33.3	0.1	33.3	0.1	.	.
Penstemon deustus	100.0	2.3	100.0	4.0	.	.
Penstemon glandulosus	33.3	1.0	.	.	75.0	0.4
Phlox aculeata	.	.	.	.	25.0	1.0
Phacelia hastata	66.7	0.1	66.7	0.1	.	.
Phacelia heterophylla	.	.	33.3	0.1	25.0	0.1
Phacelia linearis	100.0	0.1	66.7	0.1	25.0	1.0
Physaria oregana	66.7	0.6	33.3	0.1	.	.
Phlox viscida	.	.	.	.	25.0	0.5
Plectritis macrocera	.	.	.	.	25.0	0.1
Polygonum douglasii	.	.	.	.	25.0	0.1
Potentilla glandulosa	.	.	33.3	0.1	.	.
Scutellaria angustifolia	.	.	33.3	0.1	.	.
Sedum lanceolatum	33.3	0.1	.	.	.	.
Sedum stenopetalum	33.3	0.1	.	.	25.0	0.1
Silene douglasii	.	.	.	.	25.0	0.1
Stephanomeria tenuifolia	33.3	0.1	.	.	.	.
Tonella floribunda	100.0	0.7	66.7	0.1	.	.
Tragopogon dubius	33.3	0.1	100.0	0.1	50.0	0.1
Vaccaria segetalis	33.3	1.0	33.3	0.1	.	.
Zigadenus venenosus	33.3	0.1	.	.	.	.
Lichens						
Cladonia spp.		0.1		.		.
Mosses						
Homulothecium nevadensa		0.1		.		.
Tortula ruralis		40.0		.		.
Shrubs						
Amelanchier alnifolia	33.3	0.1	.	.	50.0	0.1
Artemisia tridentata	33.3	0.1	.	.	.	.
Artemisia tridentata xericensis	.	.	.	.	50.0	1.0
Berberis repens	.	.	.	.	25.0	1.0
Chrysothamnus nauseosus	.	.	.	.	25.0	0.1
Chrysothamnus viscidiflorus	.	.	.	.	25.0	0.1
Glossopetalon nevadense	66.7	7.5	33.3	2.0	.	.
Physocarpus malvaceus	.	.	.	.	25.0	0.1
Purshia tridentata	100.0	5.3	100.0	11.0	100.0	26.3
Sambucus cerulea	.	.	.	.	25.0	0.1

APPENDIX 4. Plant species list. Vascular plant species observed in Rocking M Ranch Conservation Easement Area are listed alphabetically by life form. This list is a compendium of species observed during several field seasons on Rocking M Ranch. Plant species observed in 1995 (Mancuso 1995), 1997 (this study) and 1998 (reported by Moseley 1999) are included. Nomenclature follows Hitchcock and Cronquist (1973).

Species	Common Name
Trees	
Alnus rhombifolia	white alder
Betula occidentalis	water birch
Celtis reticulata	netleaf hackberry
Juniperus occidentalis	western juniper
Malus pumila	common apple
Morus alba	white mulberry
Pinus ponderosa	ponderosa pine
Populus tremuloides	quacking aspen
Populus trichocarpa	black cottonwood
Prunus armencia	apricot
Pseudotsuga menziesii	Douglas-fir
Robinia pseudo-acacia	black locust
Salix babylonica	weeping willow
Salix rigida	Watson's willow
Shrubs	
Acer glabrum	Rocky Mtn. maple
Alnus incana	thinleaf alder
Amelanchier alnifolia	serviceberry
Artemisia tridentata tridentata	basin big sagebrush
Artemisia tridentata vaseyana	mountain big sagebrush
Atriplex spinosa	spiny hopsage
Chrysothamnus nauseosus	gray rabbitbrush
Chrysothamnus viscidiflorus	green rabbitbrush
Cornus stolonifera	red-osier dogwood
Crataegus columbiana	Columbia hawthorn
Crataegus douglasii	black hawthorn
Crataegus douglasii douglasii	black hawthorn
Iliamna rivularis	streambank globemallow
Philadelphus lewisii	syringa
Physocarpus malvaceus	mallow ninebark
Prunus emarginata	bitter cherry
Prunus virginiana	chokecherry
Purshia tridentata	bitterbrush
Rhus glabra	smooth sumac
Ribes aureum	golden currant
Ribes cereum	squaw currant
Ribes niveum	snow gooseberry
Rosa woodsii ultramontana	Wood's rose
Rosa woodsii var. ultramontana	Wood's rose
Rubus leucodermis	blackcap
Salix exigua	coyote willow
Salix lasiandra	Pacific willow
Salix lasiolepis	arroyo willow
Salix lutea	yellow willow

Salix scouleriana	Scouler's willow
Sambucus cerulea	blue elderberry
Spiraea betulifolia	shiny-leaf spiraea
Symphoricarpos albus	common snowberry
Symphoricarpos oreophilus	mountain snowberry

Herbs

Achillea millefolium	common yarrow
Aconitum columbianum	Columbia monkshood
Agastache urticifolia	nettle-leaf horse-mint
Agoseris glauca	pale agoseris
Agoseris grandiflora	large-flowered agoseris
Allium acuminatum	tapertip onion
Alyssum desertorum	desert alyssum
Amaranthus albus	prostrate pigweed
Amaranthus retroflexus	redroot amaranth
Amsinckia retrorsa	rigid fiddleneck
Amsinckia tessellata	tessellate fiddleneck
Angelica arguta	sharptooth angelica
Antennaria microphylla	rosy pussy-toes
Anthriscus scandicina	chervil
Apocynum androsaemifolium	spreading dogbane
Aquilegia formosa	red columbine
Arabis glabra	towermustard
Arabis hirsuta	hairy rockcress
Arctium minus	burdock
Arenaria macrophylla	big-leaf sandwort
Arnica cordifolia	heart-leaved arnica
Arnica sororia	twin arnica
Artemisia biennis	biennial wormwood
Artemisia dracunculus	dragon sagewort
Artemisia ludoviciana	Louisiana mugwort
Asclepias cryptoceras	Humbolt milkweed
Asclepias speciosa	showy milkweed
Asperugo procumbens	madwort
Astragalus cusickii cusickii	Cusick's milkvetch
Astragalus inflexus	hairy milkvetch
Astragalus lentiginosus	freckled milkvetch
Astragalus vallaris	Snake Canyon milkvetch
Balsamorhiza sagittata	arrowleaf balsamroot
Bidens frondosa	leafy beggar-ticks
Blepharipappus scaber	blepharipappus
Brodiaea douglasii	Douglas' brodiaea
Calochortus eurycarpus	big pod mariposa lily
Calochortus macrocarpus macrocarpus	green-band mariposa lily
Camelina microcarpa	hairy falseflax
Capsella bursa-pastoris	shepherds purse
Castilleja hispida	harsh paintbrush
Centaurea maculosa	spotted knapweed
Cerastium viscosum	sticky chickweed
Chaenactis douglasii	false yarrow
Chenopodium album	lambsquarter
Chichorium intybus	chicory
Chorispora tenella	blue mustard

Circaea alpina	enchanter's nightshade
Cirsium arvense	Canada thistle
Cirsium canovirens	gray-green thistle
Cirsium vulgare	bull thistle
Clarkia pulchella	deer horn
Clematis ligusticifolia	western clematis
Collinsia parviflora	blue-eyed Mary
Collomia grandiflora	large-flowered collomia
Collomia linearis	narrow-leaf collomia
Comandra umbellata pallida	pale bastard toad-flax
Conium maculatum	poison-hemlock
Convolvulus arvensis	field bindweed
Conzya canadensis	horseweed
Crepis acuminata	long leaved hawksbeard
Cryptantha affinis	slender cryptantha
Cryptantha intermedia	common cryptantha
Cryptantha interrupta	bristly cryptantha
Cuscuta approximata	clustered dodder
Cysopteris fragilis	brittle bladder-fern
Delphinium nuttallianum	Nutthall's larkspur
Delphinium occidentale	western larkspur
Descurania pinnata	western tansymustard
Descurania richardsonii	tansymustard
Disporum trachycarpum	Sierra fairy-bell
Draba verna	spring whitlow-grass
Epilobium angustifolium	fireweed
Epilobium densiflorum	dense spike-primrose
Epilobium glandulosum	American willow-herb
Epilobium paniculatum	tall annual willow-herb
Epilobium watsonii	Watson's willow-herb
Erigeron chrysopsidis austiniae	dwarf yellow fleabane
Erigeron linearis	desert yellow daisy
Erigeron pumilus	shaggy fleabane
Erigeron sp	fleabane
Eriogonum compositum	northern buckwheat
Eriogonum heracleoides	Wyeth's buckwheat
Eriogonum sphaerocephalum sphaerocephalum	rock buckwheat
Eriogonum strictum	strict buckwheat
Eriogonum vimineum vimineum	broom buckwheat
Erodium cicutarium	filaree
Erysimum asperum	rough wallflower
Erysium asperum	rough wallflower
Euclidium syriacum	euclidium
Euphorbia serpyllifolia	thyme-leaved spurge
Galium aparine	goose-grass cleavers
Galium multiflorum	shrubby bedstraw
Galium trifidum	small bedstraw
Galium triflorum	sweetscented bedstraw
Geranium viscosissimum	sticky geranium
Geum triflorum	prairie smoke
Gnaphalium palustre	lowland cudweed
Grindelia squarrosa	curly-gup gumweed
Hackelia micrantha	blue stickseed
Haplopappus lanuginosus lanuginosus	woolly goldenweed

Haplopappus radiatus	Snake River goldenweed
Helianthella uniflora douglasii	Rocky Mtn. helianthella
Helianthus annuus	common sunflower
Hieracium albertinum	western hawkweed
Hydrophyllum capitatum	waterleaf woolly breeches
Lactuca serriola	prickly lettuce
Lemna sp.	duckweed
Lepidium latifolium	broad-leaved peppergrass
Lepidium perfoliatum	clasping pepperweed
Lewisia rediviva	bitterroot
Lithophragma parviflora	small flowered prairie star
Lithospermum arvense	corn gromwell
Lithospermum ruderale	wayside gromwell
Lomatium dissectum multifidum	fern-leaved desert-parsley
Lomatium grayi	Gray's lomatium
Lomatium macrocarpum	large-fruit desert parsley
Lupinus laxiflorus	spurred lupine
Lupinus sericeus	silky lupine
Madia gracilis	slender tarweed
Malva neglecta	poverty weed
Medicago lupulina	black medic
Medicago sativa	alfalfa
Melilotus alba	white sweet-clover
Melilotus officinalis	yellow sweet-clover
Mentha arvense	field mint
Mentzelia albicaulis	white-stemmed mentzelia
Mentzelia laevicaulis	blazing-star
Mertensia ciliata	streamside bluebell
Mimulus cusickii	Cusick's monkeyflower
Mimulus guttatus	yellow monkeyflower
Mimulus guttatus guttatus	yellow monkeyflower
Montia perfoliata	miner's lettuce
Nemophila breviflora	Great Basin nemophila
Nemophila kirtleyi	Snake River Canyon nemophila
Nepeta cataria	catnip
Oenothera caespitosa	desert evening-primrose
Oenothera hookeri	Hooker's evening-primrose
Oenothera strigosa	common evening-primrose
Onopordum acanthium	Scotch thistle
Osmorhiza chilensis	mountain sweet-cicely
Parietaria pensylvanica	pellitory
Penstemon deustus	hot rock penstemon
Penstemon glandulosus	sticky penstemon
Penstemon venustus	Blue Mtn. penstemon
Penstemon wilcoxii	Wilcox's penstemon
Phacelia hastata	silverleaf phacelia
Phacelia heterophylla	varileaf phacelia
Phacelia linearis	threadleaf phacelia
Phacelia procera	tall phacelia
Phlox hoodii	Hood's phlox
Phlox longifolia	long-leaved phlox
Phlox viscida	sticky phlox
Physaria oregana	Oregon twinpod
Plantago major	common plantain

Plantago patagonica	Indian-wheat
Polygonum aviculare	prostrate knotweed
Polygonum convolutus	dullseed
Polygonum douglasii	Douglas' knotweed
Potentilla gracilis	slender cinquefoil
Ranunculus cymbalaria	shore buttercup
Ranunculus inamoenus	unlovely buttercup
Ranunculus scelcratus multifidus	celeryleaved buttercup
Ranunculus uncinatus	little buttercup
Rhus radicans	poison ivy
Rorippa nasturium-aquaticum	water-cress
Rorippa sp.	cress
Rumex crispus	curly dock
Rumex obtusifolius	bitterdock
Rumex salicifolius	willow dock
Scutellaria angustifolia	narrow-leaved skullcap
Sedum lanceolatum	lanceleaved sedum
Senecio integerrimus	western groundsel
Senecio serra	tall butterweed
Senecio streptanthifolius	Rocky Mtn. butterweed
Silene menziesii	Menzies silene
Silene sp.	catchfly
Sisymbrium altissimum	tumbling mustard
Smilacina stellata	star-flowered solomon-plume
Solanum dulcamara	bittersweet
Solidago canadensis	Canada goldenrod
Solidago gigantea	smooth goldenrod
Solidago occidentalis	western goldenrod
Sonchus asper	prickly sow-thistle
Stanleya viridiflora	perennial stanleya
Stellaria media	chickweed
Stellaria sp.	chickweed
Taraxacum officinale	common dandelion
Tetradymia canescens	spineless horse-brush
Thalictrum occidentale	western meadowrue
Thlaspi arvense	field pennycress
Tonella floribunda	large-flowered tonella
Tragopogon dubius	yellow salsify
Tribulus terrestris	puncture vine
Trifolium repens	white clover
Trillium ovatum	western trillium
Trillium petiolatum	purple trillium
Urtica dioica	stinging nettle
Vaccaria segetalis	cowcockle
Verbascum blattaria	moth mullein
Verbascum thapsus	flannel mullein
Verbena bracteata	bracted verbena
Veronica anagallis-aquatica	water pimpernel
Veronica arvensis	common speedwell
Veronica biloba	bilobed speedwell
Viola glabella	stream violot
Viola nuttallii	Nutthall?s violet
Viola orbiculata	round-leaved violet
Xanthium strumarium	common cocklebur

Grasses, Sedges, and Rushes

Agropyron smithii	western wheatgrass
Agropyron spicatum	bluebunch wheatgrass
Agrostis exarata	spike bentgrass
Agrostis stolonifera	redtop bentgrass
Bromus brizaeformis	rattlesnake brome
Bromus carinatus	mountain brome
Bromus inermis	smooth brome
Bromus japonicus	Japanese brome
Bromus mollis	soft brome
Bromus sterils	barren brome
Bromus tectorum	cheatgrass
Calamagrostis rubescens	pinegrass
Carex athrostachya	slenderbeak sedge
Carex backii	Backs sedge
Carex geyeri	elk sedge
Carex hoodii	Hood's sedge
Carex microptera	small-winged sedge
Catabrosa aquatica	brookgrass
Deschampsia elongata	slender hairgrass
Echinochloa crusgalli	large barnyard-grass
Eleocharis palustris	common spike-rush
Elymus caput-medusea	medusahead rye
Elymus cinereus	basin wildrye
Elymus cinerus	basin wildrye
Elymus glaucus	blue wildrye
Festuca idahoensis	Idaho fescue
Glyceria elata	tall mannagrass
Glyceria striata	fowl mannagrass
Hordeum jubatum	foxtail barley
Juncus bufonius	toad rush
Juncus ensifolius	dagger-leaf rush
Juncus tenuis	slender rush
Juncus torreyi	Torrey?s rush
Koeleria cristata	prairie junegrass
Leersia oryzoides	cutgrass
Melica bulbosa	oniongrass
Paspalum distichum	knotgrass
Phleum pratense	common timothy
Poa bulbosa	bulbous bluegrass
Poa compressa	Canada bluegrass
Poa pratensis	Kentucky bluegrass
Poa sandbergii	Sandberg's bluegrass
Polypogon monspeliensis	rabbitfoot polypogon
Puccinelia pauciflora	weak alkaligrass
Sitanion hystrix	squirrel-tail
Stipa occidentalis	western needlegrass

Ferns and Fern Allies

Equisetum hyemale	common horsetail
Equisetum laevigatum	smooth horsetail