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The Island Research Natural Area: Guidebook Supplement 35

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The **Forest Service** of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the national forests and national grasslands, it strives—as directed by Congress—to provide increasingly greater service to a growing Nation.

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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.

Cover

The Island Research Natural Area. South end visible in foreground, looking north. A near-pristine example of the *Juniperus occidentalis/Artemisia tridentata/Pseudoroegneria spicata* plant association with localized examples of the *Juniperus occidentalis/Purshia tridentata/Pseudoroegneria spicata* plant association, Jefferson County, Oregon.

Abstract

Schuller, Reid; Halvorson, Ron. 2008. The Island Research Natural Area: guidebook supplement 35. Gen. Tech. Rep. PNW-GTR-762. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 27 p.

This guidebook describes The Island Research Natural Area, an 84-ha (208-ac) tract established to represent examples of the western juniper/big sagebrush/bluebunch wheatgrass (*Juniperus occidentalis/Artemisia tridentata/Pseudoroegneria spicata*), and the western juniper/big sagebrush-antelope bitterbrush/bluebunch wheatgrass (*Juniperus occidentalis/Artemisia tridentata-Purshia tridentata/Pseudoroegneria spicata*) plant associations.

Keywords: Research natural area, *Juniperus occidentalis*, western juniper, *Artemisia tridentata*, big sagebrush, *Purshia tridentata*, antelope bitterbrush, *Pseudoroegneria spicata*, bluebunch wheatgrass, *Festuca idahoensis*, Idaho fescue, *Texosporium sancti-jacobi*, woven-spored lichen, relict vegetation, juniper invasion, sagebrush steppe.

Preface

The research natural area (RNA) described in this guidebook supplement is administered by the Prineville District, Bureau of Land Management (BLM), U.S. Department of the Interior, and the Crooked River National Grassland (CRNG), Forest Service, U.S. Department of Agriculture. The Oregon Parks and Recreation Department (OPRD) owns surrounding lands, including a <0.1-ha portion on the summit. As an agent of BLM and CRNG, OPRD monitors and controls access into the RNA, and actively participates in management of the area.

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.

The Island 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.*[1]

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.[2] 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 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.

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[1] 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].

[2] Supplement No. 34 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.

[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.

- 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 forest floor 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 listed in the *Oregon Natural Heritage Plan*.[4] The 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 ecosystems can be measured.

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[4] Oregon Natural Heritage Program. 2003. Oregon natural heritage plan. Salem, OR: Division of State Lands. 167 p.

Contents

Introduction

The Island Research Natural Area (RNA) is an 81-ha (199-ac)[1] peninsula located immediately south of the confluence of the Deschutes River and the Crooked River in Jefferson County, Oregon. The tract encompasses the upper plateau, which extends 2.8 km (1.74 mi) in length and 0.4 km (0.25 mi) at its widest point in the southern end of the peninsula.

The Island RNA was established as an RNA and as an area of critical environmental concern (ACEC) in 1986 with publication of the Two Rivers resource management plan record of decision (USDI BLM 1986). The site is jointly owned and managed by the USDI Bureau of Land Management (BLM) (64 ha, 158 ac), USDA Forest Service (17 ha, 41 ac), and the Oregon State Parks (<1 ha, <1 ac) (USDI BLM 1986, 1997).

The tract contains a near pristine example of the western juniper/big sagebrush/bluebunch wheatgrass (*Juniperus occidentalis*/*Artemisia tridentata*/*Pseudoroegneria spicata*) plant association, and an example of the western juniper/big sagebrush-antelope bitterbrush/bluebunch wheatgrass (*Juniperus occidentalis*/*Artemisia tridentata-Purshia tridentata*/*Pseudoroegneria spicata*) plant association in central Oregon (Driscoll 1964a, Dyrness et al. 1975, Murray and Kagan 2000, Oregon Natural Heritage Program 2003). These two plant associations are the primary reason for establishing this RNA and provide the basis for nomination as a national natural landmark (Murray and Kagan 2000, Oregon Natural Heritage Program 2003). In addition to the high-quality native plant communities present on the site, the tract also supports one of the few known populations of woven-spore lichen (*Texosporium sancti-jacobi*), a rare western North American lichen (DeBoldt 1990, McCune and Rosentreter 1992).

Access and Accommodations

The site occurs about 24.1 km (15 mi) south-southwest of Madras, Oregon, and may be accessed from U.S. Highway 97 via the Culver Highway from either the south or the north. Follow signs to Culver, Oregon, then to The Cove Palisades State Park. Once in the park, proceed on the paved road into the canyon, cross the bridge, and continue 1.9 km (1.2 mi) to a pull-off next to an interpretive display. From this point, proceed on the 0.8-km (0.5-mi) access trail to the mesa top in the

[1] These data are on file at the Prineville District office of the Bureau of Land Management, and at the USDA Forest Service, Pacific Northwest Research Station, Corvallis, Oregon.

southwest portion of The Island RNA (fig. 1). Permission for public access must be obtained prior to entering the site. Apply for an access permit from the State Park headquarters and if the request is within established guidelines, a free permit will be issued. Lodging accommodation is available in Bend, Redmond, and Madras, Oregon.

Environment

The Island RNA is a mesa isolated by steep cliffs and talus slopes just south of the confluence of the Deschutes and Crooked Rivers. The RNA boundary only includes the upper plateau and not the surrounding cliffs and talus slopes (fig. 2). The RNA is flat and without drainages or surface water; elevations range from 728 m (2,388 ft) on the south end to 733 m (to 2,405 ft) in the north-central portion of the RNA.

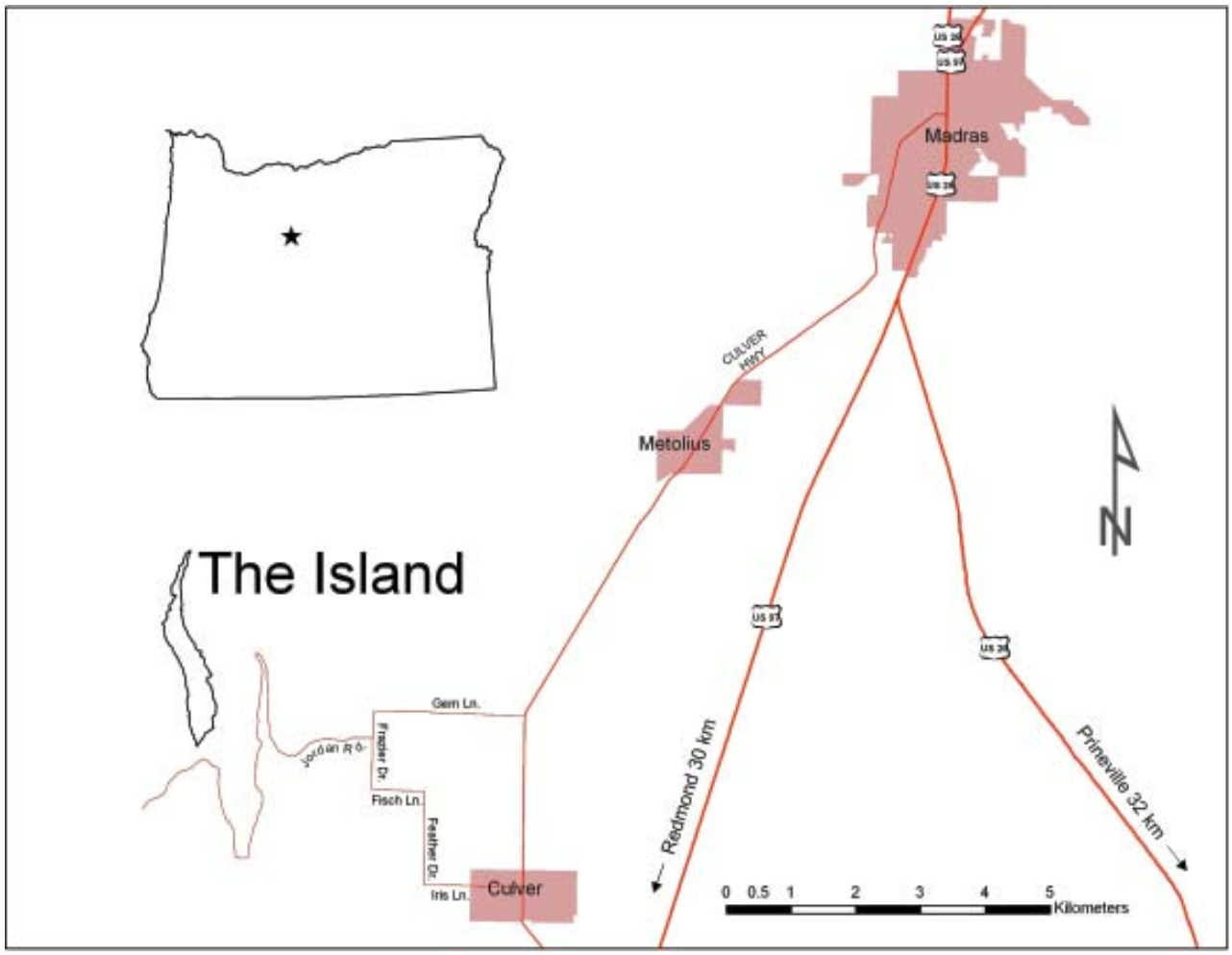

Figure 1—The Island Research Natural Area location and access.

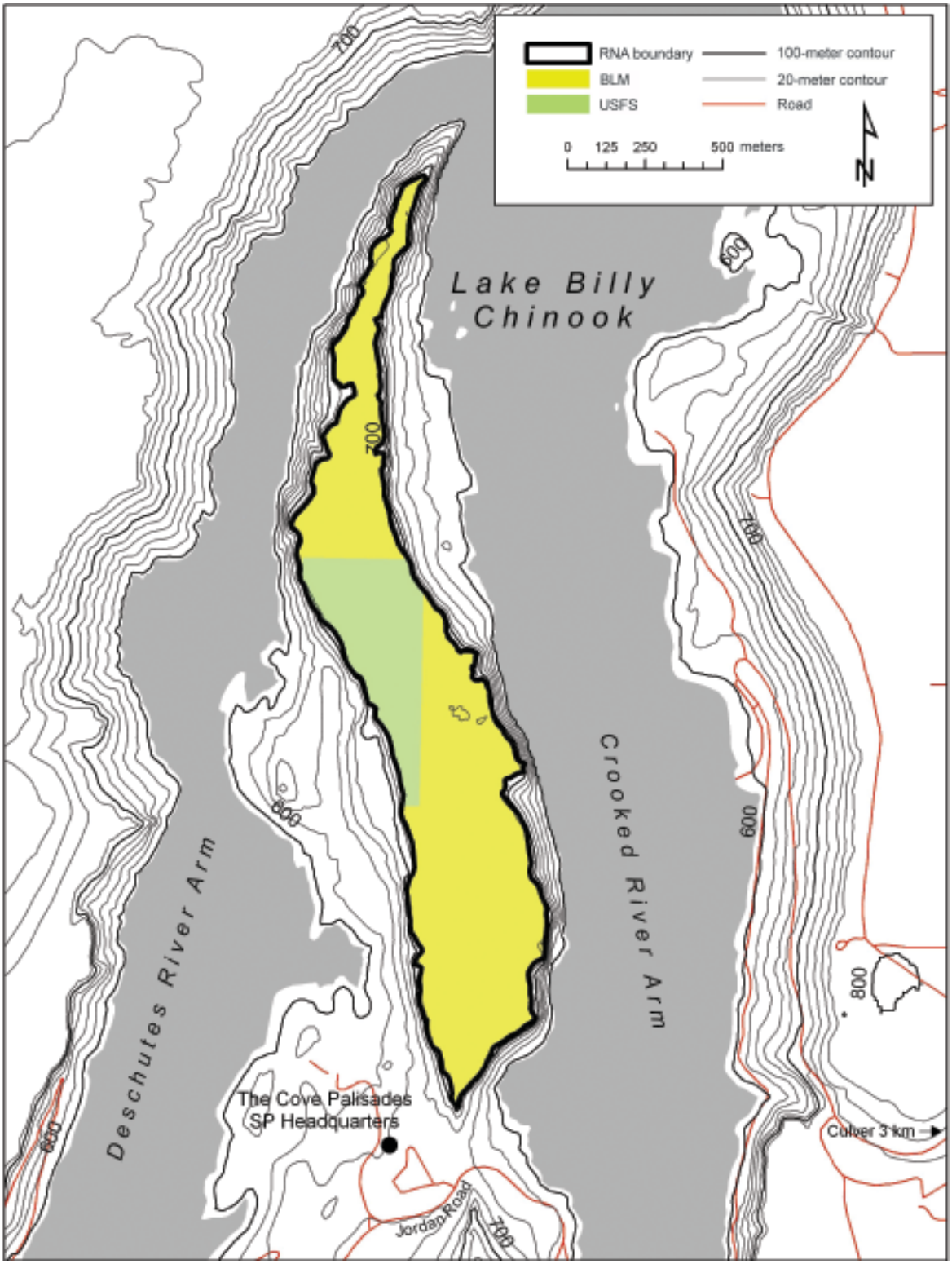

Figure 2—The Island Research Natural Area boundary, topographic map, and ownership.

The surrounding canyons cut by the Deschutes and Crooked Rivers were partially flooded in 1964 by Round Butte Dam holding back water from the Crooked, Deschutes, and Metolius Rivers to form Lake Billy Chinook. Prior to dam construction, local relief from the rivers to the summit of The Island RNA was approximately 200 m (657 ft). With the valley flooding created by the dam, local relief from the surface of Lake Billy Chinook to the top of the mesa is 137 m (449 ft) (Fox 1995, Murray and Kagan 2000, Orr and Orr 1999).

The Deschutes Basin is a broad valley situated between the Ochoco Mountains to the east, the Cascade Mountains to the west, the Mutton Mountains to the north, and the High Desert plains to the south. The ancestral Deschutes, Crooked, and Metolius Rivers have cut deep canyons and exposed large expanses of the upper Miocene to lower Pliocene Deschutes Formation, interbedded with thin beds of tuffaceous sandstone and mudstone of the Simtustus Formation (Orr and Orr 1999, Smith 1991). About 1 million years ago, lava flowed northward off the flanks of Newberry Crater into the ancestral Crooked River canyon (Driscoll 1964a, Taylor and Smith 1987). En route, the flows disrupted the river courses and dammed the Crooked, Deschutes, and Metolius Rivers to a point about 14 km (9 mi) north of The Island RNA (Halvorson 2004, Peterson and Groh 1970). The resulting lakes filled with unconsolidated sediments. Once the flows cooled, water began eroding banks in weak spots and down cutting, eventually leading to recapture of the channels (Halvorson 2004). At their peak, the lava flows filled the canyons to within 61 m (200 ft) of the canyon rim (Driscoll 1964a, Hodge 1942). Today, The Island RNA represents (along with a few “hanging valleys”) one of the few erosional remnants of the intra-canyon lava flows, and is much younger than the plateaus on the outer margins of the canyon on the west and east.

The Island RNA represents one of the few erosional remnants of the intra-canyon lava flows.

Soils within the RNA have been mapped as Agency-Madras complex, 0 to 8 percent slopes, and parent material composed of loess over residuum weathered from volcaniclastic sediments of the Deschutes Formation. Depth is 56 to 102 cm (22 to 40 in) to paralithic bedrock, and 66 to 112 cm (26 to 44 in) to lithic bedrock. Soils are well drained. A typical soil profile for the Agency series is (USDA NRCS 2007, USDA NRCS 1999):

The soil parent material is loess over residuum weathered from volcaniclastic sediments.

0 to 20.3 cm	(0 to 8 in)	Loam
20 to 61 cm	(8 to 24 in)	Loam
61 to 74 cm	(24 to 29 in)	Cobbly loam
74 to 84 cm	(29 to 33 in)	Weathered bedrock
84 to 109 cm	(33 to 43 in)	Unweathered bedrock

Soils beneath the western juniper/big sagebrush/bluebunch wheatgrass plant association are non-stony, well-developed brown loams that have developed either from hard-packed river and lake sediments, or from loose, wind-blown silts and very fine sands (Driscoll 1964a). Parent material contains numerous partially decomposed basalt fragments below the surface. A dense, non-stony clay layer at depth restricts root penetration and reduces soil water storage capacity (Driscoll 1964a). In comparison, soils beneath the western juniper/big sagebrush-antelope bitterbrush/bluebunch wheatgrass association are much stonier and lighter-textured, and root penetration thru the discontinuous hardpan is more extensive.

Climate

Climate within the RNA is continental and semiarid.

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 15 miles south of Madras, Oregon, the Madras 1 NNW, Oregon (355142) weather station provides the most comparable climate data for the 1952-2007 period (table 1).

Annual precipitation is low. In winter, precipitation is a mixture of rain and snow (Driscoll 1964a, Fox 1995, Halvorson 2004). Summers are dry with warm days and cool nights. Frost occurs rarely during the summer but may occur anytime between October and June. (Halvorson 2004, Western Regional Climate Center 2007). 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 2007).

Vegetation

Western juniper is the sole tree species in the RNA.

The RNA is situated along the boundary of four major ecological provinces (Franklin and Dyrness 1988). Depending on the mapping scheme and criteria used to define major physiographic, geologic, and vegetation zones, The Island RNA may be placed within the Columbia Basin, the Blue Mountains, the Eastern Cascades, or the High Lava Plains/High Desert provinces. Vegetation within the RNA is characteristic of portions of all the aforementioned provinces.

Western juniper is the sole tree species present within the RNA (see app. 1 for a list of plant scientific and common names). Various reports (Fox 1995, Fox and Eddleman 2003, Murray and Kagan 2000, Soulé et al. 2004) indicate that western

Table 1—Temperature and precipitation summary, Madras 1 NNW, Oregon (355142)

Average minimum January temperature	-4.1 °C (24.6 °F)
Average maximum January temperature	5.1 °C (41.1 °F)
Average minimum July temperature	9.8 °C (49.7 °F)
Average maximum July temperature	29.4 °C (84.9 °F)
Average annual precipitation	292 mm (11.51 in)
Average June-August precipitation	46 mm (1.82 in)
Average annual snowfall	378 mm (14.9 in)

Period of Record: February 20, 1952 to June 30, 2007.

juniper cover and density are increasing on the site in recent decades. Other native woody species such as big sagebrush and antelope bitterbrush predominate in the shrub layer (fig. 3). Rocky, shallow-soiled areas also support small populations of mountain mahogany (*Cercocarpus ledifolius*), rigid sagebrush (*Artemisia rigida*), and gray rabbitbrush (*Ericameria nauseosa*).

Native bunchgrasses dominate the understory. There are two major plant associations.

The herb layer is dominated by native bunchgrasses, including bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass (*Poa secunda*), and Thurber's needlegrass (*Achnatherum thurberianum*). Two invasive annual grasses can be locally common: populations of medusahead wildrye (*Taeniatherum caput-medusae*) persist in moderately low (i.e., manageable) numbers within the RNA. Cheatgrass (*Bromus tectorum*) has been present on the island for at least 50 years, although a population trend for this species has not been documented for the area in its entirety (see Fox 1995 and Fox and Eddleman 2003 for a discussion of trend within permanent plots on The Island). Perennial herbs make up a minor part of the herb layer composition. However, the entire RNA contains a large number of plant species, scattered throughout the area (app. 1).

Driscoll (1964a, 1964b) sampled and classified the vegetation on the RNA into two major plant associations. The western juniper/big sagebrush/bluebunch wheatgrass association occupies 62 ha (154 ac) primarily in the western, central, and northern portions of the mesa (fig. 3). Twenty hectares (49 ac) along the southern and eastern parts of the RNA support a western juniper/big sagebrush-antelope bitterbrush/bluebunch wheatgrass association (Driscoll 1964a, 1964b; Fox 1995; Hopkins and Kovalchik 1983; Murray and Kagan 2000). Small, discontinuous stands of the rigid sagebrush/bluebunch wheatgrass association occupy about 2 ha (5 ac) along the western edge atop a collapsed lava tube (Murray and Kagan 2000).

Four, 0.1-ha (0.25-ac) circular plots were established in 2005 to monitor structural and compositional change over time within the western juniper/big

Figure 3—Plot 696 looking north; foreground of *Purshia tridentata* (too sparse to be recorded in plot data), and *Artemisia tridentata* occupy the shrub layer with *Festuca idahoensis* and *Pseudoroegneria spicata* co-dominating the herb layer. Young *Juniperus occidentalis* trees with sapling recruitment in midground.

sagebrush/bluebunch wheatgrass association (tables 2 and 3). These plots were generally located in the central and east-central to northeast parts of the mesa in relatively homogenous patches of vegetation. All western juniper stems > 5 cm diameter at breast height (1.47 m, 4.8 ft) were tagged and measured at breast height within each plot. Tagged stems were assigned to individual trees for the purpose of recording both stem density and individual tree density within each plot.

Counts ranged from 3 to 17 individuals per plot (30 to 170 trees per ha, 12 to 69 per ac). Average western juniper density for the four plots was 75 trees per ha

Table 2—Physical features of four permanent plots within The Island Research Natural Area

	Plot			
Feature	**693**	**694**	**695**	**696**
Elevation (m)	733	733	733	733
Aspect (°)	0	315	180	0
Slope grade (%)	0	4	4	0

Table 3—Plant association, understory coverage and frequency of four permanent plots in The Island Research Natural Area

	Plant association							
	JUOC/ARTR/PSSP[a] Plot 693		JUOC/ARTR/PSSP Plot 694		JUOC/ARTR/PSSP Plot 695		JUOC/ARTR/PSSP Plot 696	
	Cover[b]	Frequency	Cover	Frequency	Cover	Frequency	Cover	Frequency
	Percent							
Litter	39	75	24	61	25	75	30	93
Lichen[c]	12	54	20	64	24	82	9	64
Moss	tr	7	4	32	5	46	2	61
Bare soil	45	68	38	71	48	86	38	82
Rock	7	32	10	46	13	54	1	14
Shrub cover:								
Artemisia tridentata[d]	3	—	4	—	2	—	7	—
Purshia tridentata		—		—	tr	—		—
Tetradymia canescens	tr	—	tr	—		—		—
Grass cover and frequency:								
Festuca idahoensis	11	54	8	25	4	14	28	86
Pseudoroegneria spicata	6	32	7	21	6	25	tr	7
Poa secunda	7	75	5	71	7	100	7	74
Achnatherum thurberianum	4	25	8	32	5	36	7	39
Vulpia microstachys	1	64	2	50	4	71	2	54
Bromus tectorum	2	18	1	29	3	46	3	18
Poa cusickii			3	14				
Herb cover and frequency:								
Draba verna	tr	32	1	50	tr	29	tr	29
Collinsia parviflora	tr	4	tr	29	tr	18	tr	29
Lomatium macrocarpum	tr	14	1	11	1	14	1	7
Astragalus conjunctus	tr	11	1	21				
Achillea millefolium	1	7	tr	11				
Uropappus lindleyi	tr	7	tr	11				
Phacelia linearis	tr	4						
Lomatium canbyi			tr	11				
Blepharipappus scaber			tr	7				
Holosteum umbellatum			tr	7				
Eriogonum sp.			tr	4				
Plectritis macrocera			tr	18			tr	4
Calochortus macrocarpus			tr	4	tr	11		
Plagiobothrys tenellus					tr	4		
Zigadenus venenosus					tr	4		
Idahoa scapigera							tr	7
Leptosiphon harknessii							tr	4

Note: JUOC = *Juniperus occidentalis,* ARTR = *Artemisia tridentata,* PSSP = *Pseudoroegneria spicata*, tr = trace (<0.5 percent foliar cover), — = not measured.

[a] Plant association names and acronyms follow Driscoll 1964b, 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 relative frequency. Zero values are not included.

[c] Taken together, lichen and moss cover form the ground-surface-dwelling microbiotic crust.

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

(30 trees per ac) (see footnote 1). Canopy cover of western juniper ranged from 7 to 16 percent among plots. This range was consistent with earlier studies (e.g., Driscoll 1964a, Fox 1995, Fox and Eddleman 2003). Sapling[2] density was 10 per ha (24.7 per ac). However, Soulé and Knapp (2000) found juvenile (i.e., sapling) western juniper densities at a much higher level, accounting for as much as 81 percent of the total tallied individuals.

Table 4 shows the shrub and grass cover recorded from three data sets over a 40+ year period. Both total shrub cover and big sagebrush cover were much lower in 2005 than in 1961 and 1993 (table 4). However, there was higher cover of most native perennial bunchgrasses in 2005 (Idaho fescue [*Festuca idahoensis*], Thurber's needlegrass [*Achnatherum thurberianum*], Sandberg bluegrass [*Poa secunda*], and higher cover of the native annual grass, small fescue [*Vulpia microstachys*]). Other prominent grasses were near or within the range of cover values recorded in the 1961 and 1993 data sets, including bluebunch wheatgrass and cheatgrass (Driscoll 1964a, Fox 1995, Fox and Eddleman 2003, Soulé and Knapp 2000). Data from Driscoll (1964a), and Fox (1995) were collected from the same plots, roughly 30 years apart, whereas data for the 2005 survey were collected at different plot locations. Thus, differences among years reflected successional change, but could also reflect high spatial variability in the distribution of shrubs and grasses, given low sampling intensites and different sampling locations.

The 2005 data show a higher cover of most native perennial bunchgasses.

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 published literature.

Disturbance History

Natural disturbances occurring within the western juniper/big sagebrush ecosystem on The Island RNA have included fire, insect infestations, and periods of drought. Driscoll (1964a) observed that fires have strongly affected the abundance of western juniper on this RNA. Evidence of charred wood and charred wood fragments on the soil surface attest to the recent historical role that lightning-ignited fires have played (Halvorson 2004). However, it appears that, in many cases, previous lightning-caused fires burned only small areas or individual trees

[2] "Saplings" refers to individual trees > 10 cm (4 in to 4.8 ft) in height but less than 5 cm (2 in) diameter at breast height (1.47 m).

Table 4—Shrub and grass cover[a] within the *Juniperus occidentalis/Artemisia tridentata/Pseudoroegneria spicata* plant association on The Island Research Natural Area in 1961, 1993, and 2005

Species	1961 (Driscoll 1964a)[b]	1993 (Fox and Eddleman 2003)	2005 (this report)
	Percentage of cover		
Artemisia tridentata[c]	8.5	15.4	4.0
Purshia tridentata	0.0	0.0	tr
Other shrubs	1.1	tr[d]	tr
Total shrubs	9.6	15.4	4.0
Pseudoroegneria spicata	9.2	3.4	4.8
Festuca idahoensis	0.4	2.6	12.8
Achnatherum thurberianum	2.0	2.9	6.0
Poa secunda	1.3	2.8	6.5
Bromus tectorum	1.7	0.1	2.3
Vulpia microstachys	0.6	0.4	2.3
Total grass	15.2	12.2	34.7
Bare ground/rock	41.3	35.3	50.0
Litter/moss/lichen	30.7	55.9	48.5

Note: tr = trace (<0.5 percent foliar cover).

[a] Cover is expressed as percentage of foliar cover.

[b] Data collected in 1960s and 1993 were collected from the same plots. Data collected in 2005 were collected from plots located elsewhere on The Island Research Natural Area.

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

struck by lightning (Halvorson 1996). There are larger areas on the RNA, however, where no trees or shrubs are present, but only lush grass-dominated stands of *Pseudoroegneria spicata, Festuca idahoensis,* and *Poa secunda* (Halvorson 2004). In the 1960s, Driscoll (1964a) observed that some areas that had recently burned were not being recolonized by *Juniperus* seedlings. 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 played only a minor role on the RNA. The relatively low abundance of nonnative, annual grasses so prevalent on big sagebrush sites throughout the intermountain West (Young et al. 1972) suggests that the Island RNA is relatively pristine compared to most areas in central and eastern Oregon. However, the RNA does support relatively small populations of highly invasive, annual grasses

like *Taeniatherum caput-medusae* (medusahead wildrye) and cheatgrass (see "Vegetation" section), and monitoring and containment/control of these populations will need to continue indefinitely.

Research History

Research Focusing on Vegetation Classification and Synecology

- A relict area of the central Oregon juniper zone (Driscoll 1964a, Greene et al. 1986)
- Vegetation-soil units in the central Oregon juniper zone (Driscoll 1964b)
- Plant association of the Crooked River National Grassland (Hopkins and Kovalchik 1983)
- The Island RNA: a vegetation study with time and location comparisons (Fox 1995)
- The Island RNA: evaluation for national natural landmark status (Murray and Kagan 2000)
- A time comparison study of vegetation on The Island RNA (Fox and Eddleman 2003)

Research Focusing on *Festuca idahoensis* (Idaho Fescue)

- Germination of Idaho fescue and cheatgrass seeds from coexisting populations (Goodwin et al. 1996)
- Persistence of Idaho fescue on degraded sagebrush steppe (Goodwin et al. 1999)
- Persistence of Idaho fescue on degraded rangelands: adaptations to defoliation or tolerance (Jaindl et al. 1994)
- Effect of temperature on growth of cheatgrass and Idaho fescue (Nasri and Doescher 1995a)
- Effects of competition by cheatgrass on shoot growth of Idaho fescue (Nasri and Doescher 1995b)

Research on *Juniperus occidentalis* (Western Juniper) Growth and Expansion

- 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)

- Vegetation change and the role of atmospheric CO_2 enrichment on a relict site in central Oregon: 1960-1994 (Knapp and Soulé 1996)
- 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)
- Western juniper expansion on adjacent disturbed and near-relict sites (Soulé and Knapp 1999)
- *Juniperus occidentalis* (western juniper) establishment history on two minimally disturbed research natural areas in central Oregon (Soulé and Knapp 2000)
- 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)

Other Research

- *Texosporium sancti-jacobi*, a rare western North American lichen (McCune and Rosentreter 1992)
- A field guide to depositional processes and facies geometry of Neogene continental volcaniclastic rocks, Deschutes Basin, central Oregon (Smith 1991)
- The influence of vegetation removal by western harvester ants (*Pogonomyrmex owyheei*) in a relict area of sagebrush-steppe in central Oregon (Soulé and Knapp 1996)

Data from the four permanent plots established in 2005 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

As early as 1910, several homestead and stock-raising homestead entries were filed on various parts of what is now The Island RNA. These entries reverted back to federal ownership in 1937, and by Executive order the unencumbered public land was put under USDA Forest Service management. Land that is now administered

by the BLM was withdrawn from entry through a power-site reserve withdrawal during the same period and was not homesteaded (USDI BLM 2008).

Sheep were grazed here for a short period.

A short period of consumptive use in the form of sheep grazing occurred for 2 years in the 1920s (Driscoll 1964a). Sheep were driven single file up and down the access trail, and water was provided from the Crooked River by use of a ramjet pump. Grazing was ended because of inaccessibility, predation from coyotes and bobcats, and sheep falling to their deaths over the steep cliffs. Evidence of the remains of a sheepherder camp was still present by the 1960s (Driscoll 1964a).

The BLM portion of the site was designated as an area of critical environmental concern (ACEC) and an RNA (USDI BLM 1996) in the Two Rivers resource management plan and record of decision (USDI BLM 1986). The Forest Service portion was designated an RNA in the 1989 *Land and Resource Management Plan for the Crooked River National Grassland* (USDA Forest Service 1989). The RNA was proposed as a national natural landmark in 1975, evaluated and nominated in 1987, and again in 2000 (Murray and Kagan 2000).

In addition to the current and pending designations, the site has a long history of research and educational use. Figure 4 documents use of the RNA from 1994 to 2007. Based on a trailhead register maintained by the Oregon Parks and Recreation Department (OPRD), both group and individual use dramatically declined in 1998, when a permit system for entry was established and vigilant oversight by OPRD began.

Maps

Maps applicable to The Island RNA: Topographic—Round Butte Dam, Oregon, 7.5 minute, 1:24,000 scale, 1962; Lower Deschutes and John Day Rivers public use map, 1:126,720 scale, 2004.

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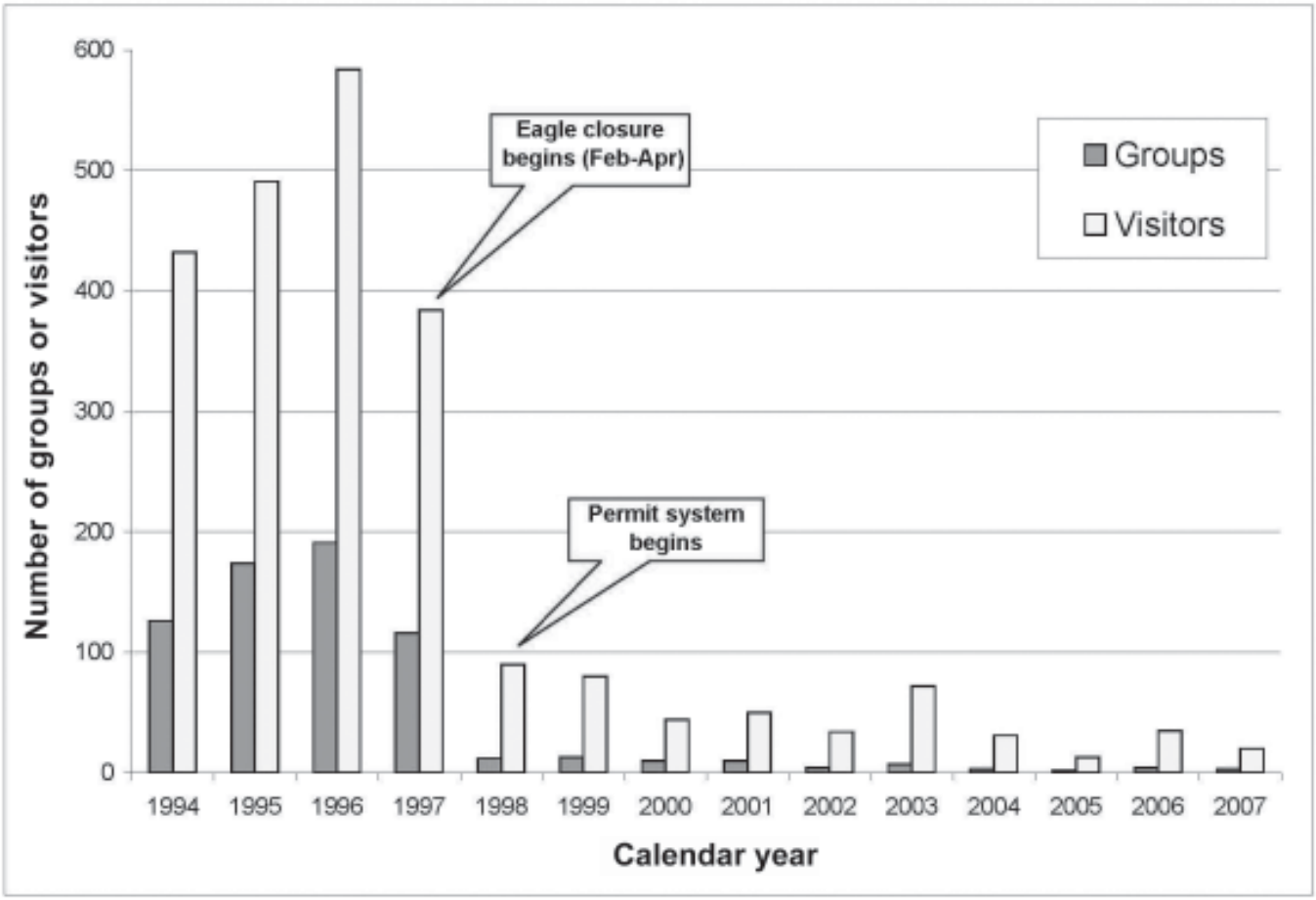

Figure 4—Visitor and group use at The Island Area of Critical Environmental Concern/Research Natural Area 1994–2007. Source: Bureau of Land Management trailhead register (1994–1997) and permit records (1998–1997).

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

1 tree per hectare = 0.405 trees per acre

1.8 degrees Celsius (C) + 32 = degrees Fahrenheit (F)

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Appendix 1: Plants

Table 5—Scientific and common names of vascular plants, ferns, and fern allies[a b]

Scientific name	Common name
Coniferous trees	
Juniperus occidentalis Hook.	Western juniper
Tall shrubs 2 to 8 m (6.6 to 26.3 ft) tall	
Amelanchier alnifolia (Nutt.) Nutt. ex Roem.	Western serviceberry
Cercocarpus ledifolius Nutt. ex Torr. & Gray	Mountain mahogany
Holodiscus dumosus (Nutt. ex Hook.) Heller	Rock spirea
Philadelphus lewisii Pursh	Lewis' mock orange
Medium shrubs 0.5 to 2 m (1.6 to 6.6 ft) tall	
Artemisia rigida (Nutt.) Gray	Rigid sagebrush
Artemisia tridentata Nutt.	Big sagebrush
Ericameria humilis (Greene) L.C. Anderson	Truckee rabbitbrush
Ericameria nauseosa (Pallas ex Pursh) Nesom & Baird	Gray rabbitbrush
Linanthus pungens (Torr.) J.M. Porter & L.A. Johnson	Granite prickly phlox
Purshia tridentata (Pursh) DC.	Antelope bitterbrush
Ribes cereum Dougl.	Wax currant
Tetradymia canescens DC.	Spineless horsebrush
Low shrubs <0.5 m (<1.6 ft) tall	
Ericameria resinosa Nutt.	Columbia goldenweed
Ferns and allies	
Cheilanthes gracillima D.C. Eaton	Lace lipfern
Pityrogramma triangularis (Kaulf.) Maxon	Goldback fern
Herbs	
Achillea millefolium L.	Common yarrow
Agoseris heterophylla (Nutt.) Greene	Annual agoseris
Allium douglasii Hook.	Douglas' onion
Allium macrum S. Wats.	Rock onion
Allium parvum Kellogg	Small onion
Amsinckia menziesii (Lehm.) Nels. & Macbr.	Menzies' fiddleneck
Ancistrocarphus filagineus Gray	False neststraw
Antennaria dimorpha (Nutt.) T.&G.	Low pussytoes
Arabis sparsiflora Nutt.	Sicklepod rockcress
Astragalus conjunctus S. Wats.	Idaho milkvetch
Astragalus filipes Torr. ex Gray	Basalt milkvetch
Astragalus misellus S. Wats.	Pauper milkvetch
Astragalus obscurus S. Wats.	Arcane milkvetch

Table 5—Scientific and common names of vascular plants, ferns, and fern allies[a b] (continued)

Scientific name	Common name
Balsamorhiza careyana Gray	Carey's balsamroot
Blepharipappus scaber Hook.	Rough eyelashweed
Calochortus macrocarpus Dougl.	Sagebrush mariposa lily
Camelina microcarpa Andrz. ex DC.	Littlepod false flax
Camissonia contorta (Dougl. ex Lehm.) Kearney	Plains evening-primrose
Castilleja applegatei Fern.	Wavyleaf Indian paintbrush
Castilleja chromosa A. Nels.	Desert Indian paintbrush
Clarkia sp.	Clarkia
Claytonia perfoliata Donn ex Willd. ssp. *perfoliata*	Miner's lettuce
Claytonia sibirica L.	Siberian springbeauty
Collinsia parviflora Dougl. ex Lindl.	Maiden blue-eyed Mary
Collomia grandiflora Dougl. ex Lindl.	Grand collomia
Crepis occidentalis Nutt.	Largeflower hawksbeard
Cryptantha ambigua (Gray) Greene	Obscure cryptantha
Cryptantha flaccida (Dougl. ex Lehm.) Greene	Weakstem cryptantha
Cryptantha rostellata (Greene) Greene	Beaked cryptantha
Delphinium sp.	Larkspur
Descurainia pinnata (Walt.) Britt.	Western tansymustard
Draba verna L.	Spring draba
Epilobium brachycarpum Presl	Tall annual willowweed
Epilobium minutum Lindl. ex Lehm.	Chapparal willowherb
Erigeron filifolius (Hook.) Nutt.	Threadleaf fleabane
Erigeron linearis (Hook.) Piper	Desert yellow fleabane
Erigeron poliospermus Gray	Cushion fleabane
Eriogonum heracleoides Nutt.	Parsnipflower buckwheat
Eriogonum sphaerocephalum Dougl. ex. Benth.	Rock buckwheat
Eriogonum strictum Benth. ssp. *proliferum* (T.&G.) S. Stokes	Blue Mountain 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 boreale L.	Northern bedstraw
Galium multiflorum Kellogg	Shrubby bedstraw
Gilia sinuata Dougl. ex Benth.	Rosy gilia
Hackelia diffusa (Lehm.) I.M. Johnston var. *cottonii* (Piper) R.L. Carr	Cotton's stickseed
Hemizonella minima (Gray) Gray	Opposite-leaved tarweed
Heuchera cylindrica Dougl. ex Hook.	Roundleaf alumroot
Holosteum umbellatum L.	Jagged chickweed
Idahoa scapigera (Hook.) Nels. & Macbr.	Flatpod
Lactuca serriola L.	Prickly lettuce

Table 5—Scientific and common names of vascular plants, ferns, and fern allies[a] [b] (continued)

Scientific name	Common name
Lagophylla ramosissima Nutt.	Branched lagophylla
Layia glandulosa (Hook.) Hook. & Arn.	Whitedaisy tidytips
Leptosiphon harknessii (Curran) J.M. Porter & L.A. Johnson	Harkness' flaxflower
Lithophragma glabrum Nutt.	Bulbous woodland-star
Lithophragma parviflorum (Hook.) Nutt. ex T.&G.	Small-flowered fringecup
Lomatium canbyi Coult. & Rose	Canby's biscuitroot
Lomatium cous (S. Wats.) Coult. & Rose	Cous biscuitroot
Lomatium macrocarpum (Nutt. ex T.&G.) Coult. & Rose	Bigseed biscuitroot
Lomatium triternatum (Pursh) Coult. & Rose	Nineleaf biscuitroot
Nama densum J.G. Lemmon	Leafy nama
Nothocalais troximoides (Gray) Greene	False agoseris
Orobanche uniflora L. var. *purpurea* (Hell.) Ach.	One-flowered broomrape
Orthocarpus tenuifolius (Pursh) Benth.	Thinleaved owl's clover
Penstemon deustus Dougl. ex Lindl.	Scabland penstemon
Penstemon fruticosus (Pursh) Greene	Bush penstemon
Penstemon richardsonii Dougl. ex Lindl.	Cutleaf beardtongue
Penstemon seorsus (A. Nels.) Keck	Shortlobe penstemon
Phacelia hastata Dougl. ex Lehm.	Silverleaf phacelia
Phacelia heterophylla Pursh	Varileaf phacelia
Phacelia linearis (Pursh) Holz.	Threadleaf phacelia
Phlox cespitosa Nutt.	Tufted phlox
Phlox gracilis (Hook.) Greene	Slender phlox
Phlox hoodii Richards.	Spiny phlox
Plagiobothrys tenellus (Nutt.) Gray	Pacific popcornflower
Plectritis macrocera T.&G.	Longhorn plectritis
Polemonium micranthum Benth.	Annual polemonium
Potentilla glandulosa Lindl.	Sticky cinquefoil
Rigiopappus leptocladus Gray	Wireweed
Scutellaria nana Gray	Dwarf skullcap
Sedum sp.	Stonecrop
Senecio canus Hook.	Woolly groundsel
Sisymbrium altissimum L.	Tall tumblemustard
Thelypodium laciniatum (Hook.) Endl.	Western thelypodium
Thysanocarpus curvipes Hook.	Sand fringepod
Tiquilia nuttallii (Hook.) A. Richards.	Nuttall's crinklemat
Tragopogon dubius Scop.	Yellow salsify
Trifolium dubium Sibth.	Suckling clover
Triteleia grandiflora Lindl.	Largeflower triteleia
Uropappus lindleyi (DC.) Nutt.	Silverpuffs

Table 5—Scientific and common names of vascular plants, ferns, and fern allies[a] [b] (continued)

Scientific name	Common name
Valeriana sp.	Valerian
Verbascum thapsus L.	Common mullein
Zigadenus venenosus S. Wats.	Meadow deathcamas
Grasses	
Achnatherum thurberianum (Piper) Barkw.	Thurber's needlegrass
Bromus hordeaceus L.	Soft brome
Bromus rubens L.	Red brome
Bromus tectorum L.	Cheatgrass
Elymus elymoides (Raf.) Swezey	Bottlebrush squirreltail
Festuca idahoensis Elmer	Idaho fescue
Koeleria macrantha (Ledeb.) Schult.	Prairie junegrass
Leymus cinereus (Scribn. & Merr.) A. Love	Basin wildrye
Poa bulbosa L.	Bulbous bluegrass
Poa cusickii Vasey ssp. *Cusickii*	Cusick's bluegrass
Poa secunda Presl	Sandberg bluegrass
Pseudoroegneria spicata (Pursh) A. Love	Bluebunch wheatgrass
Taeniatherum caput-medusae (L.) Nevski	Medusahead wildrye
Triticum aestivum L.	Wheat
Ventenata dubia (Leers) Coss. & Durieu	North Aftrica grass
Vulpia microstachys (Nutt.) Munro ex Benth.	Small fescue
Vulpia octoflora (Walter) Rydb.	Six-weeks 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 (2007).

Appendix 2: Lichens

Table 6—Scientific names of lichens[a]

Acarospora schleicheri (Ach.) A. Massal.
Amandinea punctata (Hoffm.) Coppins & Scheid.
Aspicilia reptans (Looman) Wetmore
Candelariella terrigena Räsänen
Cladonia pocillum (Ach.) Grognot
Collema sp. F.H. Wigg.
Diploschistes muscorum (Scop.) R. Sant.
Lecanora muralis (Schreber) Rabenh.
Phaeorrhiza sareptana (Tomin) H. Mayrh. & Poelt
Psora sp. Hoffm.
Texosporium sancti-jacobi (Tuck.) Nadv.

[a] Nomenclature follows Esslinger 2006.

Appendix 3: Amphibians, Reptiles, Birds, and Mammals

Table 7—Amphibians, reptiles, birds, and mammals expected to use The Island Research Natural Area[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 cyaneus	Northern harrier
	Accipiter gentilis	Northern goshawk
	Accipiter striatus	Sharp-shinned hawk
	Aquila chrysaetos	Golden eagle
	Buteo jamaicensis	Red-tailed hawk
	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

Table 7—Amphibians, reptiles, birds, and mammals expected to use The Island Research Natural Area[a] (continued)

Family	Scientific name	Common name
Strigidae	*Asio otus*	Long-eared owl
	Athene cunicularia	Burrowing owl
	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-pewee
	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 pica	Black-billed magpie
Paridae	*Parus atricapillus*	Black-capped chickadee
	Parus gambeli	Mountain chickadee
Aegithalidae	*Psaltriparus minimus*	Bushtit
Sittidae	*Sitta canadensis*	Red-breasted nuthatch
Troglodytidae	C*atherpes 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

Table 7—Amphibians, reptiles, birds, and mammals expected to use The Island Research Natural Area[a] (continued)

Family	Scientific name	Common name
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
	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

Table 7—Amphibians, reptiles, birds, and mammals expected to use The Island Research Natural Area[a] (continued)

Family	Scientific name	Common name
Leporidae	*Lepus californicus*	Black-tailed jackrabbit
	Sylvilagus nuttallii	Mountain cottontail
Sciuridae	*Spermophilus beecheyi*	California ground squirrel
	Marmota flaviventris	Yellow-bellied marmot
	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
	Microtus longicaudus	Long-tailed vole
	Neotoma cinerea	Bushy-tailed woodrat
	Onychomys leucogaster	Northern grasshopper mouse
	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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