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Powell Butte Research Natural Area

Guidebook Supplement 38

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

Abstract

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This guidebook describes Powell Butte Research Natural Area, a 210-ha (520-ac) tract established to represent examples of the western juniper/big sagebrush/Idaho fescue (*Juniperus occidentalis*/*Artemisia tridentata*/*Festuca idahoensis*) plant association, the western juniper/big sagebrush/bluebunch wheatgrass (*Juniperus occidentalis*/*Artemisia tridentata*/*Pseudoroegneria spicata*) plant association, and the western juniper/bluebunch wheatgrass (*Juniperus occidentalis/Pseudoroegneria spicata*) plant association.

Keywords: Research natural area, *Juniperus occidentalis,* western juniper, *Artemisia tridentata*, big sagebrush, *Pseudoroegneria spicata*, bluebunch wheatgrass, *Festuca idahoensis*, Idaho fescue, juniper woodland, sagebrush steppe, Northern Great Basin, Oregon High Desert.

Preface

The research natural area (RNA) described in this supplement[1] 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.

Powell Butte 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.[2]

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.

Federal RNAs provide a unique system of publicly owned and protected examples of undisturbed ecosystems where scientists can conduct research with

[1] Supplement 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.

[2] 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].

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.[3]
- 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[4] 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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[3] 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.

[4] 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.

Contents

Introduction

Powell Butte Research Natural Area (RNA) is a 210-ha (520-ac)[1] tract that occupies southwest to southeast-facing slopes in Crook County, Oregon. Powell Butte 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 reaffirmed in 2005 in the Upper Deschutes Resource Management Plan and Record of Decision (USDI BLM 2005).

The tract supports late-seral examples of three plant associations representative of warm, dry juniper woodlands in central Oregon (Hopkins and Kovalchik 1983, Johnson and Swanson 2005): (1) the western juniper/big sagebrush/bluebunch wheatgrass (*Juniperus occidentalis/Artemisia tridentata/Pseudoroegneria spicata*) plant association, (2) the western juniper/big sagebrush/Idaho fescue (*Juniperus occidentalis/Artemisia tridentata/Festuca idahoensis*) plant association, and the western juniper/bluebunch wheatgrass (*Juniperus occidentalis/Pseudoroegneria spicata*) plant association. The site is located in the extreme southwest portion of the Blue Mountains Ecological Province in central Oregon (Oregon Natural Heritage Program 2003, USDA FS 2008, USDI BLM 1996, Dyrness et al. 1975).

Access and Accommodations

From the intersection of U.S. highway 97 and state route 126 in Redmond, Oregon, proceed east for 10.8 km (6.7 mi) to Powell Butte highway. Turn south (right) on Powell Butte highway and proceed 4.5 km (2.8 mi) south to S. Alfalfa Road. Continue south on S. Alfalfa Road (also known as Johnson Market Road) for 8.7 km (5.4 mi) to Becker (Stearns) Road. Proceed east on Becker (Stearns) Road (dirt) for 2.9 km (1.8 mi) to an unnamed, high-clearance seasonal road. Proceed north on this dirt road for 1.8 km (1.1 mi) and park. Proceed on foot from this point (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 (BLM) in Prineville, Oregon. Lodging is available in Bend, Redmond, and Prineville, Oregon.

[1] These data are on file at the Bureau of Land Management, Prineville District Office, and at the U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Corvallis, Oregon.

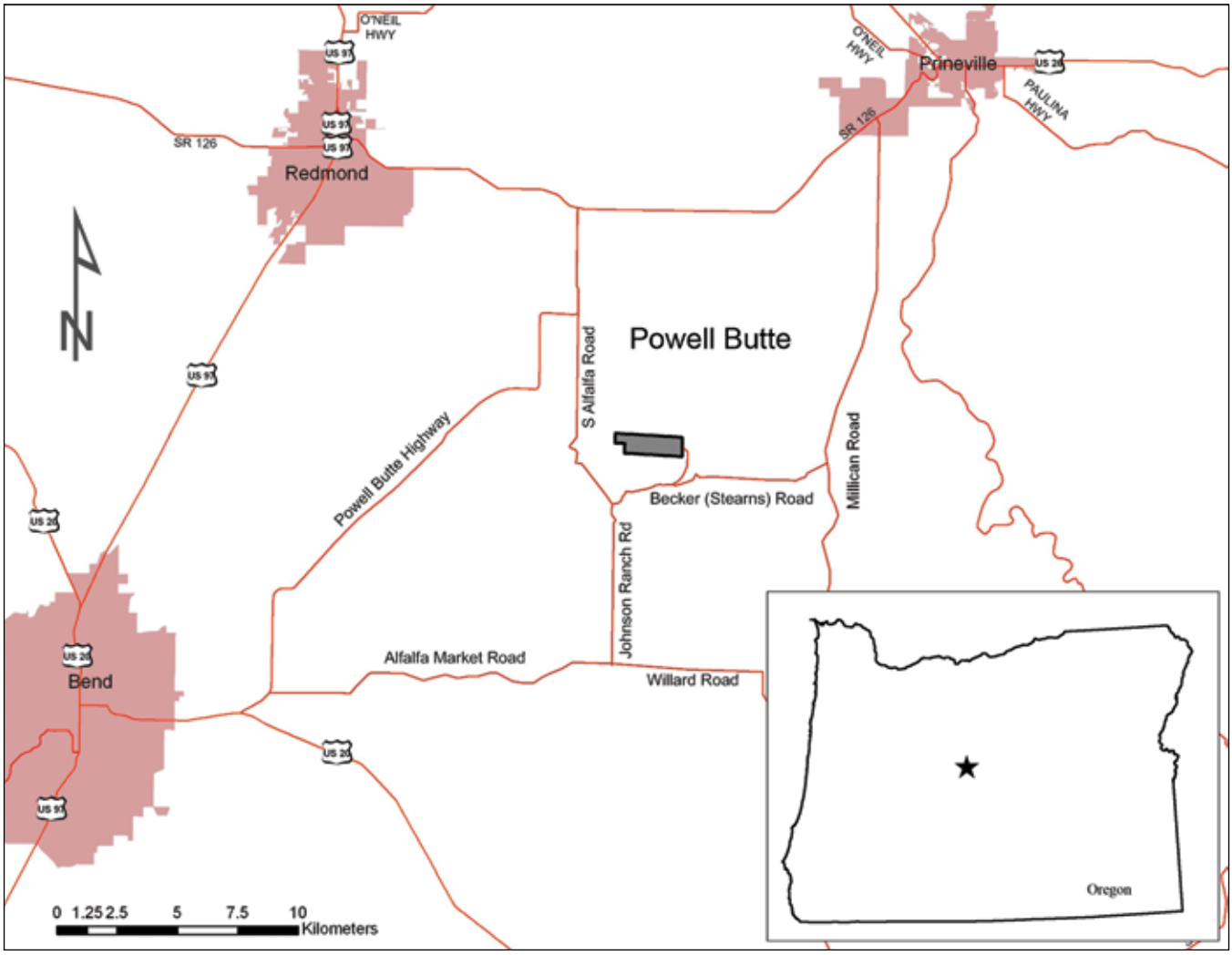

Figure 1–Powell Butte Research Natural Area location and access.

Environment

The RNA occupies the southern slopes of a large, northeast-southwest trending diastrophic butte

Elevations within the RNA range from 1080 m (3,543 ft) in the southwestern edge to 1380 m (4,528 ft) in the northeastern portion of the RNA. Four moderate- to steep-sloping canyons oriented in a south to southwest direction, extend through the RNA. These canyons do not support seasonal streams and lack streambed development (fig. 2). The parcel is situated on moderate to steep midslopes and lower slopes of Powell Butte. The long axis of the RNA extends 2.8 km (1.75 mi) in an east-west direction. The shorter, north-south axis ranges from 0.4 to 0.8 km (0.25 to 0.5 mi) in width.

The RNA occupies the southern slopes of a large, northeast-southwest trending diastrophic butte system. Rugged, rhyolite ridgetops and canyon walls are present

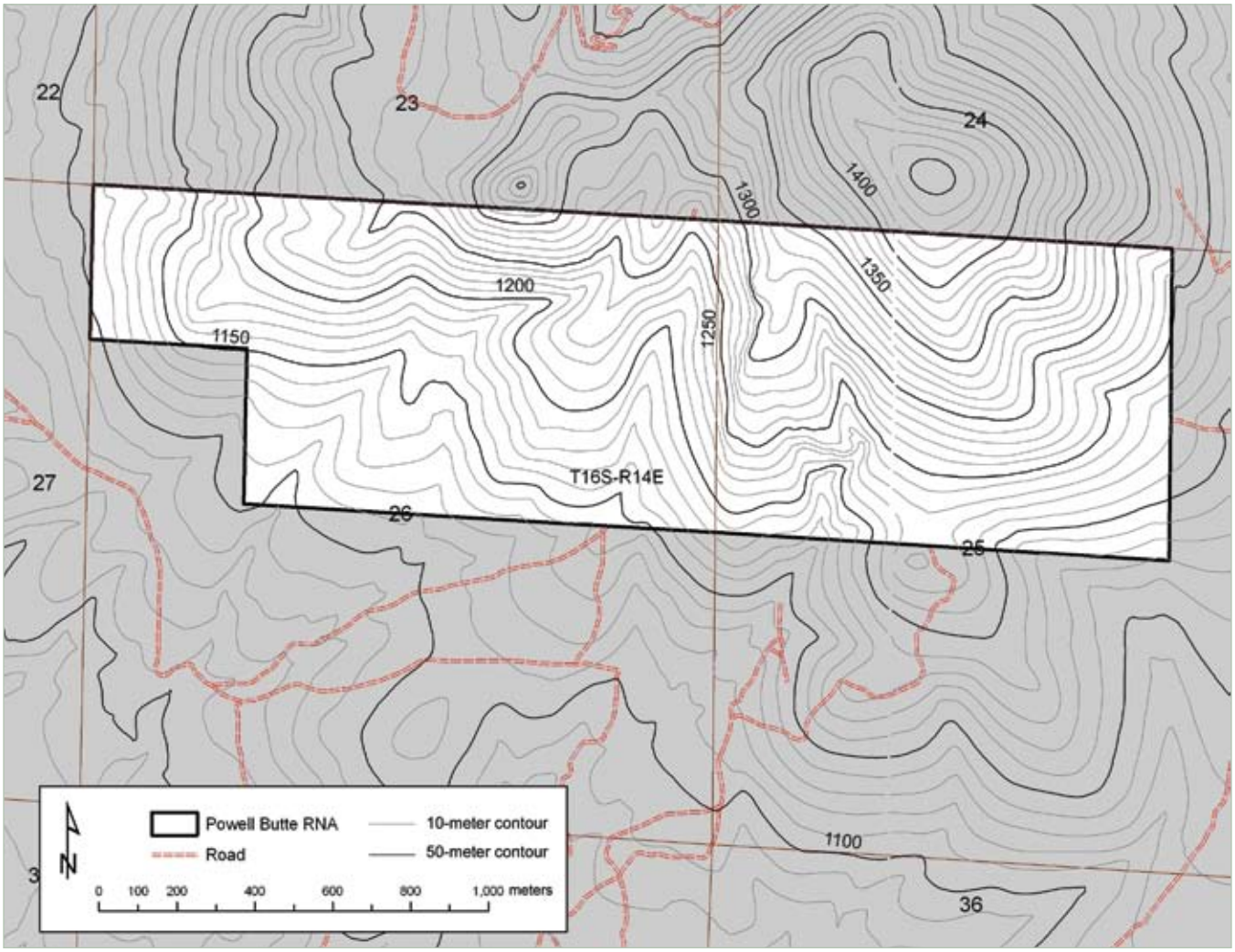

Figure 2–Powell Butte Research Natural Area topography and boundary.

at higher elevations within the various canyons. Soils are residuum and ash and are very stoney, especially on the upper elevation slopes (Hopkins and Kovalchik 1983). Lower elevation slopes are composed of gravelly alluvium that commonly includes wind-deposited sands (USDI BLM, n.d.). Rocks are present through all horizons. Depth to lithic bedrock is 25 to 51 cm (10 to 20 in). Soils are well drained. The Anatone-Tuscor complex with 30- to 75-percent south slopes occurs over 70 percent of the RNA (USDA NRCS 2008). A typical soil profile includes:

0 to 8 cm	(0 to 3 in)	Extremely cobbly ashy loam
8 to 18 cm	(3 to 7 in)	Very gravelly loam
18 to 28 cm	(7 to 11 in)	Very cobbly loam
28 to 38 cm	(11 to 15 in)	Extremely cobbly clay loam
38 to 48 cm	(15 to 19 in)	Unweathered bedrock

Climate

Climate within the RNA is continental and semiarid, modified by marine air currents from the Pacific Ocean, which provide precipitation as rain and snow. Located 24 km (15 mi) northwest of Powell Butte, the Redmond FAA AP, Oregon (357062) weather station provides climate data for the 1948-2007 period that are comparable to the Powell Butte climate (table 1).

In winter, precipitation is a mixture of rain and snow. 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. Fourteen percent of annual precipitation occurs during the 3-month dry period from July through September. Snowfall occurs from October through April. January receives the highest average monthly snowfall of 160 mm (6.3 in) (Western Regional Climate Center 2008).

Vegetation

The RNA is situated along the southwestern boundary of the Blue Mountains physiographic province (Franklin and Dyrness 1988, USDA FS 2008). Western juniper is the sole tree species present within the RNA. Major shrubs include big sagebrush, and gray rabbitbrush (*Ericameria nauseosa*), and antelope bitterbrush (*Purshia tridentata*). Rocky, shallow-soiled areas also support small populations of rigid sagebrush (*Artemisia rigida*), and rock spirea (*Holodiscus dumosus*).

The herb layer is dominated by native bunchgrasses, including bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass (*Poa secunda*), and Cusick's bluegrass (*P. cusickii*). The highly invasive annual, cheatgrass (*Bromus tectorum*), is locally common on south-facing slopes. Although vascular plant species richness is moderately high for a western juniper/big sagebrush stand, only a few species are conspicuous (app. 1), including arrowleaf balsamroot (*Balsamorhiza sagittata*), spiny phlox (*Phlox hoodii*), common yarrow (*Achillea millefolium*), and nineleaf biscuitroot (*Lomatium triternatum*).

Table 1—Temperature and precipitation summary, 7/01/1948 to 6/30/2007–Redmond FAA AP, Oregon (357062)

Average minimum January temperature	-5.5 °C (22.1 °F)
Average maximum January temperature	5.2 °C (41.4 °F)
Average minimum July temperature	8.2 °C (46.7 °F)
Average maximum July temperature	29.7 °C (85.4 °F)
Average annual precipitation	221 mm (8.71 in)
Average July—September precipitation	32 mm (1.26 in)
Average annual snowfall	495 mm (19.5 in)

The prominent plant communities present within the RNA have been described by Hopkins and Kovalchik (1983). Similar vegetation has been described to the north in the Blue and Ochoco Mountains by Johnson and Swanson (2005), and to the south by Volland (1985).

Occupying roughly 128 ha (317 ac) on primarily high-elevation slopes and ridges in the northern portions of the site, the western juniper/big sagebrush/bluebunch wheatgrass plant association is the most prevalent of the three associations within the RNA (fig. 3). Generally, the lower elevation south-facing slopes support this type, but the distribution is patchy and alternates with more highly disturbed areas where western juniper is ringed by dense populations of cheatgrass. Fifty-eight hectares (143 ac) of the western juniper/bluebunch wheatgrass association is represented on steep, southerly aspects above 1158 m (3,800 ft) (fig. 4). The western juniper/big sagebrush/Idaho fescue plant association (fig. 5) occurs on mesic sites, on protected northeast to northwest aspects totaling about 8 ha (20 ac) (USDI BLM, n. d.).

The western juniper/big sagebrush/bluebunch wheatgrass plant association is the most prevalent of the three associations within the RNA.

In 2005, four 0.1-ha circular plots were established to monitor structural and compositional vegetation change over time within the RNA. These plots occur on a variety of slope exposures within the central portions of the site (table 2). Table 3 summarizes plot data from the ground surface. Table 4 summarizes vegetation data

Figure 3–Plot 697, facing southwest. An example of the western juniper/big sagebrush/bluebunch wheatgrass plant association on a midslope ridge. Bluebunch wheatgrass is the principal perennial bunchgrass. Soils show a typically high rock and stone content.

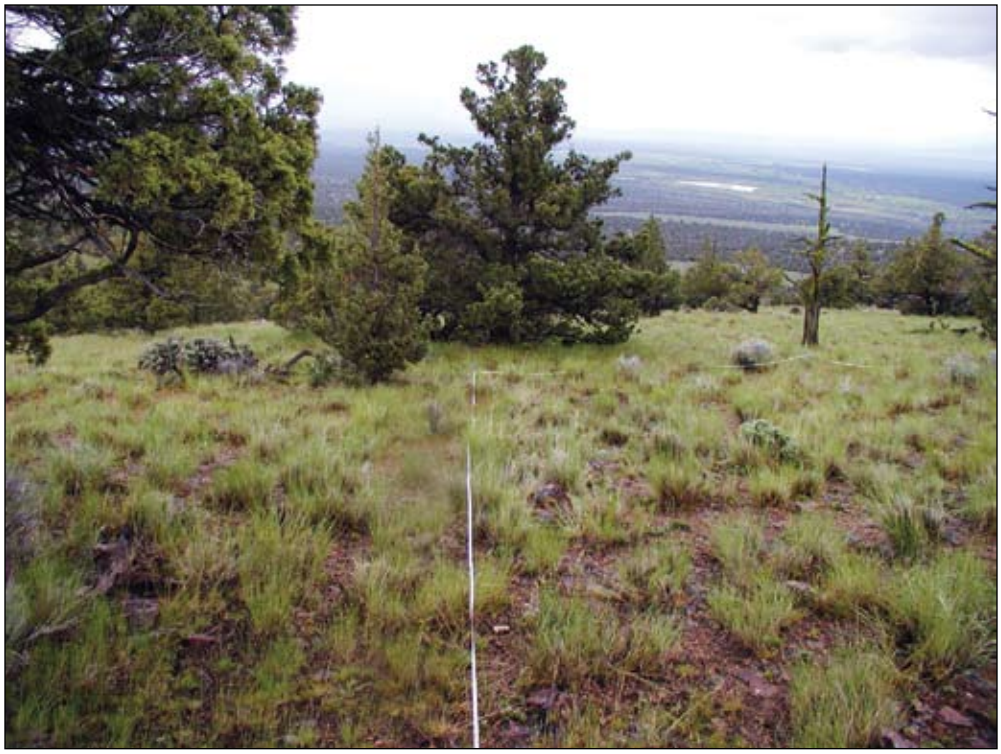

Figure 4–Plot 700, facing southeast. An example of the western juniper/bluebunch wheatgrass plant association. Shrubs include sparse amounts of rubber rabbitbrush and big sagebrush.

Figure 5–Plot 698. An example of the western juniper/big sagebrush/Idaho fescue plant association in mesic, northeast-facing slopes. Western juniper recruitment evident in midground. The major understory bunchgrass is Idaho fescue.

from the herb, shrub, and tree layers within the four permanent plots. All three of the principal plant associations present within the Powell Butte RNA were sampled. These include relatively undisturbed representative examples of the western juniper/big sagebrush/bluebunch wheatgrass association (plot 697), the western juniper/big sagebrush/Idaho fescue association (plots 698 and 699), and the western juniper/bluebunch wheatgrass association (plot 700).

Western juniper live tree density ranged from 110 to 210 trees per ha (292 to 519 trees per ac) and averaged 145 trees per ha (358 trees per ac) in the four, combined plots. Small sapling[2] density ranged from 0 to 30 per ha (74 per ac) and averaged 12.5 per ha (31 per ac). Large sapling density varied from 0 to 240 per ha (593 per ac) and averaged 70 per ha (173 per ac). In the combined, four-plot data set, 4 trees had dead tops and 14 trees were standing-dead. Coarse woody debris from downed, dead western juniper was absent in two of the four plots and sparse in the other two plots. About 10 percent of the total live trees were branched below breast height (1.47 m).

Table 2—Physical features of four permanent plots within Powell Butte Research Natural Area

	Plot			
	697	**698**	**699**	**700**
Elevation (m)	1150	1208	1240	1213
Aspect (°)	260	332	320	167
Slope grade (°)	3	17	16	14
Slope position	Ridge	Lower 1/3	Upper 1/3	Upper 1/3

Table 3—Soil, rock, litter, and microbiotic crust[a] cover and frequency within four permanent plots, Powell Butte Research Natural Area

	Plot							
	697		**698**		**699**		**700**	
	Cover[b]	**Frequency**	**Cover**	**Frequency**	**Cover**	**Frequency**	**Cover**	**Frequency**
	Percent							
Rock[c]	5	32	6	39	18	79	24	89
Gravel	35	79	7	68	6	61	24	100
Bare soil	33	79	37	75	23	82	37	100
Litter	17	57	17	43	26	68	10	68
Moss	4	36	17	86	14	93	5	61
Lichen	5	61	22	68	23	86	21	93

[a] Taken together, moss and lichen cover make up the ground surface-dwelling microbiotic crust.
[b] 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.
[c] Rock = particles >8 cm, gravel = 2 mm to 8 cm, bare soil = <2 mm.

[2] "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 slightly larger small trees > 1.47 m but less than 5 cm (2 in) diameter at breast height.

Table 4–Plant association, understory coverage and frequency of four permanent plots in Powell Butte Research Natural Area

	Plant association							
	JUOC/ARTR/ PSSP-FEID[a]		JUOC/ARTR/ FEID-PSSP		JUOC/ARTR/ FEID-PSSP		JUOC/PSSP	
	Plot 697		Plot 698		Plot 699		Plot 700	
Species	Cover[b]	Frequency	Cover	Frequency	Cover	Frequency	Cover	Frequency
	Percent							
Shrubs								
Artemisia tridentata[c]	3	–		–	2	–		–
Chrysothamnus viscidiflorus	1	–	6	–	3	–		–
Ericameria nauseosa	2	–		–		–		–
Tetradymia canescens	6	–		–		–		–
Grasses								
Poa secunda	5	75	7	75	8	86	8	89
Festuca idahoensis	2	7	16	79	12	75	1	7
Poa cusickii	3	25	+	4	2	25	+	4
Vulpia microstachys	3	75					2	64
Pseudoroegneria spicata	1	7					11	79
Achnatherum thurberianum	3	25						
Bromus tectorum	2	14	1	14				
Koeleria macrantha	1	11			1	21		
Herbs								
Phlox hoodii	4	46	1	11	1	18	3	39
Achillea millefolium	+	7	+	4	+	7		
Antennaria dimorpha	2	11					+	4
Phacelia linearis	+	11			+	7	+	7
Erigeron poliospermus	1	14					+	4
Collinsia parviflora			2	75			+	18
Descurainia pinnata	+	4	1	21	2	36		
Phlox gracilis	+	7	+	4	1	14		
Holosteum umbellatum	1	4	3	46	+	7		
Lomatium triternatum	+	4	+	14	+	7		
Lithophragma parviflora	+	4	+	11				
Plectritis macrocera	+	14	+	4				
Crepis intermedia	+	7	+	4				
Idahoa scapigera	+	14						
Calochortus macrocarpus	+	7						
Lewisia rediviva	+	4						
Nothocalais troximoides	+	4						
Astragalus conjunctus	+	4						
Blepharipappus scaber	+	4						
Nemophila parviflora			2	21	+	4		
Draba verna			3	61	+	14		

Table 4–Plant association, understory coverage and frequency of four permanent plots in Powell Butte Research Natural Area (continued)

	Plant association							
	JUOC/ARTR/ PSSP-FEID[a]		JUOC/ARTR/ FEID-PSSP		JUOC/ARTR/ FEID-PSSP		JUOC/PSSP	
	Plot 697		Plot 698		Plot 699		Plot 700	
Species	Cover[b]	Frequency	Cover	Frequency	Cover	Frequency	Cover	Frequency
				Percent				
Gilia sinuata					+	4	+	4
Eriogonum sphaerocephalum					4	68		
Lomatium macrocarpum					+	7		
Cryptantha pterocarya					+	7		
Astragalus filipes							+	
Cryptantha affinis							1	25

Note: JUOC = *Juniperus occidentalis*, ARTR = *Artemisia tridentata*, FEID = *Festuca idahoensis*, PSSP = *Pseudoroegneria spicata*, + = trace (<0.5 percent foliar cover), - = not recorded.

[a] Plant association names and acronyms follow Hopkins and Kovalchik (1983) but have been modified to incorporate current nomenclature as in Flora of North America (1993+).

[b] 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.

[c] See appendix 1 for a listing of scientific and common names.

Fauna

Reptiles, amphibians, birds, and mammals known or expected to occur within the RNA are listed in appendix 2. These lists have been compiled from field observations and knowledge of species' geographic ranges and habitat affinities (Csuti et al. 1997). Species on this list are likely to occur within the RNA for at least some portion of their life cycles.

Research History

Research focusing on vegetation classification and synecology:

- *Plant Associations of the Crooked River National Grassland* (Hopkins and Kovalchik 1983)

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

- *Topoedaphic and Morphological Complexity of Foliar Damage and Mortality With Western Juniper (*Juniperus occidentalis *var.* occidentalis*) Woodlands Following an Extreme Meteorological Event* (Soulé and Knapp 2007)
- *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_2 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)
- *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)
- *Human Agency, Environmental Drivers, and Western Juniper Establishment During the Late Holocene* (Soulé et al. 2004)

Vegetation monitoring data from 2005 are on file at the BLM Prineville District Office, and the Pacific Northwest (PNW) Research Station, USDA Forest Service (USFS), Corvallis, Oregon.

No recent fires have occurred within the area, although lightning strikes periodically occur on Powell Butte.

Disturbance History

Dense patches of cheatgrass have established under the canopy of western juniper at lower elevations, and on south-facing slopes. There is some evidence of terracing on steeper slopes (USDI BLM, n.d.). No recent fires have occurred within the area, although lightning strikes periodically occur on Powell Butte. 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 role of human-induced disturbance from grazing by domestic livestock appears to have had some impact within the RNA, especially at low elevations and south-facing aspects. The relatively low to moderate abundance of invasive grasses such as cheatgrass, so prevalent on big sagebrush sites throughout the intermountain West (Young et al. 1972), suggests the importance of Powell Butte RNA as a baseline or reference area for researchers and natural resource managers.

Site History

The site was designated as an area of critical environmental concern (ACEC) and an RNA in the Brothers/LaPine resource management plan and record of decision (USDI BLM 1989). During the mid and late 20thcentury, the site was part of a grazing allotment, but received only minor use because of relatively steep slopes and long distance to water for grazing animals. Although there is no fence surrounding the RNA today, the site is only infrequently subject to trespass grazing at lower elevations.

The RNA is a fragmented "habitat island" that today is partially isolated on its southern margin by developed lands. Two major resort developments on the southwest and southeast flanks of Powell Butte have substantially altered habitat conditions and surrounding human use patterns on adjacent lands.

Maps

Maps applicable to Powell Butte RNA: topographic—Powell Butte, Oregon, 7.5 minute, 1:24,000 scale, 1998; Ochoco National Forest and Crooked River National Grassland, 1:126,720 scale, 2000; 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 centimeter (cm) = 0.394 inch (in)
1 millimeter (mm) = 0.0394 inch

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Appendix 1: Vascular Plants and Ferns[a b]

Scientific name	Common name
Coniferous trees	
Juniperus occidentalis Hook.	Western juniper
Medium shrubs 0.5 to 2 m (1.6 to 6.6 ft) tall	
Artemisia arbuscula Nutt. ssp. *longiloba* (Osterhout) L.M. Shultz	Low sagebrush
Artemisia tridentata Nutt. ssp. *vaseyana* (Rydb.) Beetle	Mountain big sagebrush
Chrysothamnus viscidiflorus (Hook.) Nutt. ssp. *viscidiflorus*	Green rabbitbrush
Ericameria nauseosa (Pallas ex Pursh) Nesom & Baird	Rubber rabbitbrush
Grayia spinosa (Hook.) Moq.	Spiny hopsage
Holodiscus dumosus (Nutt. ex Hook.) Heller	Rock spirea
Linanthus pungens (Torr.) J.M. Porter & L.A. Johnson	Granite prickly phlox
Purshia tridentata (Pursh) DC.	Antelope bitterbrush
Ribes velutinum Greene var. velutinum	Desert gooseberry
Tetradymia canescens DC.	Spineless horsebrush
Herbs	
Achillea millefolium L.	Common yarrow
Alyssum alyssoides (L.) L.	Pale madwort
Amsinckia lycopsoides Lehm.	Tarweed fiddleneck
Amsinckia tessellata Gray var. *tessellata*	Bristly fiddleneck
Antennaria dimorpha (Nutt.) T. & G.	Low pussytoes
Antennaria geyeri Gray	Pinewoods pussytoes
Antennaria microphylla Rydb.	Littleleaf pussytoes
Arabis cusickii Wats.	Cusick's rockcress
Arabis holboellii Hornem.	Holboell's rockcress
Astragalus conjunctus S. Wats.	Idaho milkvetch
Astragalus curvicarpus (Heller) J.F. Macbr.	Curve-pod milkvetch
Astragalus filipes Torr. ex Gray	Basalt milkvetch
Astragalus lentiginosus Dougl. ex Hook. var. *chartaceus* M.E. Jones	Broadleaf milkvetch
Astragalus purshii Dougl. ex Hook.	Woollypod milkvetch
Balsamorhiza sagittata (Pursh) Nutt.	Arrowleaf balsamroot
Blepharipappus scaber Hook.	Rough eyelashweed
*Calochortus macrocar*pus Dougl.	Sagebrush mariposa lily
Chaenactis douglasii (Hook.) Hook. & Arn.	Douglas' dustymaiden
Claytonia perfoliata Donn ex Willd. ssp. *perfoliata*	Miner's lettuce
Collinsia parviflora Dougl. ex Lindl.	Maiden blue-eyed Mary
Crepis intermedia Gray	Limestone hawksbeard
Cryptantha affinis (Gray) Greene	Quill cryptantha
Cryptantha circumscissa (Hook. & Arn.) I.M. Johnston	Cushion cryptantha
Cryptantha pterocarya (Torr.) Greene	Wingnut cryptantha

Scientific name	Common name
Descurainia pinnata (Walt.) Britt.	Western tansymustard
Draba verna L.	Spring draba
Erigeron filifolius (Hook.) Nutt.	Threadleaf fleabane
Erigeron linearis (Hook.) Piper	Desert yellow fleabane
Erigeron poliospermus Gray	Cushion fleabane
Eriogonum microthecum Nutt. var. *laxiflorum* Hook.	Slender buckwheat
Eriogonum ovalifolium Nutt. var. *ovalifolium*	Cushion buckwheat
Eriogonum sphaerocephalum Dougl. ex Benth var. *sphaerocephalum*	Rock buckwheat
Eriogonum strictum Benth. ssp. proliferum (T. & G.) Stokes var. *anserinum* Greene R.J. Davis	Blue Mountain buckwheat
Eriogonum strictum Benth. ssp. strictum	Blue Mountain buckwheat
Eriogonum umbellatum Torr.	Sulphur-flower buckwheat
Eriogonum vimineum Dougl. ex. Benth.	Wickerstem buckwheat
Eriophyllum lanatum (Pursh) J. Forbes	Common woolly sunflower
Erodium cicutarium (L.) L'Her. ex Ait.	Redstem storksbill
Fritillaria pudica (Pursh) Spreng.	Yellow fritillary
Galium sp.	Bedstraw
Gayophytum ramosissimum T. & G.	Pinyon groundsmoke
Gilia sinuata Dougl. ex Benth.	Rosy gilia
Heuchera cylindrica Dougl. ex Hook.	Roundleaf alumroot
Holosteum umbellatum L.	Jagged chickweed
Idahoa scapigera (Hook.) A. Nels. & J.F. Macbr.	Oldstem idahoa
Lactuca serriola L.	Prickly lettuce
Layia glandulosa (Hook.) Hook. & Arn.	Whitedaisy tidytips
Leucocrinum montanum Nutt. ex Gray	Common starlily
Lewisia rediviva Pursh var. *rediviva*	Bitter root
Linanthus pungens (Torr.) J.M. Porter & L.A. Johnson	Granite prickly phlox
Lithophragma glabrum Nutt.	Bulbous woodlandstar
Lithophragma parviflorum (Hook.) Nutt. ex T. & G.	Smallflowered woodlandstar
Lithospermum ruderale Dougl. ex Lehm.	Western stoneseed
Lomatium macrocarpum (Nutt. ex T. & G.) Coult. & Rose	Bigseed biscuitroot
Lomatium triternatum (Pursh) Coult. & Rose	Nineleaf biscuitroot
Melilotus officinalis (L.) Lam.	Yellow sweet clover
Mentzelia albicaulis (Dougl. ex Hook.) Dougl. ex Torr. & Gray	Whitestem blazingstar
Mimulus nanus Hook. & Arn.	Dwarf purple monkeyflower
Nemophila parviflora Dougl. ex Benth. var. *austiniae* (Eastw.) Brand	Smallflower nemophila
Nothocalais troximoides (Gray) Greene	False agoseris
Orobanche corymbosa (Rydb.) Ferris ssp. *corymbosa*	Flat-top broomrape
Penstemon deustus Dougl. ex Lindl. var. *variabilis* (Suksdorf) Cronq.	Scabland penstemon
Penstemon humilis Nutt. ex Gray	Low beardtongue
Penstemon richardsonii Dougl. ex Lindl.	Cut-leaf beardtongue
Penstemon speciosus Dougl. ex Lindl.	Royal penstemon

Scientific name	Common name
Phacelia linearis (Pursh) Holz.	Threadleaf phacelia
Phlox gracilis (Hook.) Greene	Slender phlox
Phlox hoodii Rich.	Spiny phlox
Plectritis macrocera T. & G.	Longhorn plectritis
Polemonium micranthum Benth.	Annual polemonium
Potentilla glandulosa Lindl. ssp. *glandulosa*	Sticky cinquefoil
Ranunculus glaberrimus Hook.	Sagebrush buttercup
Sedum stenopetalum Pursh	Wormleaf stonecrop
Senecio canus Hook.	Woolly groundsel
Sisymbrium altissimum L.	Tall tumblemustard
Tragopogon dubius Scop.	Yellow salsify
Zigadenus venenosus S. Wats.	Meadow deathcamas
Grasses and sedges	
Achnatherum hymenoides (Roem. & Schult.) Barkw.	Indian ricegrass
Achnatherum occidentale (Thurb.) Barkw.	Common western needlegrass
Achnatherum thurberianum (Piper) Barkw.	Thurber's needlegrass
Agropyron cristatum (L.) Gaertn.	Crested wheatgrass
Bromus tectorum L.	Cheatgrass
Carex filifolia Nutt.	Threadleaf sedge
Carex geyeri Boot	Geyer's sedge
Carex rossii Boott in Hook.	Ross' sedge
Elymus elymoides (Raf.) Swezey	Bottlebrush squirreltail
Festuca idahoensis Elmer	Idaho fescue
Hesperostipa comata (Trin. & Rupr.) Barkw. ssp. comata	Needle-and-thread
Koeleria macrantha (Ledeb.) Schult.	Prairie junegrass
Leymus cinereus (Scribn. & Merr.) A. Love	Basin wildrye
Pascopyrum smithii (Rydb.) Barkw. & Dewey	Western wheatgrass
Poa cusickii Vasey ssp. *cusickii*	Cusick's bluegrass
Poa secunda J. Presl ssp. *juncifolia*	Big bluegrass
Poa secunda J. Presl ssp. *secunda*	Sandberg bluegrass
Pseudoroegneria spicata (Pursh) A. Love	Bluebunch wheatgrass
Pseudoroegneria spicata (Pursh) A. Love X *Elymus elymoides* (Raf.) Swezey	Bluebunch wheatgrass X bottlebrush squirreltail hybrid
Vulpia microstachys (Nutt.) Munro	Small fescue

[a] Compiled from numerous sources.
[b] Nomenclature for vascular plants, ferns, and fern-allies follows the Flora of North America (1993+) and the Oregon Flora Project Web site (2008).

Appendix 2: Amphibians, Reptiles, Birds, and Mammals[a]

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

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

Family	Scientific name	Common name
	Dendroica coronata	Yellow-rumped warbler
	Dendroica nigrescens	Black-throated gray warbler
	Euphagus cyanocephalus	Brewer's blackbird
	Icterus bullockii	Bullock's oriole
	Junco hyemalis	Dark-eyed junco
	Molothrus ater	Brown-headed cowbird
	Passerculus sandwichensis	Savannah sparrow
	Passerella iliaca	Fox sparrow
	Pipilo chlorurus	Green-tailed towhee
	Pipilo maculatus	Spotted towhee
	Pooecetes gramineus	Vesper sparrow
	Spizella breweri	Brewer's sparrow
	Spizella passerina	Chipping sparrow
	Sturnella neglecta	Western meadowlark
	Zonotrichia leucophrys	White-crowned sparrow
Fringillidae	*Carduelis pinus*	Pine siskin
	Carduelis psaltria	Lesser goldfinch
	Carduelis tristis	American goldfinch
	Carpodacus cassinii	Cassin's finch
	Carpodacus mexicanus	House finch
Mammals		
Soricidae	*Sorex merriami*	Merriam's shrew
	Sorex preblei	Preble's shrew
	Sorex vagrans	Vagrant shrew
Talpidae	*Scapanus orarius*	Coast mole
Vespertilionidae	*Antrozous pallidus*	Pallid bat
	Corynorhinus townsendii	Townsend's big-eared bat
	Eptesicus fuscus	Big brown bat
	Lasionycteris noctivagans	Silver-haired bat
	Myotis californicus	California myotis
	Myotis ciliolabrum	Western small-footed myotis
	Myotis evotis	Long-eared myotis
	Myotis lucifugus	Little brown myotis
	Myotis thysanodes	Fringed myotis
	Myotis volans	Long-legged myotis
	Myotis yumanensis	Yuma myotis
Leporidae	Lepus californicus	Black-tailed jackrabbit
	Sylvilagus nuttallii	Mountain cottontail
Sciuridae	*Spermophilus beecheyi*	California ground squirrel
	Spermophilus beldingi	Belding's ground squirrel
	Spermophilus townsendii	Townsend's ground squirrel
	Tamias townsendii	Townsend's chipmunk
Geomyidae	*Thomomys talpoides*	Northern pocket gopher
Heteromyidae	*Dipodomys ordii*	Ord's kangaroo rat
	Perognathus parvus	Great Basin pocket mouse
Muridae	*Lemmiscus curtatus*	Sagebrush vole
	Marmota flaviventris	Yellow-bellied marmot
	Microtus longicaudus	Long-tailed vole
	Neotoma cinerea	Bushy-tailed woodrat
	Onychomys leucogaster	Northern grasshopper mouse

Family	Scientific name	Common name
	Peromyscus crinitus	Canyon mouse
	Peromyscus maniculatus	Deer mouse
	Peromyscus truei	Pinyon mouse
Erethizontidae	*Erethizon dorsatum*	Common porcupine
Canidae	*Canis latrans*	Coyote
	Vulpes vulpes	Red fox
Procyonidae	*Procyon lotor*	Common raccoon
Mustelidae	*Mephitis mephitis*	Striped skunk
	Mustela frenata	Long-tailed weasel
	Spilogale gracilis	Western spotted skunk
	Taxidea taxus	American badger
Felidae	*Felis concolor*	Mountain lion
	Lynx rufus	Bobcat
Cervidae	*Odocoileus hemionus* ssp. *hemionus*	Black-tailed deer

[a] Nomenclature, distribution and habitat characteristics taken from Csuti et al. 1997.

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