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# Horse Ridge Research Natural Area

## Guidebook Supplement 37

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The Pacific Northwest Research Station is publishing this guidebook as part of a continuing series of guidebooks on federal research natural areas begun in 1972.

Cover:

Horse Ridge Research Natural Area—Southeast-facing view from midslope on Horse Ridge looking into Millican Valley. The lower slopes of Pine Mountain are visible in the distance. Foreground of western juniper woodland with western juniper saplings and juveniles mixed with older trees. An understory of big sagebrush, threadleaf sedge, Idaho fescue, and bluebunch wheatgrass is mixed with a relatively inconspicuous herbaceous layer. Bare soil surface alternates with patches of (barely visible) microbiotic crust in foreground.

## Abstract

**Schuller, Reid; Halvorson, Ron. 2008.** Horse Ridge Research Natural Area: guidebook supplement 37. Gen. Tech. Rep. PNW-GTR-771. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 25 p.

This guidebook describes Horse Ridge Research Natural Area, a 243-ha (600-ac) tract established to represent an example of the western juniper/big sagebrush/threadleaf sedge (*Juniperus occidentalis*/*Artemisia tridentata*/*Carex filifolia*) plant association.

Keywords: Research natural area, *Juniperus occidentalis*, western juniper, *Artemisia tridentata*, big sagebrush, *Carex filifolia*, threadleaf sedge, relict vegetation, juniper invasion, juniper woodland, sagebrush steppe, Northern Great Basin, Oregon High Desert.

## Preface

The research natural area (RNA) described in this supplement<sup>1</sup> is administered by the Prineville District, Bureau of Land Management (BLM), U.S. Department of the Interior.

Scientists and educators wishing to visit or use the RNA for scientific or educational purposes should contact the Prineville BLM field office manager in advance and provide information about research or educational objectives, sampling procedures, and other prospective activities. Research projects, educational visits, and collection of specimens from the RNA all require prior approval. There may be limitations on research or educational activities.

Horse Ridge RNA is part of a federal system of such tracts established for research and educational purposes. Each RNA is a site where natural features are protected or managed for scientific purposes and natural processes are allowed to dominate. Their main purposes are to provide:

- Baseline areas against which effects of human activities can be measured or compared.
- Sites for study of natural processes in undisturbed ecosystems.
- Gene pool preserves for all types of organisms, especially rare and endangered types.

The federal system is outlined in *A Directory of the Research Natural Areas on Federal Lands of the United States of America*.<sup>2</sup>

Of the 183 federal RNAs established in Oregon and Washington, 45 are described in *Federal Research Natural Areas in Oregon and Washington: A Guidebook for Scientists and Educators* (see footnote 1). Supplements to the guidebook such as this publication constitute additions to the system or comprehensive revisions of previously published guidebooks.

The guiding principle in management of RNAs is to prevent unnatural encroachments or activities that directly or indirectly modify ecological processes or conditions. Logging and uncontrolled grazing are not allowed, for example, nor is public use that might impair scientific or educational values. Management practices necessary to maintain or restore ecosystems may be allowed.

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<sup>1</sup> Supplement No. 37 to Franklin, J.F.; Hall, F.C.; Dyrness, C.T.; Maser, C. 1972. Federal research natural areas in Oregon and Washington: a guidebook for scientists and educators. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 498 p.

<sup>2</sup> Federal Committee on Ecological Reserves. 1977. A directory of the research natural areas on federal lands of the United States of America. Washington, DC: U.S. Department of Agriculture, Forest Service. [Irregular pagination].

Federal RNAs provide a unique system of publicly owned and protected examples of undisturbed ecosystems where scientists can conduct research with minimal interference and reasonable assurance that investments in long-term studies will not be lost to logging, land development, or similar activities. In return, a scientist wishing to use an RNA is obligated to:

- Obtain permission from the appropriate administering agency before using the area.<sup>3</sup>
- Abide by the administering agency's regulations governing use, including specific limitations on the type of research, sampling methods, and other procedures.
- Inform the administering agency on progress of the research, published results, and disposition of collected materials.

The purpose of these limitations is to:

- Ensure that the scientific and educational values of the tract are not impaired.
- Accumulate a documented body of knowledge and information about the tract.
- Avoid conflict between studies and activities.

Research must be essentially nondestructive; destructive analysis of vegetation is generally not allowed, nor are studies requiring extensive modification of the ground surface or extensive excavation of soil. Collection of plant and animal specimens should be restricted to the minimum necessary to provide voucher specimens and other research needs. Under no circumstances may collecting significantly reduce populations of species. Collecting also must be carried out in accordance with agency regulations. Within these broad guidelines, appropriate uses of RNAs are determined by the administering agency.

Prineville BLM management direction is to preserve, protect, or restore native species composition and ecological processes of biological communities including terrestrial and aquatic cells<sup>4</sup> listed in the 2003 Oregon Natural Heritage Plan. These RNAs are available for short- or long-term scientific study, research, and education and will serve as a baseline against which human impacts on natural systems can be measured.

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<sup>3</sup> Six federal agencies cooperate in this program in the Pacific Northwest: U.S. Department of the Interior, Bureau of Land Management, Fish and Wildlife Service, and National Park Service; U.S. Department of Agriculture, Forest Service; U.S. Department of Energy; and U.S. Department of Defense.

<sup>4</sup> Cells are the basic units that must be represented in a natural area system. A cell can be an ecosystem, community, habitat, or organism. Taken from Dyrness, C.T.; Franklin, J.F.; Maser, C.; Cook, S.A.; Hall, J.D.; Faxon, G. 1975. Research natural area needs in the Pacific Northwest: a contribution to land-use planning. Gen. Tech. Rep. PNW-38. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 231 p.

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## Introduction

Horse Ridge Research Natural Area (RNA) is a 243-ha (600-ac)<sup>1</sup> tract that occupies predominantly north- to northeast-facing slopes on Horse Ridge in southeast Deschutes County, Oregon. The site was originally established as an RNA in 1967. A guidebook was written for the area in 1972 (Hall 1972, Franklin et al. 1972).

The tract supports a late-seral example of the western juniper/big sagebrush/threadleaf sedge (*Juniperus occidentalis*/*Artemisia tridentata*/*Carex filifolia*) plant association (Hall 1972), and limited examples of the western juniper/big sagebrush/Idaho fescue (*Juniperus occidentalis*/*Artemisia tridentata*/*Festuca idahoensis*) plant association, and the western juniper/big sagebrush/bluebunch wheatgrass (*Juniperus occidentalis*/*Artemisia tridentata*/*Pseudoroegneria spicata*) plant association. The RNA is located in the extreme southwest portion of the Blue Mountains Ecological Province in central Oregon (Oregon Natural Heritage Program 2003, USDA FS 2008).

## Access and Accommodations

From the intersection of U.S. Highway 97 and U.S. Highway 20 in Bend, Oregon, proceed east-southeast for 32.2 km (20 mi) to Millican Valley. Turn south (right) on County Road 2015 (all season, gravel) and proceed 0.9 km (0.6 mi) south to Bureau of Land Management (BLM) Road 6515-A. Turn northwest (right) onto BLM Road 6515-A (dirt, seasonal) and proceed for 3.5 km (2.2 mi) paralleling the northwest-southeast trending ridge of Horse Ridge and park your vehicle in the turnaround next to the fence just east of the southeast corner of Horse Ridge RNA (fig. 1).

Permission for public access must be obtained prior to entering the site. Inquiries should be directed to the Prineville District Office, Bureau of Land Management in Prineville, Oregon. Lodging is available in Bend, Redmond, and Prineville, Oregon.

## Environment

Elevations within the RNA range from 1210 m (3,970 ft) near the northeast corner of the perimeter fence to 1455 m (4,774 ft) along the west-central portion of the perimeter fence. About 85 percent of the RNA is enclosed by a barbed-wire fence. Terrain is generally oriented in an east to north direction on steep to moderately inclined mid to upper slopes. These canyons do not support seasonal streams and lack streambed development (fig. 2). The long axis of the RNA extends 2 km (1.25 mi) in a north-south orientation. The shorter, east-west axis extends for 1.2 km (0.75 mi).

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<sup>1</sup> These data are on file at the Bureau of Land Management, Prineville District Office, and at the USDA Forest Service, Pacific Northwest Research Station, Corvallis, Oregon.

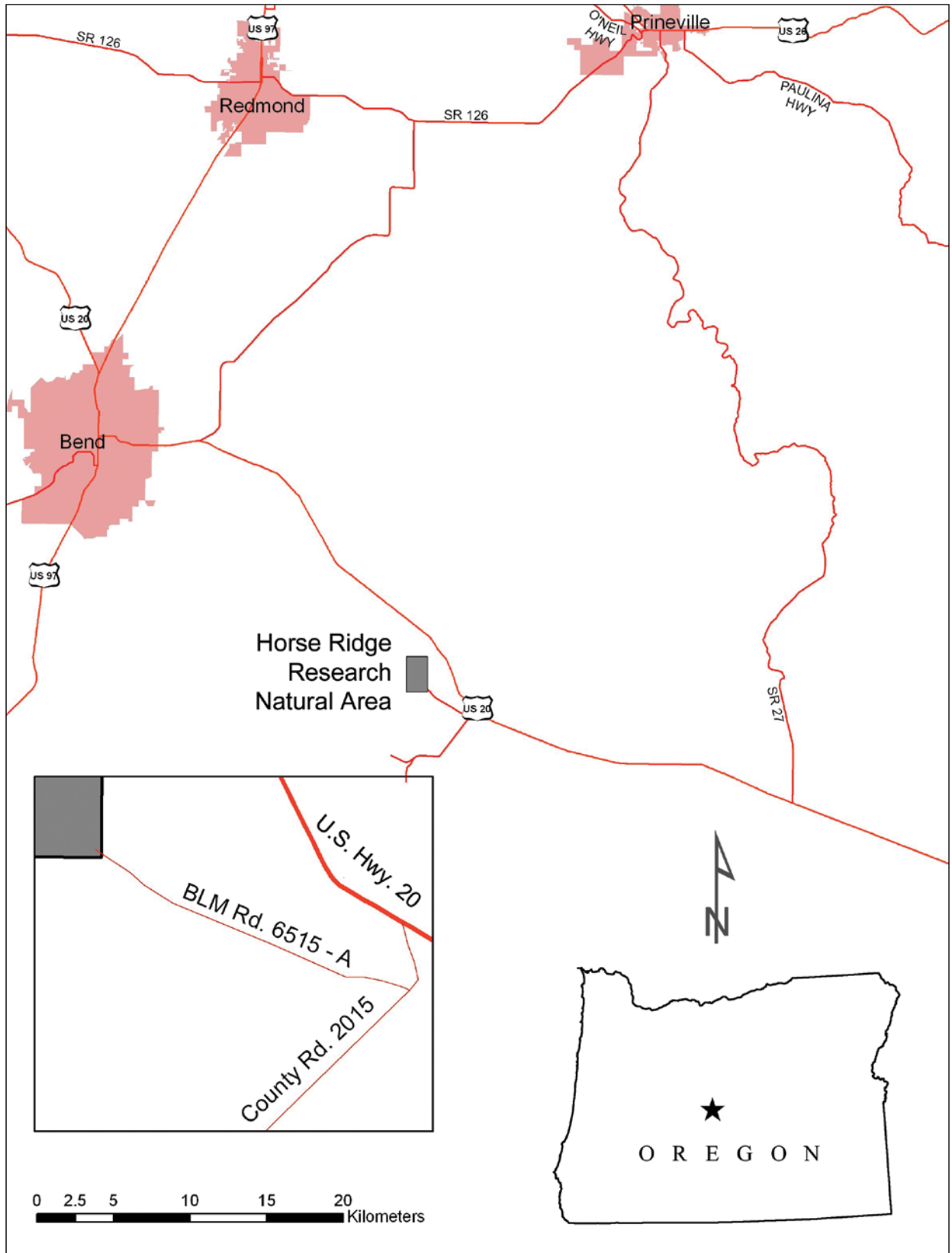


Figure 1—Horse Ridge Research Natural Area location and access.



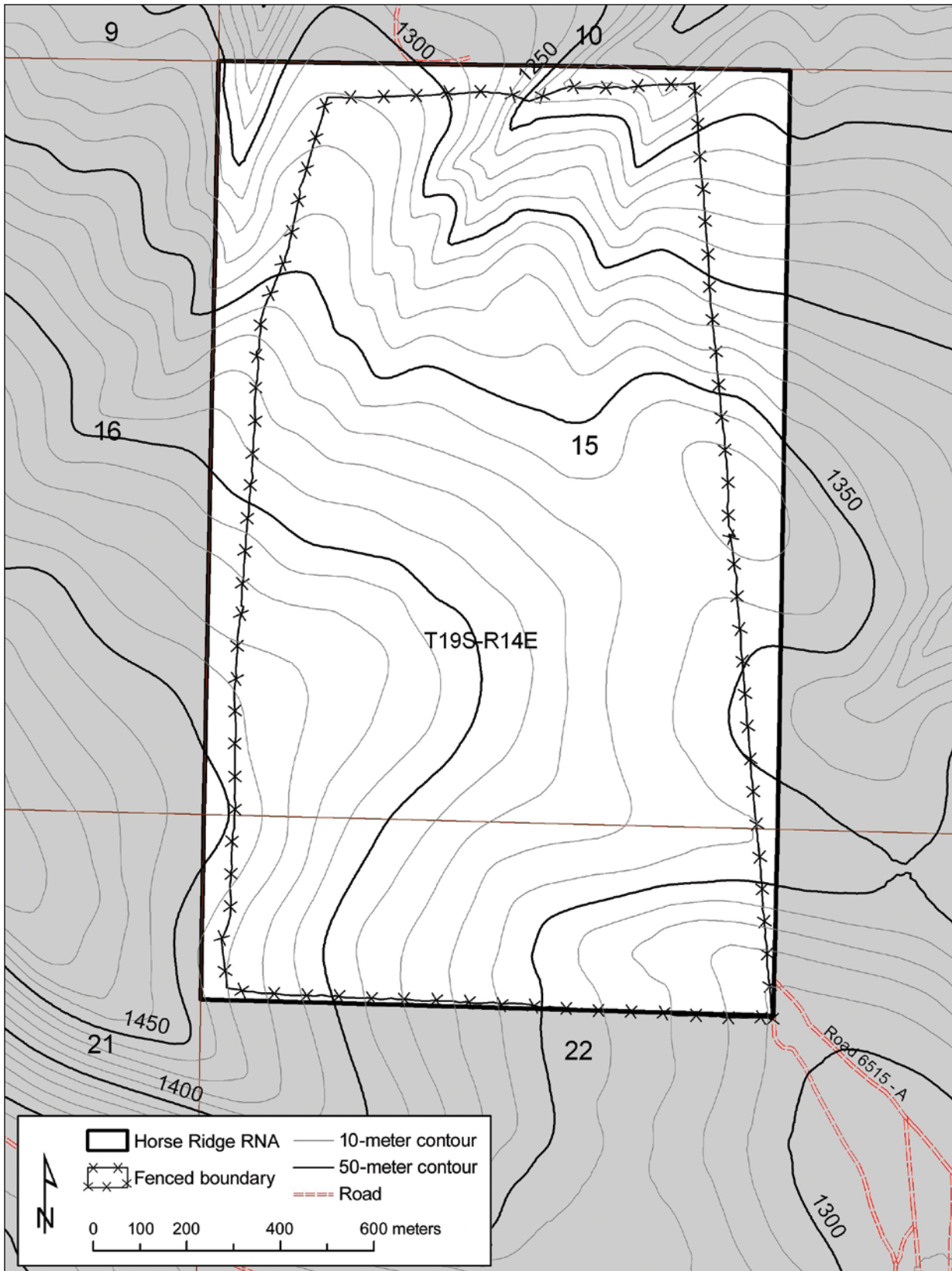


Figure 2—Horse Ridge Research Natural Area topography and boundary.

Bedrock consists of highly fractured Columbia River basalt. Soils within the RNA are primarily classified as Stookmoor-Westbutte complex, taxonomic class ash, glassy, frigid Vitritorrandic Haploxerolls. The soil is moderately deep and somewhat excessively drained. It is formed in pumiceous ash and loamy mixed material (Miller et al., n.d.). Depth to lithic bedrock is 51 to 102 cm (20 to 40 in). Generalized soil profiles for the Stookmoor-Westbutte complex, 25 to 50 percent north slopes are (USDA NRCS 2008):

	Soil depth		Soil texture
	<i>Centimeters</i>	<i>Inches</i>	
Westbutte north	0 to 23	0 to 9	Stony loam
	23 to 53	9 to 21	Very cobbly loam
	53 to 76	21 to 30	Cobbly clay loam
	76 to 102	30 to 40	Unweathered bedrock
Stookmoor north	0 to 20	0 to 6	Loamy sand
	20 to 61	6 to 14	Sandy loam
	61 to 74	14 to 24	Sandy loam
	74 to 84	24 to 34	Unweathered bedrock

## Climate

Climate within the RNA is continental and semiarid, modified by marine air currents from the Pacific Ocean that provide precipitation as rain and snow. Located 32 km (20 mi) west of Horse Ridge, the Bend 7 NE, Oregon (350699) weather station for the 1991–2007 period provides the most comparable data (table 1).

In winter, precipitation is a mixture of rain and snow (Driscoll 1964). Annual precipitation is low. Summers are dry with warm days and cool nights. Frost occurs rarely during the summer but may occur anytime between October and June. Twenty-five percent of annual precipitation occurs during the 3-month growing period from April through June. Snowfall occurs from October through March and occasionally into April. Snow depths accumulate to 25 mm (1 in) in December and January. January receives the highest average monthly snowfall of 114 mm (4.5 in) (Western Regional Climate Center 2008).

**Table 1—Temperature and precipitation summary, 5/01/1991 to 6/30/2007—Bend 7 NE, OR (350699)**

Average minimum January temperature	-3.9 °C (25.0 °F)
Average maximum January temperature	6.4 °C (43.6 °F)
Average minimum July temperature	9.1 °C (48.3 °F)
Average maximum July temperature	28.8 °C (83.8 °F)
Average annual precipitation	245 mm (9.63 in)
Average July–September precipitation	35 mm (1.39 in)

## Vegetation

The RNA is situated along the boundary of three major ecological provinces (Franklin and Dyrness 1988). Depending on the mapping scheme and criteria used to define major physiographic, geologic, and vegetation zones, Horse Ridge may be placed within the Blue Mountains, the Eastern Cascades, or the High Lava Plains province. Vegetation within the RNA is characteristic of portions of all three provinces. The distinctive feature at Horse Ridge RNA is the abundance of threadleaf sedge (*Carex filifolia*) as an understory dominant or co-dominant (Hall 1972). The primary basis for designation of Horse Ridge as an RNA is based on the presence of the western juniper/big sagebrush/threadleaf sedge (*Juniperus occidentalis*/*Artemisia tridentata*/*Carex filifolia*) plant association (Oregon Natural Heritage Program 2003, Dyrness et al. 1975). Driscoll (1964) did not find this plant association sufficiently widespread or common enough to warrant inclusion in his study of central Oregon plant communities. The relative abundance of threadleaf sedge throughout most of the site indicates the area has only been lightly grazed by livestock over the years. The relatively steep slopes at Horse Ridge, coupled with lack of a nearby water source for cattle has resulted in low grazing pressure from domestic livestock over the years. All but the extreme southeastern part of the RNA has been essentially ungrazed by domestic animals and consequently has great value as a reference area or baseline area to compare with other more intensively managed juniper woodlands in central Oregon (Hall 1972).

Minor amounts of the western juniper/big sagebrush/Idaho fescue (*Juniperus occidentalis*/*Artemisia tridentata*/*Festuca idahoensis*), and the western juniper/big sagebrush/bluebunch wheatgrass (*Juniperus occidentalis*/*Artemisia tridentata*/*Pseudoroegneria spicata*) plant associations also occur within the RNA (Miller et al., n.d.; Oregon Natural Heritage Program 2003).

In addition to the threadleaf sedge, the herb layer is dominated by native bunchgrasses, including Idaho fescue, bluebunch wheatgrass, Sandberg bluegrass (*Poa secunda*), prairie junegrass (*Koeleria macrantha*), and bottlebrush squirreltail (*Elymus elymoides*). Horse Ridge is the best example of hybridization between bluebunch wheatgrass, bottlebrush squirreltail, and possibly, thickspike wheatgrass (*Elymus lanceolatus* ssp. *lanceolatus*) in central Oregon (Hall 1972).

In June 2005, four 0.1-ha circular plots were established to monitor structural and compositional change over time within the western juniper/big sagebrush/threadleaf sedge, and the western juniper/big sagebrush/Idaho fescue plant associations. Table 2 provides a summary of the physical characteristics of the plots.

**Table 2—Physical features of four permanent plots within Horse Ridge Research Natural Area**

Feature	Plot			
	993	995	996	997
Elevation (m)	1357	1397	1405	1431
Aspect (°)	217	76	58	42
Slope grade (°)	7	10	18	16
Slope position	Mid	Upper 1/3	Upper 1/3	Upper 1/3

Table 3 shows soil, rock, litter, and microbiotic crust<sup>2</sup> aerial cover and frequency within the four plots. Table 4 summarizes shrub and herb foliar cover and herb frequency. Big sagebrush averages 5 percent cover and the principal graminoids are Idaho fescue, threadleaf sedge, bluebunch wheatgrass, Sandberg bluegrass, and prairie junegrass. Other grasses, such as Cusick’s bluegrass (*Poa cusickii*), bottlebrush squirreltail, and the invasive cheatgrass (*Bromus tectorum*) are occasionally represented. Typical herbs include maiden blue-eyed Mary (*Collinsia parviflora*), obscure cryptantha (*Cryptantha ambigua*), broadleaf milkvetch (*Astragalus lentiginosus*), and woolly groundsel (*Senecio canus*) (fig. 3).

<sup>2</sup> Microbiotic crust is composed of ground-surface-dwelling mosses and lichens.

**Table 3—Soil, rock, litter, and microbiotic crust<sup>a</sup> cover and frequency within four permanent plots, Horse Ridge Research Natural Area**

Cover type	Plot							
	993		995		996		997	
	Cover <sup>b</sup>	Frequency	Cover	Frequency	Cover	Frequency	Cover	Frequency
	<i>Percent</i>							
Rock <sup>c</sup>	2	18	4	18	9	32	6	43
Gravel	1	21	+	11	0	0	2	21
Bare soil	59	86	46	75	54	75	55	86
Litter	20	100	27	89	8	57	26	89
Moss	8	54	7	32	16	64	10	43
Lichen	11	57	5	54	10	64	7	39

Note: + = <0.5 percent cover.

<sup>a</sup> The combined foliar cover of ground-surface-dwelling mosses and lichens.

<sup>b</sup> Cover is expressed as percentage of aerial cover; frequency is expressed as percentage of occurrence within 28 2- by 5-dm microplots. Zero values are not included.

<sup>c</sup> Rock = particles >8 cm, gravel = 2 mm to 8 cm, bare soil = <2 mm.

**Table 4—Plant association, understory coverage and frequency within four permanent plots in Horse Ridge Research Natural Area**

Species	Plant association							
	JUOC/ARTR/CAFI <sup>a</sup> Plot 993		JUOC/ARTR/CAFI Plot 995		JUOC/ARTR/CAFI Plot 996		JUOC/ARTR/FEID Plot 997	
	Cover <sup>b</sup>	Frequency	Cover	Frequency	Cover	Frequency	Cover	Frequency
	<i>Percent</i>							
Shrub cover:								
<i>Artemisia tridentata</i> <sup>c</sup>	5	—	4	—	6	—	15	—
<i>Chrysothamnus viscidiflorus</i>	3	—		—	1	—		—
<i>Tetradymia canescens</i>	2	—		—		—	3	
Grass and sedge cover and frequency:								
<i>Festuca idahoensis</i>	9	61	15	57	13	71	9	43
<i>Carex filifolia</i>	3	+	9	25	3	21		
<i>Pseudoroegneria spicata</i>	4	29	+	11	1	21	1	11
<i>Poa secunda</i>	1	29	1	36	1	25	1	7
<i>Koeleria macrantha</i>	+	11	1	25	2	32	1	21
<i>Elymus elymoides</i>	+	4						
<i>Poa cusickii</i>	1	4			2	18		
<i>Bromus tectorum</i>			+	4			+	7
<i>Achnatherum thurberianum</i>							1	21
<i>Hesperostipa comata</i>							1	7
Herb cover and frequency:								
<i>Cryptantha ambigua</i>	+	7	2	18	1	4	+	4
<i>Collinsia parviflora</i>	1	32	+	7	1	39	+	14
<i>Astragalus lentiginosus</i>	1	11	+	4	+	7		
<i>Senecio canus</i>	+	11	+	7	1	11	+	4
<i>Eriogonum strictum</i>	+	4	+	4			+	7
<i>Descurainia pinnata</i>	+	4	+	4			+	7
<i>Arabis puberula</i>	+	7	+	4				
<i>Lomatium triternatum</i>	+	7			+	7		
<i>Achillea millefolium</i>	+	4						
<i>Leucocrinum montanum</i>	+	4						
<i>Fritillaria atropurpurea</i>	+	4						
<i>Leptosiphon septentrionalis</i>	+	4						
<i>Phlox gracilis</i>	+	4						
<i>Antennaria dimorpha</i>			+	4				
<i>Calochortus macrocarpus</i>			+	4				
<i>Lupinus argenteus</i>			+	7	+	4		
<i>Arabis</i> sp.					+	4		
<i>Eriogonum umbellatum</i>					1	4		
<i>Antennaria geyeri</i>					+	7		
<i>Eriogonum microthecum</i>							+	4
<i>Gilia sinuata</i>							+	7

Note: JUOC = *Juniperus occidentalis*, ARTR = *Artemisia tridentata*, CAFI = *Carex filifolia*, FEID = *Festuca idahoensis*, + = trace (<0.5 percent foliar cover), — = not recorded.

<sup>a</sup> Plant association names and acronyms follow Driscoll (1964) and Hall (1972), but have been modified to incorporate current nomenclature employed in the *Flora of North America* (1993+).

<sup>b</sup> Cover is expressed as percentage of foliar cover; frequency is expressed as percentage of occurrence within 28 2- by 5-dm microplots. Zero values are not included.

<sup>c</sup> See appendix 1 for a listing of scientific and common names.



Figure 3—Example of typical expression of western juniper/big sagebrush/threadleaf sedge plant association taken in plot 993. Exposed surface soil is sandy loam with high stone content. Native bunchgrasses predominate in the understory. Grasses include Idaho fescue, bluebunch wheatgrass, and Sandberg bluegrass mixed with threadleaf sedge.

Plot 997 (western juniper/big sagebrush/Idaho fescue plant association) was similar in overall appearance to the other plots, except for the presence of Thurber's needlegrass (*Achnatherum thurberianum*) and needle-and-thread (*Hesperostipa comata*), and the absence of threadleaf sedge (table 4, fig. 4).

Western juniper sapling<sup>3</sup> and live tree density data recorded in the four, 0.1-ha plots in 2005 are shown in table 5. Small sapling densities average 180 per ha (445 per ac), with a range from 110 to 340 per ha (272 to 840 per ac). Large sapling densities average 117.5 per ha (290 per ac), with a range from 70 to 120 per ha (173 to 297 per ac). Western juniper live tree density averages 202.5 per ha (500 per ac), with a range from 140 to 280 per ha (346 to 692 per ac). Western junipers that

<sup>3</sup>“Saplings” refers to two groups of small trees (a) those > 10 cm and < 1.47 m (> 4 in and < 4.8 ft) in height but less than 5 cm (2 in) diameter at breast height and (b) those trees > 1.47 m in height but less than 5 cm (2 in) diameter at breast height.



Figure 4—An example of the western juniper/big sagebrush/Idaho fescue plant association (plot 997). Note concentration of Idaho fescue beneath western juniper canopy in foreground.

**Table 5—Western juniper density per hectare by size class and other stand structure attributes, Horse Ridge Research Natural Area**

	Plot				Mean
	993	995	996	997	
	<i>Number per hectare</i>				
Small sapling	340	150	110	120	180
Large sapling	120	80	70	100	117.5
Live trees	280	140	190	200	202.5
Standing dead trees	0	0	0	0	0
Multibranched trees	60	80	20	30	47.5

branched below 1.47 m average 47.5 per ha (117 per ac), with a range from 20 to 80 per ha (49 to 198 per ac). Based on field observations elsewhere in central Oregon, these densities appear to be average for these associations. No standing dead trees or large coarse woody debris were found in these plots.

A list of soil crust moss and lichen scientific names appears at the end of the text in appendix 2.

## Fauna

Reptiles, amphibians, birds, and mammals known or expected to occur within the RNA are listed in appendix 3. These lists have been compiled from a combination of field observations and knowledge of species' geographic ranges and habitat affinities (Csuti et al 1997). Species on this list are likely within the RNA for at least some portions of their life cycles.

## Disturbance History

Lightning-ignited fire has played a role at Horse Ridge as evidenced by scattered, large fire-scarred, burned-out western juniper. It is unclear whether recent fires were small, burning in patches around individual trees, or were more extensive. Lack of surface fuels has been offered as an explanation for lack of fire spread in this region (Hall 1972).

Long-lived individuals of big sagebrush can be periodically subjected to infestation by *Aroga websteri*, a leaf-defoliating moth. This was observed throughout eastern and parts of central Oregon from 1962 to 1966 (Gates 1964).

The dominance and vigor of the grazing-sensitive threadleaf sedge coupled with the minor presence of invasive grasses (i.e., cheatgrass) suggests that the role of disturbance from grazing by domestic livestock appears to have played only a minor role at Horse Ridge and that the RNA has been relatively undisturbed. One notable exception to this is in the extreme southeast portion of the RNA, which was grazed by cattle prior to construction of the fenced enclosure.

The impact of invasive species on sagebrush ecosystems and juniper woodlands throughout the Northern Great Basin and the Intermountain West has been well documented (Young et al. 1972)

## Research History

Research on vegetation classification, community ecology, and inventory:

- *Biotic Soil Crusts of Oregon's Shrub Steppe* (Ponzetti 2000).
- *Horse Ridge Western Juniper Permanent Plot* (Miller et al., n.d.).
- *Plant Associations of the Crooked River National Grassland* (Hopkins and Kovalchik 1983).
- *Vegetation-Soil Units in the Central Oregon Juniper Zone* (Driscoll 1964).



Research on *Juniperus occidentalis* (western juniper) growth and expansion:

- *Occurrence of Sustained Droughts in the Interior Pacific Northwest (A.D. 1733–1980) Inferred From Tree-Ring Data* (Knapp et al. 2004).
- *Comparative Rates of Western Juniper Afforestation in South-Central Oregon and the Role of Anthropogenic Disturbance* (Soulé et al. 2003).
- *Climatic Regionalization and the Spatio-Temporal Occurrence of Extreme Single-Year Drought Events (1500–1998) in the Interior Pacific Northwest, USA* (Knapp et al. 2002).
- *Detecting Potential Regional Effects of Increased Atmospheric CO<sub>2</sub> on Growth Rates of Western Juniper* (Knapp et al. 2001a).
- *Post-Drought Growth Responses of Western Juniper (Juniperus occidentalis var. occidentalis) in Central Oregon* (Knapp et al. 2001b).
- *Juniperus occidentalis (Western Juniper) Establishment History on Two Minimally Disturbed Research Natural Areas in Central Oregon* (Soulé and Knapp 2000).
- *Geographical Distribution of an 18<sup>th</sup> Century Heart Rot Outbreak in Western Juniper (Juniperus occidentalis ssp. occidentalis Hook.)* (Knapp and Soulé 1999).
- *Recent Juniperus occidentalis (Western Juniper) Expansion on a Protected Site in Central Oregon* (Knapp and Soulé 1998).

Research on primary production:

- *Environmental Limits on Aboveground Net Primary Production, Leaf Area, and Biomass in Vegetation Zones of the Pacific Northwest* (Gholz 1982, see also Greene et al. 1986).
- *Structure and Productivity of Juniperus occidentalis in Central Oregon* (Gholz 1980, see also Greene et al. 1986).
- *Limits on Aboveground Net Primary Production, Leaf Area, and Biomass In Vegetational Zones of the Pacific Northwest* (Gholz 1979, see also Greene et al. 1986).

Other research

- *Pogonomyrmex owyheeii Nest Site Density and Size on a Minimally Impacted Site in Central Oregon* (Soulé and Knapp 1996)
- *Remote Sensing of the Leaf Area Index of Temperate Coniferous Forests* (Spanner et al. 1984, see also Greene et al. 1986).
- *Studies on the Incidence of Coniferous Needle Endophytes in the Pacific Northwest* (Carroll and Carroll 1978, see also Greene et al. 1986).

- *Bird Populations in Four Vegetational Types in Central Oregon* (Gashwiler 1977, see also Greene et al 1986).

In addition to the research and monitoring described above, four permanent vegetation plots were established in 2005 to characterize and monitor change in forest/shrub steppe composition and structure (this project summarized, in part, in tables 1 through 4.) Data are on file at the Prineville District Office, Bureau of Land Management, and the Pacific Northwest (PNW) Research Station, USDA Forest Service (USFS), Corvallis, Oregon.

## Site History

Subsequent to designation as an RNA in 1967 (Hall 1972), Horse Ridge RNA was established as a research natural area and as an area of critical environmental concern (ACEC) in 1989 with publication of the Brothers/LaPine Resource Management Plan and Record of Decision (USDI BLM 1989). This management designation was subsequently revalidated in 2005 in the Upper Deschutes Resource Management Plan and Record of Decision (USDI BLM 2005).

The land that is now the RNA was withdrawn from all forms of appropriation under the public land laws, including the mining laws, and designated as the “Juniper Natural Area” in 1962 based on its representation of a “juniper savannah.” There is no information in the record as to the history of or motivation for this designation. In 1967, the area was formally designated as the Horse Ridge RNA as an “example of western juniper (*Juniperus occidentalis*)–big sagebrush (*Artemisia tridentata*) vegetation within the juniper zone of central Oregon” (Hall 1972, Franklin et al. 1972). Designation as a national natural landmark by the National Park Service followed in 1968 along with installation of a plaque in the southeast corner (USDI BLM 1996).

The designation of Horse Ridge ACEC/RNA in the Brothers/LaPine Resource Management Plan (1989) was to formalize Horse Ridge RNA as both an RNA and an ACEC.

The RNA was evaluated for potential wilderness designation as an “instant study area” in 1979 (ISA OR-5-5) but was determined to not have wilderness characteristics, mainly related to its small size and the noise intrusion from Highway 20 to the north. This evaluation was sent to Congress as part of a national package in 1985. Congress has yet to take action on this package.

The extreme southeastern part of the RNA has been grazed by domestic livestock in the past. Prior to designation as an RNA, western juniper trees were cut for fenceposts and firewood in this same area in the southeastern part of the RNA. Traces of the access road into this area still exist (USDA USFS 2008).

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**Horse Ridge RNA was further designated as a national natural landmark in 1968.**

In the early 1970s, a barbed-wire perimeter fence was constructed, which further restricted livestock access into the RNA from adjacent lands. Recent use of the area includes trail riding within the RNA by mountain bikers, especially during the late winter and early spring.

## Maps

Maps applicable to Horse Ridge RNA: topographic—Horse Ridge, Oregon 7.5 minute, 1:24,000 scale, 1962; Brothers/LaPine Planning Area—west half, 1:100,000, 1998.

## Acknowledgments

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## English Equivalents

1 hectare (ha) = 2.47 acres (ac)

1 kilometer (km) = 0.62 miles (mi)

1 meter (m) = 3.28 feet (ft)

1 decimeter (dm) = 3.94 inch (in)

1 centimeter (cm) = 0.394 inch

1 millimeter (mm) = 0.0394 inch

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## Appendix 1: Vascular Plants and Ferns<sup>a b</sup>

Scientific name	Common name
Coniferous trees:	
<i>Juniperus occidentalis</i> Hook.	Western juniper
<i>Pinus ponderosa</i> Dougl. ex Laws. & C. Laws. var. <i>ponderosa</i>	Ponderosa pine
Medium shrubs 0.5 to 2 m (1.6 to 6.6 ft) tall:	
<i>Artemisia tridentata</i> Nutt.	Big sagebrush
<i>Chrysothamnus viscidiflorus</i> (Hook.) Nutt.	Yellow rabbitbrush
<i>Ericameria bloomeri</i> (Gray) Macbr.	Bloomer's goldenbush
<i>Ericameria humilis</i> (Greene) L.C. Anderson	Truckee rabbitbrush
<i>Ericameria nauseosa</i> (Pallas ex Pursh) Nesom & Baird	Gray rabbitbrush
<i>Grayia spinosa</i> (Hook.) Moq.	Spiny hopsage
<i>Linanthus pungens</i> (Torr.) J.M. Porter & L.A. Johnson	Granite prickly phlox
<i>Purshia tridentata</i> (Pursh) DC.	Antelope bitterbrush
<i>Ribes cereum</i> Dougl.	Wax currant
<i>Tetradymia canescens</i> DC.	Spineless horsebrush
<i>Tetradymia glabrata</i> T. & G.	Smooth horsebrush
Low shrubs <0.5 m (1.6 ft) tall:	
<i>Ericameria resinosa</i> Nutt.	Columbia goldenweed
Ferns:	
<i>Cheilanthes gracillima</i> D.C. Eaton	Lace lipfern
Herbs:	
<i>Achillea millefolium</i> L.	Common yarrow
<i>Agoseris glauca</i> (Pursh) Raf. var. <i>glauca</i>	Pale agoseris
<i>Alyssum alyssoides</i> (L.) L.	Pale madwort
<i>Amsinckia lycopoides</i> Lehm.	Tarweed fiddleneck
<i>Antennaria dimorpha</i> (Nutt.) T. & G.	Low pussytoes
<i>Antennaria geyeri</i> Gray	Pinewoods pussytoes
<i>Antennaria microphylla</i> Rydb.	Littleleaf pussytoes
<i>Arabis holboellii</i> Hornem.	Holboell's rockcress
<i>Arabis puberula</i> Nutt.	Silver rockcress
<i>Arabis sparsiflora</i> Nutt. Engelm.	Sicklepod rockcress
<i>Arceuthobium campylopodum</i>	Western dwarf mistletoe
<i>Astragalus curvicarpus</i> (Heller) J.F. Macbr.	Curve-pod milkvetch
<i>Astragalus filipes</i> Torr. ex Gray	Basalt milkvetch
<i>Astragalus lentiginosus</i> Dougl. ex Hook. var. <i>chartaceus</i> M.E. Jones	Broadleaf milkvetch
<i>Astragalus purshii</i> Dougl. ex Hook.	Woollypod milkvetch
<i>Calochortus macrocarpus</i> Dougl.	Sagebrush mariposa lily
<i>Castilleja chlorotica</i> Piper	Greentinge Indian paintbrush
<i>Castilleja miniata</i> Dougl. ex Hook.	Giant red Indian paintbrush
<i>Chaenactis douglasii</i> (Hook.) Hook. & Arn.	Douglas' dustymaiden
<i>Chenopodium fremontii</i> S. Wats.	Fremont's goosefoot
<i>Chenopodium leptophyllum</i> (Moq.) Nutt. ex S. Wats.	Narrowleaf goosefoot
<i>Collinsia parviflora</i> Dougl. ex Lindl.	Maiden blue-eyed Mary
<i>Collomia grandiflora</i> Dougl. ex Lindl.	Grand collomia
<i>Collomia linearis</i> Nutt.	Tiny trumpet
<i>Crepis acuminata</i> Nutt.	Tapertip hawksbeard
<i>Cryptantha ambigua</i> (Gray) Greene	Obscure cryptantha
<i>Cryptantha circumscissa</i> (Hook. & Arn.) I.M. Johnston	Cushion cryptantha



Scientific name	Common name
<i>Cryptantha pterocarya</i> (Torr.) Greene	Wingnut cryptantha
<i>Cryptantha torreyana</i> (Gray) Greene	Torrey's cryptantha
<i>Descurainia pinnata</i> (Walt.) Britt.	Western tansymustard
<i>Dieteria canescens</i> (Pursh) Nutt.	Hoary tansyaster
<i>Draba verna</i> L.	Spring draba
<i>Eriastrum sparsiflorum</i> (Eastw.) Mason ssp. <i>sparsiflorum</i>	Great Basin woollystar
<i>Erigeron chrysopsidis</i> Gray	Dwarf yellow fleabane
<i>Erigeron filifolius</i> (Hook.) Nutt.	Threadleaf fleabane
<i>Erigeron linearis</i> (Hook.) Piper	Desert yellow fleabane
<i>Erigeron poliospermus</i> Gray	Cushion fleabane
<i>Erigeron speciosus</i> (Lindl.) DC.	Aspen fleabane
<i>Eriogonum microthecum</i> Nutt. var. <i>laxiflorum</i> Hook.	Slender buckwheat
<i>Eriogonum ovalifolium</i> Nutt. var. <i>ovalifolium</i>	Cushion buckwheat
<i>Eriogonum strictum</i> Benth. ssp. <i>proliferum</i> (T. & G.) Stokes var. <i>anserinum</i> (Greene) R.J. Davis	Blue Mountain buckwheat
<i>Eriogonum strictum</i> Benth. ssp. <i>strictum</i>	Blue Mountain buckwheat
<i>Eriogonum umbellatum</i> Torr.	Sulphur-flower buckwheat
<i>Eriogonum vimineum</i> Dougl. ex. Benth.	Wickerstem buckwheat
<i>Eriophyllum lanatum</i> (Pursh) J. Forbes	Common woolly sunflower
<i>Erodium cicutarium</i> (L.) L'Her. ex Ait.	Redstem storksbill
<i>Erysimum</i> sp.	Wallflower
<i>Fritillaria atropurpurea</i> Nutt.	Spotted fritillary
<i>Gayophytum racemosum</i> T. & G.	Blackfoot groundsmoke
<i>Gayophytum ramosissimum</i> T. & G.	Pinyon groundsmoke
<i>Gilia sinuata</i> Dougl. ex Benth.	Rosy gilia
<i>Hesperolinon micranthum</i> (Gray) Sm.	Tidytips
<i>Holosteum umbellatum</i> L.	Jagged chickweed
<i>Layia glandulosa</i> (Hook.) Hook. & Arn.	Whitedaisy tidytips
<i>Leptosiphon septentrionalis</i> (Mason) J.M. Porter & L.A. Johnson	Northern linanthus
<i>Leucocrinum montanum</i> Nutt. ex Gray	Common starlily
<i>Lithospermum ruderale</i> Dougl. ex Lehm.	Western stoneseed
<i>Lomatium nevadense</i> (S. Wats.) Coult. & Rose	Nevada biscuitroot
<i>Lomatium triternatum</i> (Pursh) Coult. & Rose	Nineleaf biscuitroot
<i>Lupinus argenteus</i> Pursh	Silvery lupine
<i>Melilotus albus</i> Medik.	White sweet clover
<i>Mentzelia albicaulis</i> (Dougl. ex Hook.) Dougl. ex Torr. & Gray	Whitestem blazingstar
<i>Mimulus cusickii</i> (Greene) Rattan	Cusick's monkeyflower
<i>Mimulus nanus</i> Hook. & Arn.	Dwarf purple monkeyflower
<i>Nothocalais troximoides</i> (Gray) Greene	False agoseris
<i>Orobanche corymbosa</i> (Rydb.) Ferris ssp. <i>corymbosa</i>	Flat-top broomrape
<i>Orobanche fasciculata</i> Nutt.	Clustered broomrape
<i>Penstemon humilis</i> Nutt. ex Gray	Low beardtongue
<i>Phacelia hastata</i> Dougl. ex Lehm.	Silverleaf phacelia
<i>Phacelia linearis</i> (Pursh) Holz.	Threadleaf phacelia
<i>Phlox gracilis</i> (Hook.) Greene	Slender phlox
<i>Plectritis macrocera</i> T. & G.	Longhorn plectritis
<i>Polemonium micranthum</i> Benth.	Annual polemonium
<i>Ranunculus occidentalis</i> Nutt. var. <i>occidentalis</i>	Western buttercup
<i>Ranunculus testiculatus</i> Crantz	Curveseed butterwort
<i>Scutellaria nana</i> Gray	Dwarf skullcap
<i>Senecio canus</i> Hook.	Woolly groundsel

Scientific name	Common name
<i>Silene douglasii</i> Hook.	Seabluff catchfly
<i>Sisymbrium altissimum</i> L.	Tall tumbled mustard
<i>Stephanomeria minor</i> (Hook.) Nutt. var. <i>minor</i>	Narrowleaf wirelettuce
<i>Taraxacum officinale</i> G.H. Weber ex Wiggers	Common dandelion
<i>Townsendia florifer</i> (Hook.) Gray	Showy Townsend daisy
<i>Tragopogon dubius</i> Scop.	Yellow salsify
<i>Zigadenus venenosus</i> S. Wats.	Meadow deathcamas
Grasses and sedges:	
<i>Achnatherum hymenoides</i> (Roem. & Schult.) Barkw.	Indian ricegrass
<i>Achnatherum occidentale</i> (Thurb.) Barkw.	Common western needlegrass
<i>Achnatherum thurberianum</i> (Piper) Barkw.	Thurber's needlegrass
<i>Bromus tectorum</i> L.	Cheatgrass
<i>Carex filifolia</i> Nutt.	Threadleaf sedge
<i>Carex rossii</i> Boott in Hook.	Ross' sedge
<i>Elymus elymoides</i> (Raf.) Swezey	Bottlebrush squirreltail
<i>Elymus lanceolatus</i> (Scribn. & J.G. Sm.) Gould ssp. <i>lanceolatus</i>	Thickspike wheatgrass
<i>Festuca idahoensis</i> Elmer	Idaho fescue
<i>Hesperostipa comata</i> (Trin. & Rupr.) Barkw. ssp. <i>comata</i>	Needle-and-thread
<i>Koeleria macrantha</i> (Ledeb.) Schult.	Prairie junegrass
<i>Leymus cinereus</i> (Scribn. & Merr.) A. Love	Basin wildrye
<i>Pascopyrum smithii</i> (Rydb.) Barkw. & Dewey	Western wheatgrass
<i>Poa cusickii</i> Vasey ssp. <i>cusickii</i>	Cusick's bluegrass
<i>Poa secunda</i> J. Presl ssp. <i>juncifolia</i>	Big bluegrass
<i>Poa secunda</i> J. Presl ssp. <i>secunda</i>	Sandberg bluegrass
<i>Pseudoroegneria spicata</i> (Pursh) A. Love	Bluebunch wheatgrass

<sup>a</sup> Scientific names taken from Flora of North America. 1993+.

<sup>b</sup> Common names take from Oregon Flora Project. 2008.

## Appendix 2: Lichens and Mosses<sup>a b c</sup>

Scientific name	Authority
Lichens:	
<i>Amandinea punctata</i>	(Hoffm.) Coppins & Scheid.
<i>Arthonia glebosa</i>	Tuck.
<i>Aspicilia filiformis</i>	Rosent.
<i>Aspicilia hispida</i>	Mereschk.
<i>Aspicilia reptans</i>	(Looman) Wetmore
<i>Caloplaca jungermanniae</i>	(Vahl) Th. Fr.
<i>Caloplaca tominii</i>	Savicz
<i>Candelariella terrigena</i>	Rasanen
<i>Cladonia</i> spp.	P. Browne
<i>Diploschistes muscorum</i>	(Scop.) R. Sant.
<i>Lecanora</i> spp.	Ach.
<i>Leprocaulon subalbicans</i>	(Lamb) Lamb & Ward
<i>Leptochidium albociliatum</i>	(Desmaz.) M. Choisy
<i>Leptogium</i> spp.	(Ach.) A. Gray
<i>Megaspora verrucosa</i>	(Ach.) Hafellner & V. Wirth
<i>Ochrolechia upsaliensis</i>	(L.) A. Massal.
<i>Peltigera</i> spp.	Willd.
<i>Psora montana</i>	Timdal
<i>Pterygoneuron ovatum</i>	(Hedw.) Dix.
Mosses:	
<i>Bryum argenteum</i>	Hedw.
<i>Bryum</i> spp.	Hedw.
<i>Ceratodon purpureus</i>	(Hedw.) Brid.
<i>Encalypta raptocarpa</i>	Schwagr.
<i>Tortula ruralis</i>	(Hedw.) G.Gaertn. B. Mey. & Scherb.
<i>Tortula caninervis</i>	(Mitt.) Broth.

<sup>a</sup> Taken from Ponzetti, J.M. 2000.

<sup>b</sup> Lichen nomenclature follows Brodo et al. (2001), *Lichens of North America*.

<sup>c</sup> Moss nomenclature follows Missouri Botanical Garden W<sup>3</sup>MOST database (2008) for mosses and Esslinger (2006) for lichens.

### Appendix 3: Amphibians, Reptiles, Birds, and Mammals<sup>a</sup>

Family	Scientific name	Common name
Amphibians:		
Bufo	<i>Bufo boreas</i>	Western toad
Hyla	<i>Pseudacris regilla</i>	Pacific chorus frog
Pelobatidae	<i>Scaphiopus intermontanus</i>	Great Basin spadefoot
Reptiles:		
Anguilla	<i>Elgaria multicarinata</i>	Southern alligator lizard
Boidae	<i>Charina bottae</i>	Rubber boa
Colubridae	<i>Coluber constrictor</i>	Racer
	<i>Hypsiglena torquata</i>	Night snake
	<i>Masticophis taeniatus</i>	Striped whipsnake
	<i>Pituophis melanoleucus</i>	Gopher snake
	<i>Thamnophis elegans</i>	Western terrestrial garter snake
	<i>Thamnophis sirtalis</i>	Common garter snake
Iguanidae	<i>Phrynosoma douglasii</i>	Short-horned lizard
	<i>Sceloporus graciosus</i>	Sagebrush lizard
	<i>Sceloporus occidentalis</i>	Western fence lizard
	<i>Uta stansburiana</i>	Side-blotched lizard
Scincidae	<i>Eumeces skiltonianus</i>	Western skink
Teiidae	<i>Cnemidophorus velox</i>	Plateau striped whiptail
Viperidae	<i>Crotalus viridis</i>	Western rattlesnake
Birds:		
Accipitridae	<i>Accipiter cooperii</i>	Cooper's hawk
	<i>Accipiter gentilis</i>	Northern goshawk
	<i>Accipiter striatus</i>	Sharp-shinned hawk
	<i>Aquila chrysaetos</i>	Golden eagle
	<i>Buteo jamaicensis</i>	Red-tailed hawk
	<i>Circus cyaneus</i>	Northern harrier
	<i>Haliaeetus leucocephalus</i>	Bald eagle
	<i>Pandion haliaetus</i>	Osprey
Cathartidae	<i>Cathartes aura</i>	Turkey vulture
Falconidae	<i>Falco mexicanus</i>	Prairie falcon
	<i>Falco peregrinus</i>	Peregrine falcon
	<i>Falco sparverius</i>	American kestrel
Phasianidae	<i>Alectoris chukar</i>	Chukar
	<i>Callipepla californica</i>	California quail
	<i>Oreortyx pictus</i>	Mountain quail
	<i>Perdix perdix</i>	Gray partridge
Charadriidae	<i>Charadrius vociferus</i>	Killdeer
Columbidae	<i>Columbia livia</i>	Rock dove
	<i>Zenaidura macroura</i>	Mourning dove
Tytonidae	<i>Tyto alba</i>	Barn owl

Family	Scientific name	Common name
Strigidae	<i>Asio otus</i>	Long-eared owl
	<i>Athene cunicularia</i>	Burrowing owl
	<i>Bubo virginianus</i>	Great-horned owl
	<i>Glaucidium gnoma</i>	Northern pygmy owl
	<i>Otus kennicottii</i>	Western screech-owl
Caprimulgidae	<i>Chordeiles minor</i>	Common nighthawk
Apodidae	<i>Aeronautes saxatalis</i>	White-throated swift
	<i>Chaetura vauxi</i>	Vaux's swift
Trochilidae	<i>Archilochus alexandri</i>	Black-chinned hummingbird
	<i>Stellula calliope</i>	Calliope hummingbird
	<i>Selasphorus rufus</i>	Rufous hummingbird
Picidae	<i>Colaptes auratus</i>	Northern flicker
	<i>Picoides pubescens</i>	Downy woodpecker
	<i>Picoides villosus</i>	Hairy woodpecker
	<i>Sphyrapicus nuchalis</i>	Red-naped sapsucker
Tyrannidae	<i>Contopus sordidulus</i>	Western wood peewee
	<i>Empidonax oberholseri</i>	Dusky flycatcher
	<i>Empidonax wrightii</i>	Gray flycatcher
	<i>Sayornis saya</i>	Say's phoebe
	<i>Myiarchus cinerascens</i>	Ash-throated flycatcher
	<i>Tyrannus verticalis</i>	Western kingbird
Alaudidae	<i>Eremophila alpestris</i>	Horned lark
Hirundinidae	<i>Hirundo pyrrhonota</i>	Cliff swallow
	<i>Hirundo rustica</i>	Barn swallow
	<i>Stelgidopteryx serripennis</i>	Northern rough-winged swallow
	<i>Tachycineta bicolor</i>	Tree swallow
	<i>Tachycineta thalassina</i>	Violet-green swallow
Corvidae	<i>Aphelocoma californica</i>	Western scrub-jay
	<i>Corvus brachyrhynchos</i>	American crow
	<i>Corvus corax</i>	Common raven
	<i>Cyanocitta stelleri</i>	Steller's jay
	<i>Gymnorhinus cyanocephalus</i>	Pinyon jay
	<i>Nucifraga columbiana</i>	Clark's nutcracker
	<i>Pica hudsonia</i>	Black-billed magpie
Paridae	<i>Parus atricapillus</i>	Black-capped chickadee
	<i>Parus gambeli</i>	Mountain chickadee
Aegithalidae	<i>Psaltriparus minimus</i>	Bushtit
Sittidae	<i>Sitta canadensis</i>	Red-breasted nuthatch
Troglodytidae	<i>Catherpes mexicanus</i>	Canyon wren
	<i>Salpinctes obsoletus</i>	Rock wren
	<i>Troglodytes aedon</i>	House wren
Muscicapidae	<i>Myadestes townsendi</i>	Townsend's solitaire
	<i>Sialia mexicana</i>	Western bluebird
	<i>Sialia currucoides</i>	Mountain bluebird
	<i>Turdus migratorius</i>	American robin
Mimidae	<i>Oreoscoptes montanus</i>	Sage thrasher
Bombycillidae	<i>Bombycilla cedrorum</i>	Cedar waxwing

Family	Scientific name	Common name
Laniidae	<i>Lanius ludovicianus</i>	Loggerhead shrike
Sturnidae	<i>Sturnus vulgaris</i>	European starling
Vireonidae	<i>Vireo solitarius</i>	Blue-headed vireo
Emberizidae	<i>Agelaius phoeniceus</i>	Red-winged blackbird
	<i>Chondestes grammacus</i>	Lark sparrow
	<i>Dendroica coronata</i>	Yellow-rumped warbler
	<i>Dendroica nigrescens</i>	Black-throated gray warbler
	<i>Euphagus cyanocephalus</i>	Brewer's blackbird
	<i>Icterus bullockii</i>	Bullock's oriole
	<i>Junco hyemalis</i>	Dark-eyed junco
	<i>Molothrus ater</i>	Brown-headed cowbird
	<i>Passerculus sandwichensis</i>	Savannah sparrow
	<i>Passerella iliaca</i>	Fox sparrow
	<i>Pipilo chlorurus</i>	Green-tailed towhee
	<i>Pipilo maculatus</i>	Spotted towhee
	<i>Poocetes gramineus</i>	Vesper sparrow
	<i>Spizella breweri</i>	Brewer's sparrow
	<i>Spizella passerina</i>	Chipping sparrow
	<i>Sturnella neglecta</i>	Western meadowlark
	<i>Zonotrichia leucophrys</i>	White-crowned sparrow
Fringillidae	<i>Carduelis pinus</i>	Pine siskin
	<i>Carduelis psaltria</i>	Lesser goldfinch
	<i>Carduelis tristis</i>	American goldfinch
	<i>Carpodacus cassinii</i>	Cassin's finch
	<i>Carpodacus mexicanus</i>	House finch
Mammals:		
Soricidae	<i>Sorex merriami</i>	Merriam's shrew
	<i>Sorex preblei</i>	Preble's shrew
	<i>Sorex vagrans</i>	Vagrant shrew
Talpidae	<i>Scapanus orarius</i>	Coast mole
Vespertilionidae	<i>Antrozous pallidus</i>	Pallid bat
	<i>Corynorhinus townsendii</i>	Townsend's big-eared bat
	<i>Eptesicus fuscus</i>	Big brown bat
	<i>Lasionycteris noctivagans</i>	Silver-haired bat
	<i>Myotis californicus</i>	California myotis
	<i>Myotis ciliolabrum</i>	Western small-footed myotis
	<i>Myotis evotis</i>	Long-eared myotis
	<i>Myotis lucifugus</i>	Little brown myotis
	<i>Myotis thysanodes</i>	Fringed myotis
	<i>Myotis volans</i>	Long-legged myotis
	<i>Myotis yumanensis</i>	Yuma myotis
Leporidae	<i>Lepus californicus</i>	Black-tailed jackrabbit
	<i>Sylvilagus nuttallii</i>	Mountain cottontail
Sciuridae	<i>Spermophilus beecheyi</i>	California ground squirrel
	<i>Spermophilus beldingi</i>	Belding's ground squirrel
	<i>Spermophilus townsendii</i>	Townsend's ground squirrel
	<i>Tamias townsendii</i>	Townsend's chipmunk

Family	Scientific name	Common name
Geomyidae	<i>Thomomys talpoides</i>	Northern pocket gopher
Heteromyidae	<i>Dipodomys ordii</i>	Ord's kangaroo rat
	<i>Perognathus parvus</i>	Great Basin pocket mouse
Muridae	<i>Lemmiscus curtatus</i>	Sagebrush vole
	<i>Marmota flaviventris</i>	Yellow-bellied marmot
	<i>Microtus longicaudus</i>	Long-tailed vole
	<i>Neotoma cinerea</i>	Bushy-tailed woodrat
	<i>Onychomys leucogaster</i>	Northern grasshopper mouse
	<i>Peromyscus crinitus</i>	Canyon mouse
	<i>Peromyscus maniculatus</i>	Deer mouse
Erethizontidae	<i>Peromyscus truei</i>	Pinyon mouse
	<i>Erethizon dorsatum</i>	Common porcupine
	Canidae	<i>Canis latrans</i>
<i>Vulpes vulpes</i>		Red fox
Procyonidae	<i>Procyon lotor</i>	Common raccoon
Mustelidae	<i>Mephitis mephitis</i>	Striped skunk
	<i>Mustela frenata</i>	Long-tailed weasel
	<i>Spilogale gracilis</i>	Western spotted skunk
	<i>Taxidea taxus</i>	American badger
Felidae	<i>Felis concolor</i>	Mountain lion
	<i>Lynx rufus</i>	Bobcat
Cervidae	<i>Odocoileus hemionus</i> ssp. <i>hemionus</i>	Black-tailed deer

<sup>a</sup> Nomenclature, distribution and habitat characteristics taken from Csuti et al. 1997.





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