PINYON-JUNIPER WOODLAND CLASSIFICATION AND DESCRIPTION RESEARCH NATURAL AREAS OF SOUTHEASTERN IDAHO

by

Steven K. Rust
Conservation Data Center

May 1997

Idaho Department of Fish and Game
Natural Resource Policy Bureau
600 South Walnut, P.O. Box 25
Boise, Idaho 83707
Stephen P. Mealey, Director

Cooperative Challenge Cost-Share Project
Idaho Department of Fish and Game
Burley Field Office, Bureau of Land Management
USDA Forest Service, Intermountain Research Station

TABLE OF CONTENTS

Introduction

Pinyon-juniper and juniper woodland[1] vegetation occurs at the northern extent of its range in Idaho. Principle descriptive work on plant communities dominated by Utah juniper (*Juniperus osteosperma*), Rocky Mountain juniper (*Juniperus scopulorum*), and singleleaf pinyon pine (*Pinus monophylla*) has occurred in the Southern Rocky Mountains and Great Basin (e.g., Blackburn et al. 1969, Baker 1984, and others). Assessment of the conservation status of, and development of effective habitat conservation strategies for, pinyon-juniper woodland communities in Idaho is inhibited by a lack of basic ecological descriptive work. In a nation-wide study (Grossman et al. 1994), seven pinyon-juniper woodland communities are recognized as occurring exclusively in Idaho; all are ranked most rare. These Idaho-endemic pinyon-juniper woodland communities are also all considered most poorly understood.

Research natural areas are established to provide a baseline reference against which the effects of intensive management may assessed and evaluated. As well, an important objective of plant community conservation is to provide a coarse-filter by which the populations and habitats of multiple common and rare species may be encaptured. To effectively attain these goals and objectives informaton is needed on plant community composition, structure, and function. The objectives of this project are: (1) to assist with the identification and description of pinyon-juniper woodland communities on Bureau of Land Management and National Forest System lands in the Snake River Basalts, Northwest Basin and Range, and Overthrust Mountains ecological regions of Idaho and (2) to assist in the determination of their conservation status. The purpose of this report is to present an initial working classification of the pinyon-juniper vegetation observed in research natural areas and other selected sites in southeast Idaho and to summarize composition, distribution, and environmental relations. An annotated bibliography is presented.

Methods

Pinyon-juniper woodlands were sampled at proposed and designated natural areas and other selected sites within the range of pinyon-juniper woodland vegetation in Idaho. To the extent possible, stands present within each sampling site were delineated based on stand environmental features (topography and elevation) and apparent structure and composition (using aerial photography interpretation). Field sampling efforts were stratified within these reference stands. Ecology plots were selected to capture the range of conditions in stand structure and composition. Plots were placed within vegetation patches that are homogeneous in structure and composition.

Basic environmental parameters (slope aspect, gradient and horizon; elevation; micro and macro topography; etc), plant cover, and the density and size distribution of live and standing dead trees were determined on a standard (fixed) 1/10th acre (375 m^2) circular ecology plots (Bourgeron et al. 1991; USDA Forest Service 1992). Plant cover data were taken by ocular estimate for all vascular plant species. Ocular estimates of the cover of tree species were differentiated by strata (height/diameter class). Tree canopy height was determined for each height/diameter class. Live and standing dead tree stems present within the fixed area plot were tallied by species and size class (using the diameter at root crown). Soils and geology were documented from maps and, where necessary, verified and qualitatively described in the field.

Multivariate classification and ordination analytical techniques were employed in the description of plant communities and assessment of environmental factors. TWINSPAN (Hill 1979b) and DECORANA (Hill 1979a) were used interactively to derive an initial classification of the plot data through progressive decomposition of the plot data to smaller, more similar groups. This classification was refined and

[1] To ease discussion, all vegetation in which *Pinus monophylla*, *Juniperus osteosperma*, and/or *Juniperus scopulorum* are constituent species will be referred to in this report as 'pinyon-juniper woodland'.

environmental correlations were developed through the use of CANOCO (ter Braak 1991), again using an approach of progressive decomposition. Data analysis was aided through the use of ECOAID (Smith 1993), a data manipulation and summary package.

Results and Plant Community Characterizations

Pinyon-juniper woodland sites visited during the 1995 and 1996 field seasons are listed in Table 1 and shown in Figure 1. All formally designated natural areas on Burley Resource Area and National Forest System known to encompass stands of pinyon-juniper woodland were visited. Previously un-recognized pinyon-juniper woodlands were visited at Burton Canyon RNA. Sampling also occurred at four sites which occur throughout the range of *Pinus monophylla* (in Idaho), including City of Rocks RNA, Jim Sage Canyon RNA, Pine Knob, and Slide Canyon. The biological and physical characteristics and protection and stewardship status of these sites is summarized in Appendix 3.

Plot locations and sampling sites are shown in Figures 2 - 13. At some natural areas the area identified for potential pinyon-juniper woodland sampling extended beyond the designated boundary (indicated by a broken line in Figures 2 - 13).

Pinyon-juniper vegetation observed in this study is classified on the basis of perceived natural potential. Three series are recognized: *Pinus monophylla*, *Juniperus scopulorum*, *Juniperus osteosperma*, and *Cercocarpus ledifolius* on the basis of perceived potential for dominance and relative tolerance of environmental stress. The twenty-three plant associations identified within these series are listed in Table 2.

The *Pinus monophylla*, *Juniperus scopulorum*, *Juniperus osteosperma* and *Cercocarpus ledifolius* series occur on an apparent environmental gradient of moisture availability and temperature. This environmental gradient is reflected in differences in elevation, substrate characteristics and parent materials, and slope aspect and exposure. Tables 3 - 12 provide summaries of physical environmental setting of each plant association. Following is are descriptions of the floristic and environmental relationships of the associations. In this discussion the information in Tables 3 - 12 will be referenced repeatedly, for the sake of brevity, however, the tables will not be continually cited.

Cercocarpus ledifolius Series

Cercocarpus ledifolius occurs over a wide range of environmental conditions within the study area. *Cercocarpus ledifolius*-dominated vegetation was sampled only in association with the occurrence of *Pinus monophylla*, *Juniperus scopulorum*, or *Juniperus osteosperma*. *Cercocarpus ledifolius* is apparently seral to *Pinus monophylla* and *Juniperus scopulorum*. The successional and environmental relationships of *Cercocarpus ledifolius* and *Juniperus osteosperma* are less clear. *Juniperus osteosperma* was not observed reproducing successfully in the understory of *Cercocarpus ledifolius* as were *Pinus monophylla* and *Juniperus scopulorum*.

Data for a limited number of plots which represent late-seral *Cercocarpus ledifolius* woodland were collect at Burton Canyon. These samples are classified as *Cercocarpus ledifolius*/*Symphoricarpos oreophilus*/*Agropyron spicatum*. This plant association is compositionally and environmentally similar to plant associations described here as *Pinus monophylla*-*Cercocarpus ledifolius*/*Holodiscus dumosus*/*Elymus cinereus*, *Juniperus scopulorum*-*Cercocarpus ledifolius*/*Symphoricarpos oreophilus*/*Agropyron spicatum*, and *Juniperus osteosperma*-*Cercocarpus ledifolius*/*Symphoricarpos oreophilus*/*Agropyron spicatum*. Late-seral *Cercocarpus ledifolius*-dominated woodland was also observed in ridgetop positions on north-facing aspects at City of Rocks. Additional work is needed in these *Cercocarpus ledifolius*-dominated plant communities.

Juniperus scopulorum Series

Upland *Juniperus scopulorum*-dominated woodlands occur on the Wapi Flow, within the Snake River Plain; south, on lower-slope positions, in the Goose Creek drainage; and east, with increasing extent, on lower- and upper-slope positions, in the Bannock, Portneuf, and Wasatch ranges and on basalt flows of the Portneuf River valley of southeast Idaho.

Juniperus scopulorum-dominated woodlands were sampled at relatively few sites. The plant associations identified here typically have a relatively narrow distribution among the sites sampled. These data may not represent the ecological variability of *Juniperus scopulorum*-dominated woodlands within the study area. *Juniperus scopulorum* plant communities observed range from dense woodlands of the northern Wasatch Range which posses high understory cover of mountain shrub species and are characterized by the co-dominance of *Cercocarpus ledifolius*; to very open, sparsely vegetated woodlands of the Wapi Flow, on the southern end of the Great Rift system.

Juniperus scopulorum-dominated woodlands occur with a bi-modal elevational distribution. Stands were sampled at both the highest and the lowest elevations. Stands are often associated with bedrock outcrops. Bedrock may serve an ameliorative function, by reducing evaporative soil moisture loss and dampening soil temperature extremes, in an otherwise hot, dry upland rooting environment. Rock structures may also serve to funnel and encatch precipitation run-off.

Juniperus scopulorum-Cercocarpus ledifolius/*Symphoricarpos oreophilus*/*Agropyron spicatum*

Distribution: *Juniperus scopulorum-Cercocarpus ledifolius*/*Symphoricarpos oreophilus*/*Agropyron spicatum* was sampled on several plots located at one site, Burton Canyon, on the northern end of the Wasatch Range. Based on cursory reconnaissance, the association is expected to be extensive in the vicinity and may occur south in the Wasatch Range and east toward the Salt River Range.

Vegetation: This vegetation is an open (extremely xeromorphic) evergreen woodland (Federal Geographic Data Committee [FGDC] 1996). *Juniperus scopulorum* and *Cercocarpus ledifolius* are co-dominant; the later species usually being the more abundant. *Symphoricarpos oreophilus* is present and may be abundant. *Berberis repens* is often well represented. *Acer grandidentatum* and *Amelanchier utahensis* are common, but not consistently present. The herbaceous understory is diverse. *Balsamhoriza sagittata* and *Agropyron spicatum* are well represented to abundant.

Environment: This association was observed on mixed miogeosynclinal substrates. It is often associated with bedrock outcrops, but not consistently. It is located within the upper drainages of low, mountainous terrain, on mid- and lower-slope positions with southwesterly aspects.

Juniperus scopulorum/*Artemisia tridentata vaseyana-Symphoricarpos oreophilus*/*Elymus cinereus*

Distribution: *Juniperus scopulorum*/*Artemisia tridentata vaseyana*-*Symphoricarpos oreophilus*/*Elymus cinereus* was sampled on four plots located at one site, West Fork Mink Creek RNA, within the Bannock Range. The association is expected to occur in similar habitats in the Bannock and Portneuf ranges and may be present east.

Vegetation: The vegetation is (microphyllus) evergreen shrubland. The average cover of trees is < 25 % and less then the average sum of shrub, herb, and grass cover (FGDC 1996). Mid-seral occurrences were sampled; represented by the adventitious establishment of *Juniperus scopulorum* within *Artemisia tridentata vaseyana*, *Amelanchier utahensis* and *Symphoricarpos oreophilus* co-dominated shrubland. *Berberis repens* is often well represented, but not consistently. A rich assemblage of mesic forbs are present, characterized by *Agastache urticifolia* and *Eriogonum heracleoides*. *Elymus cinereus* is well represented to abundant.

Environment: This association was sampled on mixed carbonate substrates. *Juniperus scopulorum*/*Artemisia tridentata vaseyana*-*Symphoricarpos oreophilus*/*Elymus cinereus* occurs on the

upper slopes of low, mountainous terrain, within concave draws in mid- and lower-slope micro-topographical positions, often at the toe of rock outcrop or talus formations.

Juniperus scopulorum/*Artemisia tridentata wyomingensis-Chamaebatiaria millifolium*

Distribution: *Juniperus scopulorum*/*Artemisia tridentata wyomingensis-Chamaebatiaria millifolium* was only observed on the Wapi Flow. All of the data for this plant association were collected in the vicinity of Sand Kipuka RNA, on the southern end of the Wapi Flow. The community was also observed in the vicinity of Big Juniper Kipuka, on the northern end of the Wapi Flow. Similar vegetation may occur on mafic volcanic flow substrates on the Snake River Plain and in the Portneuf Valley.

Vegetation: The vegetation is characterized by an open woodland structure of (typically) large diameter, broad, limby *Juniperus scopulorum*. Shrub understory is patchy and dense in association with multiple medium sized fissures to highly fractured basalt. Shrubs include *Chamaebatiaria millifolium*, *Artemisia tridentata wyomingensis*, *Purshia tridentata*, and *Philadelphus lewisii*. *Poa secunda* is common. Understory regeneration of *Juniperus scopulorum* is usually present in a range of age and size classes.

Environment: *Juniperus scopulorum*/*Artemisia tridentata wyomingensis-Chamaebatiaria millifolium* occurs on mafic volcanic flow substrates. The sites are highly fractured, undulating basalt basins of collapsed lava tubes. The community tends to occur on northeast and easterly aspects, adjacent to (downslope of) *Juniperus scopulorum*/*Holodiscus dumosus* on lava and *Juniperus scopulorum*/*Artemisia tridentata wyomingensis* at the contact of lava and kipuka sand.

Juniperus scopulorum/*Holodiscus dumosus*

Distribution: *Juniperus scopulorum*/*Holodiscus dumosus* was only observed on the Wapi Flow. The community was sampled at both the northern and southern end of the flow. Similar vegetation may occur on mafic volcanic flow substrates on the Snake River Plain.

Vegetation: This is sparse (needle-leaved or microphyllous) evergreen dwarf-shrubland (FGDC 1996) vegetation. *Juniperus scopulorum* density is low and the tree canopy is very open. Many sites sampled on the northern Wapi Flow are early-seral. This vegetation is developing in the vicinity of Pillar Butte, north of Big Juniper Kipuka, through primary succession. Stands in the south are characterized by low growing, wind trained *Juniperus scopulorum*. *Holodiscus dumosus* is typically associated with few, large fissures on these sites. *Haplopappus nanus* is often well represented and occurs with *Penstemon deustus* on multiple fine crevices. Moss and lichen are usually abundant. *Poa secunda* is often growing in thick moss/leaf litter mats which occur in the understory of *Juniperus scopulorum*.

Environment: *Juniperus scopulorum*/*Holodiscus dumosus* occurs on mafic volcanic flow substrates. The sites are of convex micro-topography, dry, and well drained. The plant association is usually located on south and southeast aspects on the crest of lava pressure ridges. Few large tension fissures are present with many to numerous small crevices. *Juniperus scopulorum*/*Haplopappus nanus* and *Juniperus scopulorum*/*Artemisia tridentata wyomingensis-Chamaebatiaria millifolium* are adjacent, respectively, on sites with fewer large fissures and highly fractured basalt.

Juniperus scopulorum/*Haplopappus nanus*

Distribution: *Juniperus scopulorum*/*Haplopappus nanus* was only observed on the Wapi Flow. The community was sampled at both the northern and southern end of the flow. Similar vegetation may occur on mafic volcanic flow substrates on the Snake River Plain.

Vegetation: This is (needle-leaved or microphyllous) evergreen dwarf-shrubland vegetation. The average cover of trees is less then the average sum of shrub, herb, and grass cover (FGDC 1996). *Juniperus scopulorum*/*Haplopappus nanus* is structurally intermediate to *Juniperus scopulorum*/*Holodiscus dumosus*

and *Juniperus scopulorum*/*Artemisia tridentata wyomingensis*-*Chamaebatiaria millifolium*. *Juniperus scopulorum* tree density is low, canopy cover is low. *Haplopappus nanus*, *Leptodactylon pungens* and *Penstemon deustus* are common, though typically not well represented. Mosses and lichens are usually abundant. As described for *Juniperus scopulorum*/*Holodiscus dumosus*, early-seral occurrences of this association are on the northern end of the Wapi Flow; late-seral occurrences, the southern.

Environment: *Juniperus scopulorum*/*Haplopappus nanus* occurs on mafic volcanic flow substrates. The sites are variable in configuration and slope position. This plant association typically occurs on basalt surfaces with multiple medium to fine fissures; rather than with large crevices or highly fractured basalt. These relative flat, smooth bedrock substrates occur on both pressure ridgelines and within basins formed through the collapse of lava tubes. *Juniperus scopulorum*/*Holodiscus dumosus* and *Juniperus scopulorum*/*Artemisia tridentata wyomingensis*-*Chamaebatiaria millifolium* are adjacent communities.

Juniperus scopulorum/*Artemisia tridentata wyomingensis*

Distribution: *Juniperus scopulorum*/*Artemisia tridentata wyomingensis* was sampled within Sand Kipuka on two plots. The association is common on the Wapi Flow where wind-deposited sand has the capability to support *Juniperus scopulorum*. Similar vegetation likely occurs northeast of the Wapi Flow, within the Snake River Plain (The Nature Conservancy et al. 1987).

Vegetation: This is (microphyllus) evergreen shrubland vegetation. The average cover of trees is less then the average sum of shrub, herb, and grass cover (FGDC 1996). Mid-seral occurrences were sampled, represented by the adventitious establishment of *Juniperus scopulorum* within, otherwise, *Artemisia tridentata wyomingensis*-dominated shrubland. *Juniperus scopulorum* density is low, tree canopy cover is low. *Artemisia tridentata wyomingensis* is well represented with *Chrysothamnus viscidiflorus*. *Opuntia polyacantha* is common. *Elymus flavescens* is characteristically well represented.

Environment: This plant association occurs on stabilized, wind-blown sand deposits within mafic volcanic flow formations on basin bottom and toe-slope positions immediately adjacent basalt bedrock.

Pinus monophylla Series

Pinus monophylla is known in Idaho from the Albion, Jim Sage, and Black Pine Mountains. Stands were sampled at four sites within the extent of its range in Idaho. *Pinus monophylla* is co-dominant in this woodland vegetation with *Cercocarpus ledifolius* and *Juniperus osteosperma.* Plant communities range in character from open, savanna-like woodlands with an open grassy understory to dense stands with abundant, continuous shrub cover. *Pinus monophylla* woodlands are located in upslope positions on the spur ridges of moderately high mountainous terrain.

Pinus monophylla-Cercocarpus ledifolius/Holodiscus dumosus/Elymus cinereus

Distribution: *Pinus monophylla-Cercocarpus ledifolius/Holodiscus dumosus/Elymus cinereus* was sampled as City of Rocks RNA, on the southern end of the Albion Range. The association is well represented at this location but has not been observed elsewhere.

Vegetation: This plant association is (rounded crowned temperate or subpolar needle-leaved) evergreen forest (FGDC 1996). *Pinus monophylla* and *Cercocarpus ledifolius* are co-dominant, the later usually being the most abundant. *Juniperus scopulorum* is common, but rarely abundant. The understory is characterized by abundant cover of mountain shrub species (in order of importance): *Holodiscus dumosus*, *Berberis repens*, and *Symphoricarpos oreophilus*. *Artemisia tridentata vaseyana* and *Ribes cereum* are often present, but not abundant. Few understory herbaceous species occur in these forest/woodlands. *Elymus cinereus* is consistently present but only common.

Environment: *Pinus monophylla-Cercocarpus ledifolius/Holodiscus dumosus/Elymus cinereus* is only observed on granitic substrates within the Albion Mountains. The plant association occurs on lower ridge spurs of moderately high elevation mountainous terrain in upper-slope positions on relatively dry, steep, convex north- to east- to south-facing slopes. The soil surface is usually bouldery. Stands sampled show moderate to high woody fuel accumulations.

Pinus monophylla-Cercocarpus ledifolius/Symphoricarpos oreophilus-Berberis repens/Agropyron spicatum

Distribution: *Pinus monophylla-Cercocarpus ledifolius/Symphoricarpos oreophilus-Berberis repens/Agropyron spicatum* was observed in the west-central and southern Albion Mountains. The association is expected to have at least a moderately extensive distribution within the range of *Pinus monophylla*, but this has not been determined.

Vegetation: This is (rounded crowned temperate or subpolar needle-leaved) evergreen forest vegetation (by the standard of FGDC 1996). Early- to mid-seral occurrences were sampled. In these conditions *Cercocarpus ledifolius* is dominant in the overstory. *Pinus monophylla* is often present in the overstory and is consistently present in the understory. The understory shrub structure is similar to that *Pinus monophylla-Cercocarpus ledifolius/Holodiscus dumosus/Elymus cinereus*. Mountain shrub species are consistently well represented to abundant, including: *Berberis repens*, and *Symphoricarpos oreophilus*. *Artemisia tridentata vaseyana* and *Ribes cereum* are often present, but usually with low cover. *Holodiscus dumosus* is usually not present. A good number of herbaceous species may be present. Grass species are well represented. *Agropyron spicatum* and *Leucopoa kingii* are common and relatively consistent.

Environment: The plant association is observed on both carbonate and granitic substrates. Sites are located on lower ridge spurs of moderately high elevation mountainous terrain in mid- and upper-slope positions on relatively dry, steep, convex east- to south- to west-facing slopes. Fuels are characteristically fine herbaceous materials with some dead stemwood. *Pinus monophylla-Cercocarpus ledifolius/Symphoricarpos oreophilus-Berberis repens/Agropyron spicatum* is adjacent to *Pinus monophylla-Cercocarpus ledifolius/Holodiscus dumosus/Elymus cinereus*, on more southwesterly aspects and is often upslope of *Pinus monophylla-Cercocarpus ledifolius/Poa secunda*.

Pinus monophylla-Cercocarpus ledifolius/Poa secunda

Distribution: *Pinus monophylla-Cercocarpus ledifolius/Poa secunda* was observed on eighteen plots located in the west-central and southern Albion Mountains, at Slide Canyon and City of Rocks, respectively. The association is expected to have at least a moderately extensive distribution within the range of *Pinus monophylla*, but this has not been determined.

Vegetation: This vegetation is classified by current FGDC (1996) standards as rounded-crowned temperate or subpolar needle-leaved evergreen woodland. In stands sampled *Pinus monophylla* and *Cercocarpus ledifolius* are co-dominant in often nearly equal proportions. *Symphoricarpos oreophilus* and *Artemisia tridentata vaseyana* are often present and may be well represented. *Poa secunda* is consistently well represented. *Bromus tectorum* is usually abundant.

Environment: The plant association is observed on both carbonate and granitic substrates. Sites are located on lower ridge spurs of moderately high elevation mountainous terrain in mid- and upper-slope positions on relatively dry, moderately sloped, undulating south-facing slopes. The soil surface is rocky. Fuels on sites sampled were fine herbaceous materials with some dead stemwood.

Pinus monophylla-Juniperus osteosperma/Artemisia tridentata vaseyana/Agropyron spicatum

Distribution: *Pinus monophylla-Juniperus osteosperma/Artemisia tridentata vaseyana/Agropyron spicatum* was sampled on nine plots located in the Jim Sage Mountains and in the northwestern and west-central

Albion Mountains, at Jim Sage Canyon, Pine Knob, and Slide Canyon, respectively.

Vegetation: This vegetation is rounded-crowned temperate or subpolar needle-leaved evergreen woodland (using FGDC [1996] standards). *Pinus monophylla* and *Juniperus osteosperma* are co-dominant often with nearly equal cover. Stands are open, with a mix a medium to large sized mature trees and seedling, sapling and pole sized regeneration. *Artemisia tridentata vaseyana* is well represented in the relatively sparse shrub layer. *Agropyron spicatum* is consistently well represented; *Poa secunda* is present.

Environment: *Pinus monophylla-Juniperus osteosperma/Artemisia tridentata vaseyana/Agropyron spicatum* occurs on carbonate, felsic pyroclastic, and sandstone substrates. The plant association is located on lower and upper ridge spurs of mountainous terrain in ridgetop and upper-slope micro-topographical positions. Moderately steep slopes are undulating are north to northwest and east to southeast facing.

Pinus monophylla-Juniperus osteosperma/Agropyron spicatum

Distribution: *Pinus monophylla-Juniperus osteosperma/Agropyron spicatum* was only observed in the Jim Sage Mountains, at Jim Sage Canyon RNA. Data was collected at seven plots.

Vegetation: The vegetation is an (rounded-crowned temperate or subpolar needle-leaved) evergreen woodland (FGDC 1996). *Juniperus osteosperma* is the dominant tree species in the early- to mid-seral occurrences observed. Medium to large sized trees occur with moderately density. *Pinus monophylla* and *Juniperus osteosperma* are present as seedling, sapling, and pole regeneration. *Agropyron spicatum* is abundant in the open, park like woodland.

Environment: *Pinus monophylla-Juniperus osteosperma/Agropyron spicatum* was only observed on felsic pyroclastic substrates. Sites are located on upper ridge spurs in mountainous terrain, on mid- to upper-slope micro-topographical positions. Slopes are primarily south- and southwest-facing, straight and relatively gentle. The soil surface is stony with fine, porous, continuous herbaceous fuels.

Pinus monophylla-Juniperus osteosperma/Artemisia arbuscula nova/Poa secunda

Distribution: *Pinus monophylla-Juniperus osteosperma/Artemisia arbuscula nova/Poa secunda* was observed in the Jim Sage Mountains and the northwestern Albion Mountains, at Jim Sage Canyon RNA and Pine Knob, respectively. Data were collected at nine plots.

Vegetation: The vegetation is classified as rounded-crowned temperate or subpolar needle-leaved evergreen woodland (FGDC 1996). *Pinus monophylla* and *Juniperus osteosperma* are co-dominant. Stands are open and moderately dense. Pole, sapling, and seedling sized *Pinus monophylla* and *Juniperus osteosperma* regeneration occurs in the understory of large and medium size trees. Understory shrub cover is sparse. *Artemisia arbuscula arbuscula* and *Artemisia arbuscula nova* may both be present; the later species is consistently more abundant. Herbaceous cover is typically well represented; herbaceous species composition is not consistent. *Agropyron spicatum* is often present, though not abundant. *Poa secunda* is consistently well represented.

Environment: *Pinus monophylla-Juniperus osteosperma/Artemisia arbuscula nova/Poa secunda* was observed on carbonate and sandstone substrates. Sites are located on lower ridge spurs in mountainous terrain, on mid-slope micro-topographical positions. Dry east-, southeast-, south-, and southwest-facing slopes are straight and moderately gentle. The stony soil surface is with fine, porous, continuous herbaceous fuels.

Juniperus osteosperma Series

Juniperus osteosperma-dominated woodlands occur in the South Hills, east to Malad and Banock ranges and north across the Snake River Plain to the southern end of the Lost River and Lemhi ranges. Stands were sampled at six sites within the southern portion of this distribution. Vegetation within the series ranges from open woodland to dwarf-shrubland and shrubland (almost grassland) with dispersed trees. *Juniperus osteosperma*-dominated woodlands occur on upper-slope and ridgetop positions in mesa and moderate elevation mountainous terrain. Ten plant associations are recognized.

Juniperus osteosperma-Cercocarpus ledifolius/Symphoricarpos oreophilus/Agropyron spicatum

Distribution: *Juniperus osteosperma-Cercocarpus ledifolius/Symphoricarpos oreophilus/Agropyron spicatum* was observed in the north end of the Wasatch Range and in the Bannock Range. This plant association is probably more widely distributed and extensive, though it is represented here by only two plots.

Juniperus osteosperma/Symphoricarpos oreophilus/Agropyron spicatum

Distribution: *Juniperus osteosperma/Symphoricarpos oreophilus/Agropyron spicatum* was observed in the South Hills, Jim Sage Mountains, and Malad Ranger. This association may be present along the southern range of *Juniperus osteosperma* in Idaho.

Vegetation: This vegetation is rounded-crowned temperate or subpolar needle-leaved evergreen woodland (FGDC 1996). An open canopy of medium and large tree *Juniperus osteosperma* typically occurs with moderate shrub cover and abundant grass cover. *Artemisia tridentata vaseyana* and *Symphoricarpos oreophilus* are characteristic shrub species. Numerous herbs are observed on *Juniperus osteosperma/Symphoricarpos oreophilus/Agropyron spicatum* sites; few with great constancy. *Lupinus* spp. and *Opuntia polyacantha* are fairly constant. *Agropyron spicatum* is usually abundant; *Poa secunda* is often present.

Environment: The plant association occurs on carbonate, felsic pyroclastic, and sandstone substrates. *Juniperus osteosperma/Symphoricarpos oreophilus/Agropyron spicatum* sites are on mesa and upper ridge spurs of moderately high mountainous or terrain on mid- to upper-slope micro-topographical positions. Southeast-, south-, and southwest-facing slopes are straight and gentle.

Juniperus osteosperma/Artemisia tridentata wyomingensis/Stipa comata

Distribution: *Juniperus osteosperma/Artemisia tridentata wyomingensis/Stipa comata* was observed only in the Goose Creek drainage, adjacent Goose Creek Mesa RNA. It is expected that the plant association is more widely distributed; additional occurrences were not documented. The existing data essentially document a single stand; additional information is needed to describe the variability of this distinctive vegetation.

Juniperus osteosperma/Artemisia tridentata vaseyana/Festuca idahoensis

Distribution: *Juniperus osteosperma/Artemisia tridentata vaseyana/Festuca idahoensis* was observed in the South Hills at both Trapper Creek and Goose Creek Mesa. It is expected to occur throughout the eastern edge of the South Hills, but with low areal extent.

Vegetation: This is an evergreen microphyllus shrubland. The modal abundance of trees is < 25 % cover and is less then the modal sum of shrub, herb, and grass abundance (FGDC 1996). *Juniperus osteosperma/Artemisia tridentata vaseyana/Festuca idahoensis* stands are open, with an even (and relatively high) density of medium and large sized trees. *Artemisia tridentata vaseyana* is typically well represented. *Purshia tridentata* is often present. Herbs are usually well represented; important species include *Balsamorhiza sagittata*, *Phlox hoodii*, and *Opuntia polyacantha*. *Agropyron spicatum* is often well represented. *Festuca idahoensis* is usually abundant.

Environment: The plant association was observed felsic pyroclastic and sandstone substrates. Sites are located on mesa tops and upper ridge spurs of moderately high mountainous terrain, in ridgetop and upper-slope micro-topographical positions. Northeast-facing slopes are straight and gentle.

Juniperus osteosperma/Artemisia tridentata vaseyana/Agropyron spicatum

Distribution: *Juniperus osteosperma/Artemisia tridentata vaseyana/Agropyron spicatum* was observed in the southern South Hills, Malad Range, and Bannock Range. This plant association probably occurs at additional site within these geographical extremes.

Vegetation: This is a rounded-crowned temperate or subpolar needle-leaved evergreen woodland (FGDC 1996). Medium- and few large-sized *Juniperus osteosperma* contribute to a tree canopy of 20 - 50 % closure. Pole-, sapling-, and seedling-sized *Juniperus osteosperma* regeneration is moderately dense. *Artemisia tridentata vaseyana* is well represented; often with *Purshia tridentata*. Numerous herbs occur in these woodlands. *Balsamorhiza sagittata* is most constant, and often is abundant. *Agropyron spicatum* is well represented to abundant.

Environment: The plant association occurs on carbonate, felsic pyroclastic, and sandstone substrates. Sites are located on upper ridge spurs of moderately high mountainous terrain, in (ridgetop) upper- to lower-slope micro-topographical positions. Dry south- and west-facing slopes are moderately steep.

Juniperus osteosperma/Artemisia tridentata vaseyana/Oryzopsis hymenoides

Distribution: *Juniperus osteosperma/Artemisia tridentata vaseyana/Oryzopsis hymenoides* was only observed at Goose Creek Mesa. The plant association is expected to occur in similar habitats within the South Hills.

Vegetation: This is a rounded-crowned temperate or subpolar needle-leaved evergreen woodland. *Juniperus osteosperma* tree canopy cover ranges from 20 - 40 %. Very large-, large-, and medium-sized trees contribute to a moderate stem density of 10 trees per acre. Relatively little pole- and seedling-sized regeneration is present. *Artemisia tridentata vaseyana* and *Purshia tridentata* are common. Relatively few herbaceous species are observed; *Leptodactylon pungens* and *Senecio multilobatus* are common and constant. *Agropyron spicatum*, *Poa secunda*, and *Oryzopsis hymenoides* are common and characteristic species. *Agropyron spicatum* is most abundant.

Environment: The plant association was observed on felsic pyroclastic and sandstone substrates. These sites are located in upper- and middle-slope micro-topographical positions within mesa terrain. Dry, southwest- and west-facing slopes are straight and steep. *Juniperus osteosperma/Artemisia tridentata vaseyana/Oryzopsis hymenoides* occurs on raveling colluvium; cobbles, stones, and gravel are abundant on the soil surface.

Juniperus osteosperma/Artemisia arbuscula arbuscula/Festuca idahoensis

Distribution: *Juniperus osteosperma/Artemisia arbuscula arbuscula/Festuca idahoensis* was sampled at Goose Creek Mesa and Trapper Creek. This plant association is expected to occur throughout the South Hills.

Vegetation: This vegetation is needle-leaved or microphyllus evergreen dwarf-shrubland with needle-leaved evergreen trees (FGDC 1996). *Juniperus osteosperma/Artemisia arbuscula arbuscula/Festuca idahoensis* is open woodland/dwarf-shrubland. Tree, low shrub, and grass components often occur in equal proportions. Observed very large-, large-, and medium-sized tree density was low to moderate (12 trees per acre [tpa]) relative to other *Juniperus osteosperma* associations. Understory regeneration was relatively low, with an average of 2 tpa pole-, sapling-, and seedling-sized *Juniperus osteosperma*. *Artemisia arbuscula arbuscula* is well represented and often abundant in the understory with *Purshi*

tridentata, and *Artemisia arbuscula nova*. Numerous herbaceous species are observed; few are very constant. *Eriogonum caespitosum* and *Opuntia polyacantha* are important herbs. *Festuca idahoensis*, *Poa secunda*, and *Agropyron spicatum* are important grass species. *Festuca idahoensis* is usually well represented to abundant.

Environment: The plant association was observed primarily on felsic pyroclastic substrate, but also on sandstone. Sites are located on basalt mesa tops, in ridgetop and upper-slope positions. Dry, well drained north- and southeast-facing slopes are straight, and gentle (or flat). The soil surface is gravelly.

Juniperus osteosperma/Artemisia arbuscula arbuscula/Agropyron spicatum

Distribution: *Juniperus osteosperma/Artemisia arbuscula arbuscula/Agropyron spicatum* was observed in the South Hills, Jim Sage Mountains, and Bannock Range. The association may also occur in the Cotterel Mountains, Sublett Range, and Deep Creek Mountains.

Vegetation: This is rounded-crowned temperate or subpolar needle-leaved evergreen woodland vegetation. Observed very large-, large-, and medium-sized tree density was low (9 tpa) relative to other *Juniperus osteosperma* associations. Understory regeneration is moderately high, with an average of 7 tpa pole-, sapling-, and seedling-sized *Juniperus osteosperma*. The understory is occupy by abundant low shrubs, herbs, and grasses. *Artemisia arbuscula arbuscula* is consistently well represented to abundant. *Symphoricarpos oreophilus* is usually presented but not well represented. *Balsamorhiza sagittata* is consistently present and usually well represented. *Opuntia polyacantha* is also an important herb. *Agropyron spicatum* and *Poa secunda* are both consistently present; the former being most abundant and well represented to abundant.

Environment: The association was observed felsic pyroclastic, mixed carbonate, and (primarily) sandstone substrates. Sites are located on mesa tops and upper ridge spurs of moderately high mountainous terrain, most frequently in upper-slope micro-topographical positions. Dry, southeast-, south-, and southwest-facing slopes are horizontally convex, vertically straight, and moderately gentle. *Juniperus osteosperma/Artemisia arbuscula arbuscula/Agropyron spicatum* often occurs in association with fragmented bedrock. Large rock fragments (boulders, cobbles, and stones) occupy between 15 and 45 % cover.

Juniperus osteosperma/Artemisia arbuscula nova/Agropyron spicatum

Distribution: *Juniperus osteosperma/Artemisia arbuscula nova/Agropyron spicatum* was observed at in the Jim Sage Mountains and Bannock Range. This plant association is probably repeated in similar ridgetop habitats in the Cotterel Mountains, Sublett Range, and Deep Creek Mountains; but not with large, extensive occurrences.

Vegetation: This vegetation is needle-leaved or microphyllus evergreen dwarf-shrubland with needle-leaved evergreen trees (FGDC 1996). *Juniperus osteosperma* large- and medium-sized trees occur with moderate density (15 tpa). Understory regeneration is relatively abundant compared to other *Juniperus osteosperma* associations with 15 tree per acre. The tree canopy is very open, low shrubs, and grasses are abundant in the understory. *Artemisia arbuscula nova* and *Artemisia arbuscula arbuscula* are both present; the former dominant and well represented to abundant. *Phlox hoodii* is a common and characteristic herb. *Agropyron spicatum* and *Poa secunda* are both consistently present. *Agropyron spicatum* is well represented to abundant.

Environment: The association was sampled primarily on felsic pyroclastic substrate, but also occurs on sandstone. Sites are located on upper ridge spurs of moderately high mountainous terrain, most frequently in upper-slope micro-topographical positions. Gentle, dry, well drained, south- and west-facing slopes are horizontally convex and vertically straight. Cobbles and stones are well represented to abundant.

Juniperus osteosperma/Artemisia arbuscula nova/Poa secunda

Distribution: *Juniperus osteosperma/Artemisia arbuscula nova/Poa secunda* was observed in the South Hills. The extend of the association within the area and adjacent areas is not known.

Vegetation: This vegetation is needle-leaved or microphyllus evergreen dwarf-shrubland with needle-leaved evergreen trees (FGDC 1996). *Juniperus osteosperma* canopy cover ranges from 1 - 25 %. Dwarf-shrub species are the dominant life form. *Artemisia arbuscula nova* is usually abundant; *Artemisia arbuscula arbuscula* is often present. *Eriogonum microthecum*, *Eriogonum caespitosum*, and *Balsamorhiza hookeri* are common and characteristic herbs. *Poa secunda* is consistently well represented.

Environment: *Juniperus osteosperma/Artemisia arbuscula nova/Poa secunda* was only observed on felsic pyroclastic substrates. Sites are located on mesa tops, most frequently in ridgetop micro-topographical positions. Gentle slopes occur with a range of aspects and micro-configurations. These sites are very rocky. Large- to medium-sized rock fragments (cobbles, stones, and gravel) may occupy 45 - 70 % of the surface.

Literature Cited

Baker, W. L. 1984a. A preliminary classification of the natural vegetation of Colorado. The Great Basin Naturalist 44(4):647-676.

Blackburn, W. H., P. T. Tueller and R. E. Eckert Jr. 1969. Vegetation and soils of the Churchill Canyon Watershed. Nevada Agricultural Experiment Station Bulletin R-45. Reno. 157 pp.

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

Federal Geographic Data Committee-Vegetation Subcommittee. 1996. Vegetation Classification and Information Standards. USDI, Geological Survey, Reston.

Grossman, D. H., K. L. Goodin, and C. L. Reuss, editors. 1994. Rare plant communities of the coterminous United States - an initial survey. Prepared for the USDI Fish and Wildlife Service. The Nature Conservancy, Arlington, VA. 620 p.

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

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

Rust, S. K. 1996b. Natural plant communities of Idaho, a working list for the conservation of biological diversity. Idaho Conservation Data Center, Idaho Department of Fish and Game, Boise. 14 pp.

Smith, B. G. 1993. ECOAID, a users guide. Unpublished software and guide. USDA Forest Service, Pacific Northwest Region, Portland.

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

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

USDI Bureau of Land Management. 1992. Rare plants and natural plant communities: a strategy for the future. USDI Bureau of Land Management. Washington, D. C. 60 pp.

Classification of Pinyon-Juniper Woodland Communities
in Research Natural Areas of Southeastern Idaho

Abbreviation	*Scientific Name*	Common Name
	***Cercocarpus ledifolius* Series**	
CELE/SYOR/BASA/AGSP	*Cercocarpus ledifolius/Balsamorhiza sagittata/Agropyron spicatum*	curlleaf mountain mahogany/arrowleaf balsamroot/bluebunch wheatgrass
	***Juniperus osteosperma* Series**	
JUOS-CELE/SYOR/AGSP	*Juniperus osteosperma-Cercocarpus ledifolius/Symphoricarpos oreophilus/Agropyron spicatum*	Utah juniper-curlleaf mountain mahogany/mountain snowberry/bluebunch wheatgrass
JUOS/SYOR/AGSP	*Juniperus osteosperma/Symphoricarpos oreophilus/Agropyron spicatum*	Utah juniper/mountain snowberry/bluebunch wheatgrass
JUOS/ARTRW/STCO	*Juniperus osteosperma/Artemisia tridentata wyomingensis/Stipa comata*	Utah juniper/Wyoming big sagebrush/needle-and-thread
JUOS/ARTRV/FEID	*Juniperus osteosperma/Artemisia tridentata vaseyana/Festuca idahoensis*	Utah juniper/mountain big sagebrush/Idaho fescue
JUOS/ARTRV/AGSP	*Juniperus osteosperma/Artemisia tridentata vaseyana/Agropyron spicatum*	Utah juniper/mountain big sagebrush/bluebunch wheatgrass
JUOS/ARTRV/ORHY	*Juniperus osteosperma/Artemisia tridentata vaseyana/Oryzopsis hymenoides*	Utah juniper/mountain big sagebrush/indian ricegrass
JUOS/ARAR/FEID	*Juniperus osteosperma/Artemisia arbuscula arbuscula/Festuca idahoensis*	Utah juniper/low sagebrush/Idaho fescue
JUOS/ARAR/AGSP	*Juniperus osteosperma/Artemisia arbuscula arbuscula/Agropyron spicatum*	Utah juniper/low sagebrush/bluebunch wheatgrass
JUOS/ARNO/AGSP	*Juniperus osteosperma/Artemisia arbuscula nova/Agropyron spicatum*	Utah juniper/black sagebrush/bluebunch wheatgrass
JUOS/ARNO/POSE	*Juniperus osteosperma/Artemisia arbuscula nova/Poa secunda*	Utah juniper/black sagebrush/Sandberg bluegrass
	***Juniperus scopulorum* Series**	
JUSC-CELE/SYOR/AGSP	*Juniperus scopulorum-Cercocarpus ledifolius/Symphoricarpos oreophilus/Agropyron spicatum*	Rocky Mountain juniper-curlleaf mountain mahogany/mountain snowberry/bluebunch wheatgrass
JUSC/ARTRV-SYOR/ELCI	*Juniperus scopulorum/Artemisia tridentata vaseyana-Symphoricarpos oreophilus/Agropyron spicatum*	Rocky Mountain juniper/mountain big sagebrush-mountain snowberry/bluebunch wheatgrass
JUSC/ARTRW-CHMI	*Juniperus scopulorum/Artemisia tridentata wyomingensis-Chamaebatiaria millifolium*	Rocky Mountain juniper/Wyoming big sagebrush/desertsweet
JUSC/ARTRW	*Juniperus scopulorum/Artemisia tridentata wyomingensis*	Rocky Mountain juniper/Wyoming big sagebrush
JUSC/HODU	*Juniperus scopulorum/Holodiscus dumosus*	Rocky Mountain juniper/bush oceanspray

Abbreviation	*Scientific Name*	Common Name
JUSC/HANA	*Juniperus scopulorum/Haplopappus nanus*	Rocky Mountain juniper/dwarf goldenweed

Pinus monophylla Series

PIMO-CELE/HODU/ELCI	*Pinus monophylla-Cercocarpus ledifolius/Holodiscus dumosus/Elymus cinereus*	singleleaf pinyon pine-curlleaf mountain mahogany/bush oceanspray/Great Basin wildrye
PIMO-CELE/SYOR-BERE/AGSP	*Pinus monophylla-Cercocarpus ledifolius/Symphoricarpos oreophilus-Berberis repens/Agropyron spicatum*	singleleaf pinyon pine-curlleaf mountain mahogany/mountain snowberry-Oregongrape/bluebunch wheatgrass
PIMO-CELE/POSE	*Pinus monophylla-Cercocarpus ledifolius/Poa secunda*	singleleaf pinyon pine-curlleaf mountain mahogany/Sandberg bluegrass
PIMO-JUOS/ARTRV/AGSP	*Pinus monophylla-Juniperus osteosperma/Artemisia tridentata vaseyana/Agropyron spicatum*	singleleaf pinyon pine-Utah juniper/mountain big sagebrush/bluebunch wheatgrass
PIMO-JUOS/AGSP	*Pinus monophylla-Juniperus osteosperma/Agropyron spicatum*	singleleaf pinyon pine-Utah juniper/bluebunch wheatgrass
PIMO-JUOS/ARNO/POSE	*Pinus monophylla-Juniperus osteosperma/Artemisia arbuscula nova/Poa secunda*	singleleaf pinyon pine-Utah juniper/black sagebrush/Sandberg bluegrass

KEY TO PINYON-JUNIPER VEGETATION
of Southeast Idaho

Pinus monophylla is common (> 1 % cover) and reproducing successfully (*Pinus monophylla* Series).

Cercocarpus ledifolius is more abundant than *Juniperus osteosperma*, or *Juniperus scopulorum* is present.

Holodiscus dumosus is > 2 % cover. . . . . — *Pinus monophylla-Cercocarpus ledifolius*/*Holodiscus dumosus*/*Elymus cinereus*

Holodiscus dumosus and *Berberis repens* occur with a combined cover > 5 %, or *Symphoricarpos oreophilus* is abundant (> 25 % cover). . . . . — *Pinus monophylla*/*Symphoricarpos oreophilus-Berberis repens*/*Agropyron spicatum*

Poa secunda is common. . . . . — *Pinus monophylla-Cercocarpus ledifolius*/*Poa secunda*

Juniperus osteosperma is more abundant than *Cercocarpus ledifolius* and well represented (often abundant).

Artemisia tridentata vaseyana is common (if only present, *Holodiscus dumosus* is common); *Agropyron spicatum* is common but not abundant (not > 25 % cover). . . . . — *Pinus monophylla-Juniperus osteosperma*/*Artemisia tridentata vaseyana*/*Agropyron spicatum*

Agropyron spicatum is abundant (> 25 % cover). . . . — *Pinus monophylla-Juniperus osteosperma*/*Agropyron spicatum*

Poa secunda is well represented. . . . . — *Pinus monophylla-Juniperus osteosperma*/*Artemisia arbuscula nova*/*Poa secunda*

Juniperus scopulorum is common and reproducing successfully (*Juniperus scopulorum* Series).

Cercocarpus ledifolius is well represented (often abundant). — *Juniperus scopulorum-Cercocarpus ledifolius*/*Symphoricarpos oreophilus*/*Agropyron spicatum*

Artemisia tridentata vaseyana and Symphoricarpos oreophilus are common, *Elymus cinereus* is well represented. . . . . — *Juniperus scopulorum*/*Artemisia tridentata vaseyana-Symphoricarpos oreophilus*/*Elymus cinereus*

Chamaebatiaria millifolium and *Artemisia tridentata wyomingensis* are common (*Philadelphus lewisii* may replace *Chamaebatiaria millifolium*). . . . . — *Juniperus scopulorum*/*Artemisia tridentata wyomingensis-Chamaebatiaria*

millifolium

Holodiscus dumosus is common. . . . . *Juniperus scopulorum*/*Holodiscus dumosus*

Haplopappus nanus is common. . . . . *Juniperus scopulorum*/*Haplopappus nanus*

Artemisia tridentata wyomingensis is common. . . . . *Juniperus scopulorum*/*Artemisia tridentata wyomingensis*

Juniperus osteosperma is common and reproducing successfully (*Juniperus osteosperma* Series).

Cercocarpus ledifolius is well represented (often abundant). *Juniperus osteosperma-Cercocarpus ledifolius*/*Symphoricarpos oreophilus*/*Agropyron spicatum*

Artemisia tridentata wyomingensis is the most abundant sagebrush species; *Stipa comata* is abundant. . . . . *Juniperus osteosperma*/*Artemisia tridentata wyomingensis*/*Stipa comata*

Artemisia tridentata vaseyana is the most abundant sagebrush species.

Festuca idahoensis is well represented. . . . . *Juniperus osteosperma*/*Artemisia tridentata vaseyana*/*Festuca idahoensis*

Symphoricarpos oreophilus is common; *Purshia tridentata*, if present, is usually scarce (< 1 % cover); *Agropyron spicatum* is well represented. . . . . *Juniperus osteosperma*/*Symphoricarpos oreophilus*/*Agropyron spicatum*

Artemisia tridentata vaseyana is well represented; *Agropyron spicatum* is well represented; *Oryzopsis hymenoides* is absent. . . . . *Juniperus osteosperma*/*Artemisia tridentata vaseyana*/*Agropyron spicatum*

Artemisia tridentata vaseyana is common; *Oryzopsis hymenoides* is common. . . . . *Juniperus osteosperma*/*Artemisia tridentata vaseyana*/*Oryzopsis hymenoides*

Artemisia arbuscula arbuscula is common (often abundant) and more abundant than *Artemisia arbuscula nova*.

Festuca idahoensis is well represented (usually abundant). . . . . *Juniperus osteosperma*/*Artemisia arbuscula arbuscula*/*Festuca idahoensis*

Agropyron spicatum is well represented (usually abundant). . . . . *Juniperus osteosperma*/*Artemisia arbuscula arbuscula*/*Agropyron spicatum*

Artemisia arbuscula nova is common (often abundant) and more abundant than *Artemisia arbuscula arbuscula*.

Agropyron spicatum is well represented (usually abundant). . . . . *Juniperus osteosperma*/*Artemisia arbuscula nova*/*Agropyron spicatum*

Poa secunda is well represented. . . . . *Juniperus osteosperma*/*Artemisia arbuscula nova*/*Poa secunda*

Cercocarpus ledifolius is common and reproducing successfully (*Cercocarpus ledifolius* Series).

Symphoricarpos oreophilus is common (often abundant). . *Cercocarpus ledifolius*/*Symphoricarpos oreophilus*/*Agropyron spicatum*

SYNTHESIS TABLES

1. *Juniperus scopulorum* Series

2. *Pinus monophylla* Series

3. *Juniperus osteosperma* Series

Juniperus scopulorum Series

	JUSC-CELE/SYOR/AGSP		JUSC/ARTRV-SYOR/ELCI		JUSC/ARTRW	
	7 Plots		4 Plots		2 Plots	
Species	CON	CHAR	CON	CHAR	CON	CHAR
Trees						
Acer grandidentatum	57.1	3.0	.	.	.	.
Cercocarpus ledifolius	100.0	34.2	.	.	.	.
Juniperus osteosperma	28.6	7.5	25.0	5.0	.	.
Juniperus scopulorum	100.0	9.6	100.0	10.0	100.0	11.5
Pseudotsuga menziesii	14.3	0.1	25.0	15.0	.	.
Shrubs						
Amelanchier utahensis	71.4	1.2	100.0	3.3	.	.
Artemisia tridentata vaseyana	.	.	100.0	5.8	.	.
Artemisia tridentata wyomingensis	.	.	.	.	100.0	14.0
Berberis repens	85.7	4.3	75.0	10.3	.	.
Ceanothus velutinus	.	.	25.0	5.0	.	.
Chrysothamnus nauseosus	.	.	.	.	100.0	1.5
Chrysothamnus viscidiflorus	.	.	.	.	100.0	15.0
Haplopappus suffruticosus	28.6	0.1	25.0	0.1	.	.
Holodiscus dumosus	.	.	.	.	.	.
Pachistima myrsinites	.	.	25.0	2.0	.	.
Philadelphus lewisii	.	.	.	.	.	.
Prunus virginiana	.	.	75.0	5.0	.	.
Purshia tridentata	14.3	1.0	75.0	6.3	50.0	1.0
Ribes aureum	.	.	.	.	.	.
Rosa nutkana	.	.	25.0	0.1	.	.
Sambucus cerulea	.	.	25.0	2.0	.	.
Sorbus scopulina	.	.	25.0	0.1	.	.
Symphoricarpos oreophilus	100.0	6.1	100.0	8.8	.	.
Herbs						
Achillea millefolium	14.3	0.1	25.0	0.1	.	.
Agastache urticifolia	.	.	100.0	1.3	.	.
Agoseris glauca	28.6	0.1	25.0	0.1	50.0	1.0
Allium acuminatum	.	.	25.0	0.1	100.0	1.0
Arabis holboellii	.	.	.	.	.	.
Aster ascendens	28.6	0.6	.	.	.	.
Aster engelmannii	.	.	50.0	0.1	.	.
Aster scopulorum	28.6	0.1	.	.	.	.
Balsamorhiza sagittata	100.0	12.9	75.0	5.0	50.0	4.0
Castilleja hispida	.	.	25.0	0.1	.	.
Castilleja spp.	.	.	.	.	.	.
Chaenactis douglasii	14.3	0.1	.	.	.	.
Chrysopsis villosa hispida	.	.	.	.	.	.
Cirsium canovirens	57.1	0.1	.	.	.	.
Cirsium spp.	.	.	.	.	.	.
Collinsia parviflora	.	.	25.0	0.1	.	.
Collomia grandiflora	.	.	25.0	0.1	.	.
Comandra umbellata pallida	57.1	1.1	50.0	1.1	.	.
Crepis acuminata	71.4	0.3	75.0	0.1	50.0	1.0
Cryptantha spiculifera	.	.	.	.	.	.
Cystopteris fragilis	.	.	.	.	.	.
Descurainia pinnata	.	.	.	.	.	.
Descurainia richardsonii	.	.	.	.	.	.
Draba spp.	.	.	.	.	.	.
Epilobium paniculatum	.	.	25.0	0.1	.	.
Erigeron pumilus	.	.	.	.	.	.
Eriogonum caespitosum	.	.	.	.	.	.
Eriogonum heracleoides	.	.	100.0	1.0	.	.
Eriogonum microthecum	14.3	5.0	.	.	.	.

Eriogonum ovalifolium	.	.	.	.	.	.
Eriogonum umbellatum	71.4	0.8	.	.	.	.
Galium triflorum	.	.	25.0	0.1	.	.
Gutierrezia sarothrae	14.3	1.0	.	.	.	.
Hackelia micrantha	42.9	0.1	50.0	0.6	.	.
Helianthella uniflora	28.6	3.0	50.0	4.5	.	.
Lactuca spp.	.	.	.	.	50.0	0.1
Lepidium spp.	14.3	1.0	.	.	.	.
Lepidium virginicum	.	.	.	.	.	.
Leptodactylon pungens	.	.	.	.	.	.
Linum perenne	28.6	1.0	.	.	.	.
Lithospermum ruderale	28.6	0.1	.	.	50.0	2.0
Lomatium dissectum	14.3	0.1	75.0	0.1	100.0	3.0
Lomatium grayi	57.1	1.0	.	.	.	.
Lupinus caudatus	.	.	.	.	50.0	2.0
Machaeranthera canescens	85.7	0.1	.	.	.	.
Mertensia longiflora	.	.	25.0	0.1	.	.
Opuntia polyacantha	.	.	.	.	100.0	1.5
Penstemon cyaneus	.	.	.	.	50.0	0.1
Penstemon deustus	.	.	75.0	0.5	50.0	7.0
Penstemon humilis	85.7	1.7	.	.	.	.
Penstemon spp.	.	.	25.0	0.1	.	.
Petradoria pumila	42.9	5.7	.	.	.	.
Petrophytum caespitosum	14.3	1.0	.	.	.	.
Phacelia hastata	14.3	0.1	.	.	.	.
Phacelia heterophylla	.	.	50.0	0.6	.	.
Phlox hoodii	.	.	.	.	.	.
Polygonum douglasii	.	.	25.0	0.1	.	.
Potentilla glandulosa	.	.	.	.	.	.
Potentilla gracilis	.	.	.	.	.	.
Psoralea lanceolata	.	.	.	.	100.0	8.0
Senecio canus	.	.	.	.	.	.
Senecio integerrimus	71.4	0.1	25.0	0.1	.	.
Senecio multilobatus	14.3	0.1	.	.	.	.
Senecio streptanthifolius	14.3	0.1	25.0	0.1	.	.
Sisymbrium altissimum	.	.	.	.	50.0	1.0
Solidago velutina	.	.	25.0	0.1	.	.
Stephanomeria tenuifolia	.	.	.	.	.	.
Tragopogon dubius	85.7	0.1	50.0	0.1	100.0	0.1
Grasses and Sedges						
Agropyron spicatum	100.0	18.6	75.0	1.0	50.0	17.0
Aristida purpurea	.	.	.	.	.	.
Bromus carinatus	.	.	25.0	0.1	.	.
Bromus japonicus	14.3	1.0	50.0	3.5	.	.
Bromus tectorum	57.1	1.3	75.0	1.7	100.0	40.0
Carex rossii	57.1	1.0	.	.	.	.
Danthonia unispicata	.	.	.	.	.	.
Elymus cinereus	14.3	0.5	100.0	30.0	.	.
Elymus flavescens	.	.	.	.	100.0	11.5
Elymus glaucus	.	.	50.0	0.6	.	.
Festuca spp.	.	.	.	.	.	.
Melica bulbosa	.	.	25.0	0.1	.	.
Oryzopsis hymenoides	42.9	5.4	.	.	50.0	0.1
Poa cusickii	14.3	0.1	25.0	0.1	.	.
Poa pratensis	.	.	50.0	0.6	.	.
Poa secunda	71.4	1.4	25.0	0.1	50.0	0.1
Sitanion hystrix	.	.	.	.	.	.
Stipa comata	14.3	0.1	.	.	50.0	2.0
Stipa occidentalis	.	.	50.0	0.1	.	.
Stipa thurberiana	.	.	.	.	.	.
Ferns						
Woodsia oregana	.	.	50.0	0.6	.	.

Species	JUSC/ARTRW-CHMI 6 Plots CON	CHAR	JUSC/HANA 15 Plots CON	CHAR	JUSC/HODU 7 Plots CON	CHAR
Trees						
Acer grandidentatum	.	.	.	.	.	.
Cercocarpus ledifolius	.	.	.	.	.	.
Juniperus osteosperma	.	.	.	.	.	.
Juniperus scopulorum	100.0	23.9	86.7	13.3	57.1	2.6
Pseudotsuga menziesii	.	.	.	.	.	.
Shrubs						
Amelanchier utahensis	.	.	6.7	0.5	14.3	0.2
Artemisia tridentata vaseyana	.	.	.	.	.	.
Artemisia tridentata wyomingensis	100.0	5.8	40.0	5.0	.	.
Berberis repens	.	.	.	.	.	.
Ceanothus velutinus	.	.	.	.	.	.
Chrysothamnus nauseosus	83.3	1.2	73.3	1.4	57.1	0.2
Chrysothamnus viscidiflorus	33.3	2.5	.	.	.	.
Haplopappus suffruticosus	.	.	.	.	.	.
Holodiscus dumosus	33.3	1.0	46.7	0.6	100.0	2.4
Pachistima myrsinites	.	.	.	.	.	.
Philadelphus lewisii	50.0	1.3	26.7	3.8	28.6	2.0
Prunus virginiana	.	.	.	.	.	.
Purshia tridentata	66.7	0.8	73.3	4.5	57.1	0.8
Ribes aureum	16.7	1.0	26.7	1.8	.	.
Rosa nutkana	.	.	.	.	.	.
Sambucus cerulea	.	.	.	.	.	.
Sorbus scopulina	.	.	.	.	.	.
Symphoricarpos oreophilus	.	.	.	.	.	.
Herbs						
Achillea millefolium	.	.	.	.	.	.
Agastache urticifolia	.	.	.	.	.	.
Agoseris glauca	.	.	.	.	.	.
Allium acuminatum	.	.	.	.	.	.
Arabis holboellii	.	.	6.7	1.0	.	.
Aster ascendens	.	.	.	.	.	.
Aster engelmannii	.	.	.	.	.	.
Aster scopulorum	.	.	.	.	.	.
Balsamorhiza sagittata	.	.	.	.	.	.
Castilleja hispida	.	.	.	.	.	.
Castilleja spp.	.	.	.	.	28.6	0.1
Chaenactis douglasii	83.3	0.8	26.7	0.1	85.7	0.3
Chrysopsis villosa hispida	.	.	40.0	2.1	71.4	1.3
Cirsium canovirens	16.7	0.1	60.0	0.5	28.6	0.5
Cirsium spp.	16.7	1.0	.	.	.	.
Collinsia parviflora	.	.	.	.	.	.
Collomia grandiflora	.	.	.	.	.	.
Comandra umbellata pallida	.	.	.	.	.	.
Crepis acuminata	.	.	6.7	0.1	.	.
Cryptantha spiculifera	.	.	46.7	0.2	71.4	0.4
Cystopteris fragilis	.	.	6.7	0.1	.	.
Descurainia pinnata	33.3	1.5	26.7	0.1	.	.
Descurainia richardsonii	16.7	0.1	.	.	.	.
Draba spp.	16.7	0.1	.	.	.	.
Epilobium paniculatum	.	.	26.7	0.1	28.6	0.1
Erigeron pumilus	.	.	13.3	0.1	71.4	0.1
Eriogonum caespitosum	.	.	33.3	0.2	71.4	1.0
Eriogonum heracleoides	.	.	.	.	.	.
Eriogonum microthecum	.	.	46.7	0.5	100.0	0.8
Eriogonum ovalifolium	.	.	.	.	28.6	0.1
Eriogonum umbellatum	.	.	.	.	.	.
Galium triflorum	.	.	.	.	.	.
Gutierrezia sarothrae	.	.	20.0	0.7	14.3	1.0
Hackelia micrantha	.	.	.	.	.	.
Helianthella uniflora	.	.	.	.	.	.
Lactuca spp.	66.7	1.3	26.7	0.1	28.6	0.1
Lepidium spp.	.	.	6.7	0.1	.	.
Lepidium virginicum	16.7	0.1	13.3	0.1	.	.
Leptodactylon pungens	83.3	1.2	80.0	1.8	85.7	1.4
Linum perenne	.	.	.	.	.	.
Lithospermum ruderale	.	.	.	.	.	.
Lomatium dissectum	16.7	0.1	.	.	.	.

Lomatium grayi	.	.	.	.	.	.
Lupinus caudatus	.	.	.	.	.	.
Machaeranthera canescens	.	.	.	.	.	.
Mertensia longiflora	.	.	.	.	.	.
Opuntia polyacantha	33.3	0.2	40.0	1.2	.	.
Penstemon cyaneus	.	.	.	.	.	.
Penstemon deustus	83.3	2.4	93.3	2.3	100.0	2.2
Penstemon humilis	.	.	.	.	.	.
Penstemon spp.	.	.	.	.	.	.
Petradoria pumila	.	.	.	.	.	.
Petrophytum caespitosum	.	.	.	.	.	.
Phacelia hastata	.	.	26.7	0.2	.	.
Phacelia heterophylla	.	.	.	.	.	.
Phlox hoodii	.	.	6.7	0.1	.	.
Polygonum douglasii	.	.	.	.	.	.
Potentilla glandulosa	16.7	0.1	86.7	0.5	71.4	0.8
Potentilla gracilis	.	.	.	.	14.3	0.5
Psoralea lanceolata	.	.	.	.	.	.
Senecio canus	.	.	46.7	2.0	57.1	0.8
Senecio integerrimus	.	.	.	.	.	.
Senecio multilobatus	.	.	.	.	.	.
Senecio streptanthifolius	.	.	.	.	.	.
Sisymbrium altissimum	16.7	3.0	.	.	.	.
Solidago velutina	.	.	.	.	.	.
Stephanomeria tenuifolia	83.3	1.0	86.7	0.7	71.4	0.3
Tragopogon dubius	.	.	46.7	0.1	14.3	0.1
Grasses and Sedges						
Agropyron spicatum	16.7	1.0	13.3	1.5	14.3	0.1
Aristida purpurea	.	.	26.7	2.0	42.9	1.3
Bromus carinatus	.	.	.	.	.	.
Bromus japonicus	.	.	.	.	.	.
Bromus tectorum	100.0	1.8	66.7	3.6	42.9	1.7
Carex rossii	.	.	.	.	.	.
Danthonia unispicata	.	.	6.7	0.1	14.3	0.1
Elymus cinereus	16.7	0.1	.	.	.	.
Elymus flavescens	.	.	.	.	.	.
Elymus glaucus	.	.	.	.	.	.
Festuca spp.	.	.	13.3	0.1	.	.
Melica bulbosa	.	.	.	.	.	.
Oryzopsis hymenoides	16.7	2.0	26.7	2.5	71.4	1.3
Poa cusickii	.	.	.	.	.	.
Poa pratensis	.	.	.	.	.	.
Poa secunda	100.0	3.9	86.7	4.1	100.0	3.2
Sitanion hystrix	33.3	0.1	33.3	0.5	100.0	0.6
Stipa comata	16.7	0.1	6.7	1.0	14.3	1.0
Stipa occidentalis	.	.	.	.	.	.
Stipa thurberiana	16.7	1.0	60.0	0.6	57.1	0.6
Ferns						
Woodsia oregana	.	.	.	.	.	.

	PIMO-CELE/HODU/ELCI		PIMO-CELE/POSE		PIMO-CELE/SYOR-BERE/AGSP	
	7 Plots		18 Plots		5 Plots	
Species	CON	CHAR	CON	CHAR	CON	CHAR
Trees						
Cercocarpus ledifolius	100.0	47.1	100.0	22.1	100.0	69.0
Juniperus osteosperma	.	.	11.1	17.5	20.0	4.0
Juniperus scopulorum	71.4	6.1	38.9	5.1	40.0	4.0
Pinus monophylla	100.0	17.3	100.0	24.2	100.0	3.9
Shrubs						
Amelanchier utahensis	.	.	.	.	20.0	0.2
Artemisia arbuscula arbuscula	.	.	.	.	.	.
Artemisia arbuscula nova	.	.	.	.	.	.
Artemisia ludoviciana	14.3	1.0	.	.	.	.
Artemisia tridentata vaseyana	71.4	1.1	83.3	2.0	60.0	0.1
Artemisia tridentata wyomingensis	.	.	5.6	0.5	.	.
Berberis repens	100.0	7.7	44.4	2.1	100.0	12.6
Chrysothamnus nauseosus	.	.	.	.	.	.
Chrysothamnus viscidiflorus	14.3	1.0	5.6	0.5	.	.
Haplopappus suffruticosus	28.6	0.1	77.8	0.6	100.0	0.7
Holodiscus dumosus	100.0	11.7	38.9	2.8	20.0	1.0
Prunus virginiana	28.6	20.0	5.6	0.1	40.0	2.5
Purshia tridentata	.	.	27.8	1.1	.	.
Ribes cereum	57.1	2.5	33.3	0.5	60.0	4.0
Symphoricarpos oreophilus	85.7	9.8	72.2	2.2	100.0	10.2
Herbs						
Achillea millefolium	28.6	0.1	5.6	0.1	40.0	0.1
Agoseris glauca	.	.	16.7	0.1	.	.
Allium acuminatum	.	.	.	.	20.0	0.1
Antennaria microphylla	.	.	.	.	.	.
Arabis holboellii	.	.	.	.	.	.
Arabis spp.	.	.	.	.	.	.
Astragalus cibarius	.	.	.	.	.	.
Astragalus purshii	.	.	5.6	0.5	.	.
Astragalus spp.	.	.	5.6	0.1	20.0	0.1
Balsamorhiza hookeri	.	.	.	.	.	.
Balsamorhiza sagittata	14.3	0.1	83.3	6.3	60.0	13.3
Besseya wyomingensis	.	.	.	.	.	.
Brickellia grandiflora	14.3	1.0	.	.	20.0	0.1
Calochortus spp.	.	.	.	.	.	.
Castilleja hispida	.	.	.	.	.	.
Castilleja miniata	.	.	.	.	.	.
Castilleja spp.	.	.	.	.	.	.
Chaenactis douglasii	.	.	22.2	0.1	.	.
Cirsium canovirens	.	.	38.9	0.8	80.0	1.2
Collinsia parviflora	28.6	2.0	5.6	0.1	.	.
Collomia grandiflora	.	.	5.6	0.1	60.0	0.1
Comandra umbellata pallida	.	.	5.6	0.2	.	.
Crepis acuminata	.	.	11.1	0.1	100.0	0.3
Cryptantha spiculifera	.	.	.	.	.	.
Draba spp.	14.3	0.1	5.6	0.1	.	.
Erigeron pumilus	.	.	.	.	.	.
Eriogonum heracleoides	.	.	27.8	0.2	20.0	0.5
Eriogonum microthecum	14.3	0.1	33.3	0.8	.	.
Eriogonum umbellatum	.	.	5.6	0.5	.	.
Eupatorium occidentale	28.6	2.0	.	.	.	.
Fritillaria spp.	.	.	11.1	0.1	.	.
Galium spp.	.	.	5.6	0.1	20.0	0.1
Gilia aggregata	.	.	5.6	0.1	.	.
Gutierrezia sarothrae	.	.	.	.	.	.
Habenaria spp.	.	.	.	.	20.0	1.0
Hackelia micrantha	85.7	0.7	61.1	1.0	100.0	3.4
Haplopappus acaulis	28.6	0.3	33.3	2.2	.	.
Helianthella uniflora	.	.	.	.	20.0	0.1
Heuchera cylindrica	14.3	0.1	.	.	.	.
Leptodactylon pungens	.	.	.	.	.	.
Lithospermum ruderale	.	.	11.1	0.3	40.0	0.3
Lupinus spp.	14.3	0.1	16.7	0.1	60.0	0.1
Machaeranthera canescens	71.4	0.5	83.3	0.3	80.0	0.6
Mertensia longiflora	.	.	.	.	40.0	1.0
Opuntia polyacantha	.	.	77.8	2.0	.	.

Orobanche corymbosa	.	.	.	.	.	.
Orthocarpus tenuifolius	.	.	.	.	.	.
Penstemon humilis	.	.	.	.	20.0	1.0
Penstemon perpulcher	.	.	.	.	.	.
Penstemon spp.	.	.	.	.	20.0	0.1
Phacelia hastata	.	.	16.7	0.1	60.0	0.4
Phlox hoodii	.	.	.	.	.	.
Phlox longifolia	.	.	5.6	2.0	20.0	1.0
Sedum lanceolatum	.	.	11.1	1.5	.	.
Senecio integerrimus	.	.	11.1	0.1	.	.
Senecio multilobatus	.	.	55.6	0.3	.	.
Silene douglasii	.	.	11.1	0.1	40.0	0.1
Smilacina racemosa	14.3	1.0	.	.	.	.
Tragopogon dubius	.	.	27.8	0.1	60.0	0.1
Grasses and Sedges						
Agropyron spicatum	14.3	0.1	61.1	2.9	100.0	11.0
Agropyron spp.	.	.	.	.	60.0	1.2
Bromus tectorum	42.9	17.7	94.4	25.4	80.0	0.7
Carex rossii	.	.	5.6	0.5	40.0	0.1
Danthonia unispicata	.	.	5.6	0.5	.	.
Elymus cinereus	100.0	2.1	44.4	1.9	60.0	4.3
Elymus glaucus	.	.	.	.	20.0	0.1
Festuca idahoensis	.	.	.	.	.	.
Koeleria cristata	.	.	5.6	0.1	.	.
Leucopoa kingii	.	.	5.6	1.0	80.0	1.5
Melica bulbosa	.	.	5.6	0.1	20.0	1.0
Oryzopsis hymenoides	42.9	0.7	55.6	3.0	.	.
Poa cusickii	.	.	.	.	.	.
Poa secunda	85.7	1.7	94.4	6.9	60.0	2.0
Sitanion hystrix	.	.	.	.	.	.
Stipa comata	.	.	33.3	6.0	40.0	5.5
Stipa occidentalis	28.6	1.0	.	.	20.0	0.1
Stipa spp.	.	.	16.7	0.5	.	.
Stipa thurberiana	.	.	11.1	0.6	.	.
Ferns						
Woodsia oregana	14.3	0.1	.	.	.	.

	PIMO-JUOS/AGSP		PIMO-JUOS/ARNO/POSE		PIMO-JUOS/ARTRV/AGSP	
	7 Plots		9 Plots		9 Plots	
Species	CON	CHAR	CON	CHAR	CON	CHAR
Trees						
Cercocarpus ledifolius	14.3	4.1	33.3	4.4	33.3	7.5
Juniperus osteosperma	100.0	31.2	100.0	18.9	100.0	16.4
Juniperus scopulorum	.	.	.	.	.	.
Pinus monophylla	85.7	3.4	100.0	20.6	100.0	16.0
Shrubs						
Amelanchier utahensis	.	.	.	.	33.3	1.2
Artemisia arbuscula arbuscula	71.4	15.0	22.2	0.1	11.1	0.1
Artemisia arbuscula nova	57.1	6.5	88.9	4.6	33.3	0.4
Artemisia ludoviciana	.	.	.	.	.	.
Artemisia tridentata vaseyana	71.4	0.5	11.1	0.1	100.0	8.5
Artemisia tridentata wyomingensis	.	.	.	.	.	.
Berberis repens	.	.	.	.	11.1	1.0
Chrysothamnus nauseosus	14.3	0.1	.	.	.	.
Chrysothamnus viscidiflorus	.	.	.	.	11.1	1.0
Haplopappus suffruticosus	57.1	0.3	55.6	0.6	55.6	4.0
Holodiscus dumosus	14.3	1.0	.	.	66.7	4.2
Prunus virginiana	.	.	.	.	.	.
Purshia tridentata	28.6	0.8	.	.	11.1	0.1
Ribes cereum	28.6	0.6	.	.	55.6	0.7
Symphoricarpos oreophilus	85.7	1.5	.	.	33.3	0.5
Herbs						
Achillea millefolium	.	.	.	.	44.4	1.0
Agoseris glauca	28.6	0.6	.	.	.	.
Allium acuminatum	57.1	0.1	.	.	22.2	0.1
Antennaria microphylla	57.1	0.8	.	.	33.3	0.9
Arabis holboellii	14.3	0.1	11.1	0.1	.	.
Arabis spp.	.	.	11.1	1.0	.	.
Astragalus cibarius	.	.	22.2	20.0	.	.
Astragalus purshii	.	.	.	.	.	.
Astragalus spp.	.	.	.	.	11.1	1.0
Balsamorhiza hookeri	85.7	3.2	44.4	1.5	33.3	9.3
Balsamorhiza sagittata	14.3	0.1	22.2	1.5	33.3	5.3
Besseya wyomingensis	.	.	.	.	11.1	1.0
Brickellia grandiflora	.	.	.	.	.	.
Calochortus spp.	14.3	0.1	.	.	.	.
Castilleja hispida	14.3	0.1	.	.	.	.
Castilleja miniata	.	.	.	.	11.1	0.1
Castilleja spp.	14.3	0.1	.	.	.	.
Chaenactis douglasii	71.4	0.1	33.3	0.1	11.1	0.1
Cirsium canovirens	.	.	11.1	0.1	33.3	0.1
Collinsia parviflora	57.1	0.8	.	.	22.2	0.1
Collomia grandiflora	14.3	1.0	.	.	.	.
Comandra umbellata pallida	14.3	2.0	.	.	.	.
Crepis acuminata	71.4	0.1	11.1	0.1	55.6	0.8
Cryptantha spiculifera	.	.	22.2	0.6	.	.
Draba spp.	.	.	.	.	.	.
Erigeron pumilus	14.3	0.1	11.1	0.1	11.1	0.1
Eriogonum heracleoides	.	.	.	.	.	.
Eriogonum microthecum	71.4	0.6	.	.	33.3	0.1
Eriogonum umbellatum	71.4	0.4	.	.	33.3	0.2
Eupatorium occidentale	.	.	.	.	.	.
Fritillaria spp.	.	.	.	.	22.2	0.1
Galium spp.	.	.	.	.	.	.
Gilia aggregata	.	.	22.2	1.5	11.1	0.1
Gutierrezia sarothrae	.	.	11.1	2.0	.	.
Habenaria spp.	.	.	.	.	.	.
Hackelia micrantha	28.6	0.1	33.3	1.0	44.4	1.0
Haplopappus acaulis	.	.	22.2	1.0	44.4	0.2
Helianthella uniflora	.	.	.	.	.	.
Heuchera cylindrica	.	.	.	.	22.2	0.1
Leptodactylon pungens	42.9	0.7	.	.	33.3	0.1
Lithospermum ruderale	.	.	.	.	.	.
Lupinus spp.	14.3	0.1	.	.	22.2	0.6
Machaeranthera canescens	.	.	44.4	0.1	22.2	0.6
Mertensia longiflora	.	.	.	.	.	.
Opuntia polyacantha	71.4	1.2	22.2	0.8	11.1	2.0
Orobanche corymbosa	14.3	0.1	.	.	.	.
Orthocarpus tenuifolius	14.3	0.1	.	.	.	.

Penstemon humilis	.	.	22.2	1.0	11.1	0.1
Penstemon perpulcher	.	.	.	.	11.1	0.1
Penstemon spp.	.	.	.	.	.	.
Phacelia hastata	.	.	.	.	11.1	0.1
Phlox hoodii	42.9	0.2	22.2	0.3	.	.
Phlox longifolia	.	.	.	.	.	.
Sedum lanceolatum	14.3	1.0	.	.	22.2	2.0
Senecio integerrimus	57.1	0.2	.	.	.	.
Senecio multilobatus	42.9	0.7	66.7	0.4	55.6	0.1
Silene douglasii	14.3	0.1	.	.	22.2	1.5
Smilacina racemosa	.	.	.	.	.	.
Tragopogon dubius	.	.	11.1	0.1	22.2	0.1
Grasses and Sedges						
Agropyron spicatum	100.0	40.7	88.9	3.2	100.0	13.6
Agropyron spp.	.	.	.	.	.	.
Bromus tectorum	14.3	3.0	66.7	1.9	22.2	2.5
Carex rossii	57.1	1.0	.	.	.	.
Danthonia unispicata	14.3	0.1	.	.	.	.
Elymus cinereus	.	.	.	.	.	.
Elymus glaucus	.	.	.	.	.	.
Festuca idahoensis	.	.	.	.	33.3	16.0
Koeleria cristata	28.6	0.6	.	.	22.2	0.1
Leucopoa kingii	28.6	1.0	.	.	11.1	10.0
Melica bulbosa	.	.	.	.	.	.
Oryzopsis hymenoides	.	.	66.7	0.5	.	.
Poa cusickii	28.6	1.0	11.1	0.1	11.1	0.1
Poa secunda	71.4	7.2	100.0	7.1	100.0	1.9
Sitanion hystrix	42.9	0.2	22.2	1.0	.	.
Stipa comata	.	.	.	.	.	.
Stipa occidentalis	.	.	.	.	.	.
Stipa spp.	.	.	.	.	.	.
Stipa thurberiana	.	.	.	.	.	.
Ferns						
Woodsia oregana	14.3	1.0	.	.	22.2	0.1

Species	JUOS-CELE/SYOR/AGSP 2 Plots CON	CHAR	JUOS/ARAR/AGSP 24 Plots CON	CHAR	JUOS/ARAR/FEID 10 Plots CON	CHAR
Trees						
Cercocarpus ledifolius	100.0	25.0	.	.	.	.
Juniperus osteosperma	100.0	12.5	100.0	25.4	100.0	24.4
Pinus monophylla	.	.	.	.	.	.
Shrubs						
Amelanchier utahensis	100.0	0.6	37.5	1.2	40.0	0.2
Artemisia arbuscula arbuscula	.	.	100.0	17.8	100.0	24.6
Artemisia arbuscula nova	.	.	20.8	4.8	50.0	1.2
Artemisia tridentata vaseyana	100.0	7.6	25.0	0.6	40.0	0.4
Artemisia tridentata wyomingensis	.	.	.	.	.	.
Atriplex canescens	.	.	.	.	.	.
Berberis repens	50.0	12.0	4.2	2.0	.	.
Chrysothamnus nauseosus	.	.	.	.	.	.
Chrysothamnus viscidiflorus	.	.	12.5	0.1	30.0	0.5
Haplopappus suffruticosus	50.0	0.1	45.8	0.3	40.0	0.2
Holodiscus dumosus	.	.	.	.	10.0	2.0
Prunus virginiana	50.0	1.0	.	.	.	.
Purshia tridentata	.	.	41.7	1.6	90.0	2.0
Ribes cereum	.	.	8.3	0.3	10.0	0.5
Ribes viscosissimum	.	.	.	.	.	.
Symphoricarpos oreophilus	100.0	8.5	83.3	1.1	50.0	0.7
Herbs						
Achillea millefolium	.	.	8.3	0.1	.	.
Agoseris glauca	50.0	0.1	50.0	0.2	10.0	0.1
Allium acuminatum	.	.	70.8	0.3	30.0	0.7
Antennaria dimorpha	.	.	16.7	0.1	.	.
Antennaria microphylla	.	.	8.3	0.8	10.0	0.1
Arabis holboellii	.	.	.	.	.	.
Arabis spp.	.	.	8.3	0.3	.	.
Arenaria aculeata	.	.	20.8	2.2	30.0	3.0
Arenaria congesta	.	.	4.2	0.5	.	.
Arnica sororia	.	.	4.2	2.0	.	.
Aster scopulorum	50.0	1.0	.	.	70.0	0.2
Astragalus cibarius	.	.	4.2	0.1	.	.
Astragalus filipes	.	.	4.2	0.1	.	.
Astragalus purshii	.	.	.	.	.	.
Balsamorhiza hookeri	.	.	16.7	3.3	60.0	5.3
Balsamorhiza sagittata	100.0	17.5	87.5	8.0	40.0	2.5
Calochortus nuttallii	.	.	.	.	10.0	0.1
Calochortus spp.	.	.	4.2	0.1	.	.
Castilleja angustifolia	.	.	.	.	.	.
Castilleja hispida	.	.	8.3	0.6	.	.
Castilleja spp.	.	.	25.0	0.1	.	.
Chaenactis douglasii	.	.	16.7	0.3	10.0	0.1
Cirsium canovirens	.	.	4.2	0.1	.	.
Collinsia parviflora	50.0	1.0	75.0	0.6	.	.
Collomia grandiflora	.	.	12.5	1.0	.	.
Comandra umbellata pallida	50.0	0.2	50.0	1.3	20.0	0.2
Cordylanthus ramosus	.	.	.	.	10.0	0.1
Crepis acuminata	50.0	0.1	58.3	0.6	20.0	0.1
Cryptantha spiculifera	.	.	4.2	0.1	30.0	0.1
Delphinium spp.	.	.	12.5	0.1	.	.
Epilobium paniculatum	.	.	4.2	0.1	.	.
Erigeron pumilus	.	.	20.8	2.8	.	.
Eriogonum caespitosum	.	.	16.7	0.8	90.0	1.7
Eriogonum cernuum	.	.	.	.	.	.
Eriogonum heracleoides	100.0	1.5	45.8	0.3	20.0	0.1
Eriogonum microthecum	.	.	8.3	0.6	40.0	0.7
Eriogonum ovalifolium	.	.	.	.	.	.
Eriogonum strictum	.	.	.	.	.	.
Eriogonum umbellatum	.	.	45.8	0.3	10.0	1.0
Erysimum spp.	.	.	4.2	0.1	.	.
Fritillaria pudica	.	.	12.5	0.1	.	.
Fritillaria spp.	.	.	4.2	0.1	.	.
Galium triflorum	.	.	.	.	.	.
Gilia aggregata	.	.	.	.	.	.
Grindelia squarrosa	.	.	4.2	1.0	.	.
Gutierrezia sarothrae	.	.	.	.	.	.

Hackelia micrantha	100.0	0.1	58.3	0.3	20.0	0.3
Haplopappus acaulis	.	.	29.2	2.4	50.0	2.6
Haplopappus carthamoides	.	.	.	.	.	.
Helianthella uniflora	50.0	2.0	8.3	1.0	.	.
Heuchera grossulariifolia	.	.	.	.	10.0	0.1
Hieracium albertinum	.	.	.	.	10.0	0.1
Hydrophyllum capitatum	.	.	4.2	0.1	.	.
Lepidium spp.	50.0	1.0	.	.	.	.
Leptodactylon pungens	.	.	4.2	0.1	10.0	0.1
Lewisia rediviva	.	.	.	.	.	.
Linum perenne	.	.	.	.	.	.
Lithospermum ruderale	.	.	4.2	0.1	.	.
Lomatium dissectum	50.0	0.5	50.0	0.9	.	.
Lomatium grayi	.	.	4.2	1.0	10.0	0.1
Lomatium nudicaule	.	.	4.2	0.1	.	.
Lomatium spp.	.	.	.	.	.	.
Lomatium triternatum	50.0	0.1	16.7	0.1	.	.
Lupinus argenteus	.	.	.	.	10.0	0.1
Lupinus spp.	50.0	0.1	16.7	0.2	.	.
Lycodesmia spinosa	.	.	4.2	0.1	.	.
Machaeranthera canescens	100.0	0.1	20.8	0.1	.	.
Mertensia longiflora	.	.	4.2	0.1	.	.
Opuntia polyacantha	.	.	79.2	1.1	90.0	0.9
Orobanche corymbosa	.	.	.	.	.	.
Orobanche uniflora	.	.	.	.	10.0	0.1
Orthocarpus tenuifolius	.	.	8.3	0.6	.	.
Pediocactus simpsonii	.	.	.	.	20.0	0.1
Penstemon deustus	.	.	4.2	1.0	.	.
Penstemon humilis	50.0	0.5	58.3	0.8	70.0	0.5
Penstemon perpulcher	.	.	.	.	.	.
Petradoria pumila	.	.	.	.	.	.
Phacelia hastata	.	.	4.2	0.1	20.0	0.2
Phlox hoodii	.	.	29.2	5.9	50.0	1.8
Phlox pulvinata	.	.	.	.	20.0	0.1
Polygonum douglasii	.	.	8.3	0.1	.	.
Sedum lanceolatum	.	.	20.8	1.6	10.0	0.1
Senecio canus	.	.	16.7	2.6	10.0	0.1
Senecio integerrimus	50.0	0.1	45.8	0.1	50.0	0.5
Senecio multilobatus	.	.	4.2	0.1	.	.
Silene douglasii	.	.	12.5	0.2	10.0	0.1
Sisymbrium altissimum	.	.	.	.	.	.
Tragopogon dubius	50.0	0.1	37.5	0.1	.	.
Wyethia amplexicaulis	50.0	1.0	8.3	1.0	.	.
Zigadenus elegans	50.0	0.1	.	.	.	.
Zigadenus venenosus	.	.	4.2	0.1	40.0	0.1
Grasses and Sedges						
Agropyron spicatum	100.0	13.0	100.0	19.9	80.0	4.5
Agropyron spp.	50.0	10.0	4.2	0.1	.	.
Bromus brizaeformis	.	.	.	.	.	.
Bromus carinatus	50.0	1.0	4.2	0.1	.	.
Bromus japonicus	.	.	4.2	1.0	.	.
Bromus tectorum	50.0	1.0	62.5	2.5	10.0	1.0
Carex douglasii	.	.	.	.	.	.
Carex geyeri	.	.	.	.	.	.
Carex pachystachya	.	.	.	.	.	.
Carex rossii	.	.	.	.	10.0	10.0
Danthonia unispicata	.	.	.	.	10.0	7.0
Elymus cinereus	.	.	12.5	0.4	.	.
Festuca idahoensis	.	.	.	.	100.0	18.7
Koeleria cristata	.	.	20.8	0.7	20.0	0.1
Leucopoa kingii	.	.	8.3	6.1	.	.
Melica bulbosa	100.0	0.6	12.5	0.1	.	.
Oryzopsis hymenoides	.	.	.	.	.	.
Poa bulbosa	50.0	0.1	12.5	0.8	.	.
Poa cusickii	50.0	0.1	62.5	4.1	.	.
Poa secunda	50.0	7.0	95.8	4.7	90.0	3.7
Sitanion hystrix	.	.	4.2	0.1	30.0	0.1
Stipa comata	50.0	5.0	33.3	1.6	.	.
Stipa occidentalis	.	.	.	.	.	.
Stipa spp.	.	.	4.2	4.0	10.0	2.0
Stipa thurberiana	.	.	4.2	2.0	10.0	0.1
Ferns						
Woodsia oregana	.	.	16.7	0.6	.	.

	JUOS/ARNO/AGSP		JUOS/ARNO/POSE		JUOS/ARTRV/AGSP	
	5 Plots		4 Plots		9 Plots	
Species	CON	CHAR	CON	CHAR	CON	CHAR
Trees						
Cercocarpus ledifolius	.	.	.	.	.	.
Juniperus osteosperma	100.0	8.8	100.0	7.3	100.0	27.3
Pinus monophylla	20.0	1.0	.	.	.	.
Shrubs						
Amelanchier utahensis	20.0	0.2	25.0	0.2	44.4	1.0
Artemisia arbuscula arbuscula	100.0	4.6	75.0	12.0	44.4	3.8
Artemisia arbuscula nova	100.0	20.0	100.0	30.0	.	.
Artemisia tridentata vaseyana	40.0	0.3	.	.	100.0	5.8
Artemisia tridentata wyomingensis	.	.	.	.	.	.
Atriplex canescens	.	.	.	.	.	.
Berberis repens	.	.	.	.	22.2	3.0
Chrysothamnus nauseosus	20.0	0.1	.	.	11.1	4.0
Chrysothamnus viscidiflorus	60.0	0.5	75.0	0.7	11.1	0.1
Haplopappus suffruticosus	80.0	0.3	.	.	66.7	0.2
Holodiscus dumosus	.	.	25.0	6.0	.	.
Prunus virginiana	.	.	.	.	.	.
Purshia tridentata	.	.	.	.	100.0	3.3
Ribes cereum	.	.	25.0	1.0	.	.
Ribes viscosissimum	.	.	.	.	.	.
Symphoricarpos oreophilus	40.0	0.1	25.0	1.0	44.4	5.8
Herbs						
Achillea millefolium	.	.	.	.	.	.
Agoseris glauca	20.0	0.1	.	.	44.4	0.1
Allium acuminatum	.	.	.	.	22.2	0.1
Antennaria dimorpha	.	.	.	.	.	.
Antennaria microphylla	20.0	2.0	.	.	11.1	0.1
Arabis holboellii	.	.	.	.	.	.
Arabis spp.	.	.	.	.	.	.
Arenaria aculeata	20.0	2.0	.	.	.	.
Arenaria congesta	.	.	.	.	.	.
Arnica sororia	.	.	.	.	.	.
Aster scopulorum	.	.	.	.	.	.
Astragalus cibarius	.	.	.	.	.	.
Astragalus filipes	.	.	.	.	.	.
Astragalus purshii	.	.	50.0	0.1	.	.
Balsamorhiza hookeri	40.0	6.0	75.0	0.8	.	.
Balsamorhiza sagittata	20.0	0.1	.	.	100.0	9.6
Calochortus nuttallii	.	.	.	.	.	.
Calochortus spp.	.	.	.	.	.	.
Castilleja angustifolia	.	.	50.0	0.1	.	.
Castilleja hispida	20.0	0.1	.	.	.	.
Castilleja spp.	20.0	0.1	.	.	.	.
Chaenactis douglasii	100.0	0.1	100.0	1.0	11.1	0.1
Cirsium canovirens	.	.	.	.	11.1	0.1
Collinsia parviflora	.	.	.	.	22.2	1.0
Collomia grandiflora	.	.	.	.	22.2	0.6
Comandra umbellata pallida	20.0	6.0	.	.	44.4	1.5
Cordylanthus ramosus	.	.	25.0	0.1	.	.
Crepis acuminata	20.0	0.1	.	.	44.4	0.5
Cryptantha spiculifera	.	.	.	.	.	.
Delphinium spp.	.	.	.	.	11.1	0.1
Epilobium paniculatum	.	.	.	.	.	.
Erigeron pumilus	60.0	1.7	75.0	0.7	.	.
Eriogonum caespitosum	20.0	2.0	75.0	1.0	.	.
Eriogonum cernuum	.	.	.	.	.	.
Eriogonum heracleoides	.	.	.	.	44.4	1.0
Eriogonum microthecum	60.0	1.4	100.0	5.5	33.3	0.1
Eriogonum ovalifolium	.	.	25.0	2.0	.	.
Eriogonum strictum	.	.	.	.	.	.
Eriogonum umbellatum	20.0	0.1	.	.	22.2	0.3
Erysimum spp.	.	.	.	.	.	.
Fritillaria pudica	.	.	.	.	22.2	0.1
Fritillaria spp.	.	.	.	.	.	.
Galium triflorum	.	.	.	.	22.2	0.6
Gilia aggregata	.	.	.	.	22.2	0.1
Grindelia squarrosa	.	.	.	.	.	.

Gutierrezia sarothrae	.	.	.	.	11.1	1.0
Hackelia micrantha	.	.	.	.	55.6	0.9
Haplopappus acaulis	40.0	2.5	.	.	11.1	0.1
Haplopappus carthamoides	20.0	0.1	.	.	.	.
Helianthella uniflora	.	.	.	.	33.3	2.4
Heuchera grossulariifolia	.	.	.	.	.	.
Hieracium albertinum	.	.	.	.	.	.
Hydrophyllum capitatum	.	.	.	.	11.1	0.1
Lepidium spp.	.	.	.	.	.	.
Leptodactylon pungens	40.0	1.0	25.0	1.0	.	.
Lewisia rediviva	.	.	50.0	0.1	.	.
Linum perenne	.	.	.	.	22.2	0.1
Lithospermum ruderale	.	.	.	.	33.3	0.4
Lomatium dissectum	.	.	.	.	22.2	0.6
Lomatium grayi	.	.	50.0	0.6	22.2	1.0
Lomatium nudicaule	.	.	.	.	.	.
Lomatium spp.	.	.	.	.	33.3	0.1
Lomatium triternatum	.	.	.	.	11.1	0.1
Lupinus argenteus	.	.	.	.	.	.
Lupinus spp.	40.0	0.1	.	.	11.1	0.1
Lycodesmia spinosa	.	.	.	.	11.1	1.0
Machaeranthera canescens	.	.	.	.	44.4	0.1
Mertensia longiflora	.	.	.	.	.	.
Opuntia polyacantha	60.0	0.7	50.0	1.1	33.3	0.3
Orobanche corymbosa	20.0	0.1	25.0	0.1	.	.
Orobanche uniflora	.	.	25.0	0.1	.	.
Orthocarpus tenuifolius	40.0	1.0	.	.	.	.
Pediocactus simpsonii	40.0	0.1	50.0	0.1	.	.
Penstemon deustus	.	.	.	.	.	.
Penstemon humilis	20.0	1.0	75.0	0.8	33.3	0.4
Penstemon perpulcher	.	.	.	.	.	.
Petradoria pumila	.	.	.	.	22.2	3.0
Phacelia hastata	.	.	25.0	0.2	11.1	0.1
Phlox hoodii	80.0	3.8	.	.	33.3	0.7
Phlox pulvinata	.	.	75.0	0.1	.	.
Polygonum douglasii	.	.	.	.	22.2	0.1
Sedum lanceolatum	20.0	4.0	75.0	0.7	11.1	0.1
Senecio canus	20.0	1.0	.	.	.	.
Senecio integerrimus	.	.	.	.	44.4	0.1
Senecio multilobatus	40.0	0.6	.	.	11.1	0.5
Silene douglasii	.	.	.	.	11.1	0.1
Sisymbrium altissimum	.	.	.	.	.	.
Tragopogon dubius	20.0	0.1	.	.	44.4	0.1
Wyethia amplexicaulis	.	.	.	.	11.1	0.1
Zigadenus elegans	.	.	.	.	.	.
Zigadenus venenosus	.	.	.	.	.	.
Grasses and Sedges						
Agropyron spicatum	100.0	32.0	25.0	0.1	100.0	17.9
Agropyron spp.	.	.	.	.	.	.
Bromus brizaeformis	.	.	.	.	44.4	2.3
Bromus carinatus	.	.	.	.	22.2	1.0
Bromus japonicus	.	.	.	.	22.2	1.0
Bromus tectorum	20.0	2.0	.	.	66.7	2.2
Carex douglasii	.	.	.	.	.	.
Carex geyeri	.	.	25.0	0.1	.	.
Carex pachystachya	.	.	.	.	.	.
Carex rossii	.	.	.	.	.	.
Danthonia unispicata	.	.	.	.	.	.
Elymus cinereus	.	.	.	.	22.2	3.5
Festuca idahoensis	.	.	25.0	0.1	.	.
Koeleria cristata	20.0	5.0	.	.	33.3	2.2
Leucopoa kingii	.	.	.	.	.	.
Melica bulbosa	.	.	.	.	22.2	0.1
Oryzopsis hymenoides	.	.	25.0	10.0	11.1	1.0
Poa bulbosa	.	.	.	.	44.4	2.0
Poa cusickii	20.0	1.0	.	.	22.2	3.5
Poa secunda	100.0	3.8	100.0	8.8	66.7	3.5
Sitanion hystrix	.	.	75.0	0.5	.	.
Stipa comata	.	.	25.0	20.0	11.1	1.0
Stipa occidentalis	.	.	.	.	.	.
Stipa spp.	.	.	75.0	2.7	.	.
Stipa thurberiana	.	.	.	.	11.1	1.0
Ferns						
Woodsia oregana	.	.	.	.	11.1	0.3

	JUOS/ARTRV/FEID		JUOS/ARTRV/ORHY		JUOS/ARTRW/STCO	
	5 Plots		7 Plots		4 Plots	
Species	CON	CHAR	CON	CHAR	CON	CHAR
Trees						
Cercocarpus ledifolius	.	.	.	.	.	.
Juniperus osteosperma	80.0	23.1	100.0	28.6	100.0	24.1
Pinus monophylla	.	.	.	.	.	.
Shrubs						
Amelanchier utahensis	20.0	0.2	14.3	2.0	.	.
Artemisia arbuscula arbuscula	60.0	26.7	.	.	.	.
Artemisia arbuscula nova	40.0	0.6	14.3	2.0	25.0	1.0
Artemisia tridentata vaseyana	100.0	6.6	85.7	2.3	.	.
Artemisia tridentata wyomingensis	.	.	28.6	1.0	100.0	6.0
Atriplex canescens	.	.	14.3	3.0	.	.
Berberis repens	.	.	.	.	.	.
Chrysothamnus nauseosus	.	.	.	.	.	.
Chrysothamnus viscidiflorus	60.0	0.7	71.4	1.0	100.0	1.0
Haplopappus suffruticosus	80.0	0.7	71.4	1.1	.	.
Holodiscus dumosus	.	.	.	.	.	.
Prunus virginiana	.	.	.	.	.	.
Purshia tridentata	100.0	1.8	100.0	1.9	.	.
Ribes cereum	20.0	0.1	.	.	.	.
Ribes viscosissimum	20.0	0.1	.	.	.	.
Symphoricarpos oreophilus	40.0	0.6	14.3	0.1	.	.
Herbs						
Achillea millefolium	.	.	.	.	.	.
Agoseris glauca	.	.	.	.	.	.
Allium acuminatum	40.0	0.1	.	.	.	.
Antennaria dimorpha	.	.	.	.	.	.
Antennaria microphylla	40.0	0.3	.	.	.	.
Arabis holboellii	40.0	0.1	14.3	0.1	50.0	0.1
Arabis spp.	.	.	.	.	.	.
Arenaria aculeata	.	.	.	.	.	.
Arenaria congesta	.	.	.	.	.	.
Arnica sororia	.	.	.	.	.	.
Aster scopulorum	60.0	0.1	.	.	.	.
Astragalus cibarius	.	.	.	.	.	.
Astragalus filipes	.	.	.	.	75.0	0.1
Astragalus purshii	20.0	0.1	.	.	.	.
Balsamorhiza hookeri	40.0	1.5	.	.	.	.
Balsamorhiza sagittata	80.0	5.0	42.9	0.4	25.0	1.0
Calochortus nuttallii	.	.	.	.	.	.
Calochortus spp.	.	.	.	.	.	.
Castilleja angustifolia	20.0	0.1	.	.	.	.
Castilleja hispida	.	.	.	.	.	.
Castilleja spp.	.	.	.	.	.	.
Chaenactis douglasii	.	.	71.4	0.3	75.0	0.1
Cirsium canovirens	.	.	.	.	.	.
Collinsia parviflora	.	.	.	.	.	.
Collomia grandiflora	.	.	28.6	0.1	25.0	1.0
Comandra umbellata pallida	40.0	1.1	.	.	.	.
Cordylanthus ramosus	.	.	.	.	.	.
Crepis acuminata	.	.	42.9	0.7	100.0	0.3
Cryptantha spiculifera	40.0	0.1	57.1	0.5	50.0	0.3
Delphinium spp.	.	.	.	.	75.0	0.1
Epilobium paniculatum	.	.	.	.	.	.
Erigeron pumilus	.	.	.	.	.	.
Eriogonum caespitosum	80.0	0.7	.	.	.	.
Eriogonum cernuum	.	.	71.4	0.1	.	.
Eriogonum heracleoides	60.0	0.1	.	.	.	.
Eriogonum microthecum	80.0	0.4	57.1	0.6	50.0	1.0
Eriogonum ovalifolium	20.0	0.1	14.3	0.5	100.0	0.9
Eriogonum strictum	.	.	.	.	25.0	1.0
Eriogonum umbellatum	20.0	0.1	28.6	0.6	.	.
Erysimum spp.	.	.	.	.	.	.
Fritillaria pudica	.	.	.	.	.	.
Fritillaria spp.	20.0	0.1	.	.	.	.
Galium triflorum	.	.	.	.	.	.
Gilia aggregata	.	.	.	.	.	.
Grindelia squarrosa	.	.	.	.	.	.
Gutierrezia sarothrae	.	.	.	.	.	.

Hackelia micrantha	60.0	0.1	71.4	1.0	.	.
Haplopappus acaulis	20.0	1.0	.	.	.	.
Haplopappus carthamoides	.	.	.	.	.	.
Helianthella uniflora	.	.	.	.	.	.
Heuchera grossulariifolia	.	.	.	.	.	.
Hieracium albertinum	.	.	.	.	.	.
Hydrophyllum capitatum	.	.	.	.	.	.
Lepidium spp.	.	.	.	.	.	.
Leptodactylon pungens	20.0	0.1	85.7	0.9	75.0	3.3
Lewisia rediviva	.	.	.	.	.	.
Linum perenne	.	.	.	.	.	.
Lithospermum ruderale	80.0	0.1	85.7	0.5	50.0	0.1
Lomatium dissectum	.	.	.	.	.	.
Lomatium grayi	.	.	.	.	.	.
Lomatium nudicaule	.	.	.	.	.	.
Lomatium spp.	.	.	.	.	.	.
Lomatium triternatum	.	.	.	.	.	.
Lupinus argenteus	20.0	2.0	.	.	.	.
Lupinus spp.	40.0	0.8	14.3	0.1	.	.
Lycodesmia spinosa	.	.	14.3	0.5	.	.
Machaeranthera canescens	.	.	57.1	0.3	.	.
Mertensia longiflora	.	.	.	.	.	.
Opuntia polyacantha	100.0	0.5	71.4	1.5	75.0	0.5
Orobanche corymbosa	.	.	.	.	.	.
Orobanche uniflora	.	.	.	.	.	.
Orthocarpus tenuifolius	.	.	.	.	.	.
Pediocactus simpsonii	.	.	.	.	.	.
Penstemon deustus	.	.	14.3	0.1	.	.
Penstemon humilis	40.0	0.1	.	.	.	.
Penstemon perpulcher	.	.	.	.	.	.
Petradoria pumila	.	.	.	.	.	.
Phacelia hastata	.	.	71.4	1.0	.	.
Phlox hoodii	80.0	1.5	42.9	0.7	50.0	1.5
Phlox pulvinata	.	.	.	.	.	.
Polygonum douglasii	.	.	.	.	.	.
Sedum lanceolatum	.	.	.	.	.	.
Senecio canus	.	.	.	.	.	.
Senecio integerrimus	.	.	.	.	.	.
Senecio multilobatus	60.0	0.4	85.7	2.2	75.0	2.7
Silene douglasii	.	.	.	.	.	.
Sisymbrium altissimum	.	.	.	.	25.0	1.0
Tragopogon dubius	.	.	.	.	.	.
Wyethia amplexicaulis	.	.	.	.	.	.
Zigadenus elegans	.	.	.	.	.	.
Zigadenus venenosus	80.0	0.2	.	.	.	.
Grasses and Sedges						
Agropyron spicatum	80.0	3.0	85.7	7.8	25.0	0.1
Agropyron spp.	.	.	.	.	.	.
Bromus brizaeformis	.	.	.	.	.	.
Bromus carinatus	.	.	.	.	.	.
Bromus japonicus	.	.	.	.	.	.
Bromus tectorum	.	.	42.9	0.4	.	.
Carex douglasii	.	.	.	.	50.0	0.8
Carex geyeri	.	.	.	.	.	.
Carex pachystachya	.	.	.	.	.	.
Carex rossii	40.0	1.0	.	.	.	.
Danthonia unispicata	.	.	.	.	.	.
Elymus cinereus	.	.	57.1	0.6	25.0	0.1
Festuca idahoensis	100.0	46.0	14.3	3.0	.	.
Koeleria cristata	40.0	0.1	.	.	.	.
Leucopoa kingii	.	.	.	.	.	.
Melica bulbosa	.	.	.	.	.	.
Oryzopsis hymenoides	40.0	0.2	100.0	3.7	75.0	7.3
Poa bulbosa	.	.	.	.	.	.
Poa cusickii	.	.	.	.	.	.
Poa secunda	60.0	1.7	100.0	1.4	75.0	6.0
Sitanion hystrix	40.0	0.1	14.3	0.1	50.0	0.1
Stipa comata	.	.	71.4	11.4	100.0	38.8
Stipa occidentalis	.	.	.	.	.	.
Stipa spp.	.	.	.	.	.	.
Stipa thurberiana	.	.	14.3	3.0	25.0	1.0
Ferns						
Woodsia oregana	.	.	.	.	.	.

Species	8 Plots CON	CHAR
Trees		
Cercocarpus ledifolius	.	.
Juniperus osteosperma	100.0	37.4
Pinus monophylla	12.5	0.1
Shrubs		
Amelanchier utahensis	25.0	0.3
Artemisia arbuscula arbuscula	50.0	0.8
Artemisia arbuscula nova	37.5	0.4
Artemisia tridentata vaseyana	100.0	9.0
Artemisia tridentata wyomingensis	.	.
Atriplex canescens	.	.
Berberis repens	.	.
Chrysothamnus nauseosus	.	.
Chrysothamnus viscidiflorus	25.0	0.6
Haplopappus suffruticosus	100.0	1.8
Holodiscus dumosus	12.5	1.0
Prunus virginiana	.	.
Purshia tridentata	12.5	2.0
Ribes cereum	25.0	6.0
Ribes viscosissimum	.	.
Symphoricarpos oreophilus	100.0	2.7
Herbs		
Achillea millefolium	12.5	0.1
Agoseris glauca	12.5	0.1
Allium acuminatum	25.0	0.1
Antennaria dimorpha	.	.
Antennaria microphylla	12.5	1.0
Arabis holboellii	.	.
Arabis spp.	.	.
Arenaria aculeata	.	.
Arenaria congesta	.	.
Arnica sororia	.	.
Aster scopulorum	.	.
Astragalus cibarius	12.5	0.1
Astragalus filipes	12.5	0.5
Astragalus purshii	.	.
Balsamorhiza hookeri	25.0	1.5
Balsamorhiza sagittata	37.5	3.7
Calochortus nuttallii	.	.
Calochortus spp.	.	.
Castilleja angustifolia	.	.
Castilleja hispida	12.5	1.0
Castilleja spp.	.	.
Chaenactis douglasii	75.0	0.1
Cirsium canovirens	25.0	0.1
Collinsia parviflora	12.5	1.0
Collomia grandiflora	12.5	1.0
Comandra umbellata pallida	12.5	0.2
Cordylanthus ramosus	.	.
Crepis acuminata	50.0	0.1
Cryptantha spiculifera	.	.
Delphinium spp.	.	.
Epilobium paniculatum	.	.
Erigeron pumilus	.	.
Eriogonum caespitosum	.	.
Eriogonum cernuum	.	.
Eriogonum heracleoides	12.5	0.1
Eriogonum microthecum	37.5	0.2
Eriogonum ovalifolium	.	.
Eriogonum strictum	.	.
Eriogonum umbellatum	37.5	0.7
Erysimum spp.	.	.
Fritillaria pudica	.	.
Fritillaria spp.	.	.
Galium triflorum	.	.
Gilia aggregata	.	.
Grindelia squarrosa	.	.
Gutierrezia sarothrae	.	.
Hackelia micrantha	50.0	0.5

Haplopappus acaulis	.	.
Haplopappus carthamoides	.	.
Helianthella uniflora	.	.
Heuchera grossulariifolia	.	.
Hieracium albertinum	.	.
Hydrophyllum capitatum	.	.
Lepidium spp.	.	.
Leptodactylon pungens	37.5	0.2
Lewisia rediviva	.	.
Linum perenne	12.5	0.1
Lithospermum ruderale	.	.
Lomatium dissectum	.	.
Lomatium grayi	.	.
Lomatium nudicaule	.	.
Lomatium spp.	.	.
Lomatium triternatum	.	.
Lupinus argenteus	.	.
Lupinus spp.	75.0	0.9
Lycodesmia spinosa	25.0	0.1
Machaeranthera canescens	12.5	0.1
Mertensia longiflora	.	.
Opuntia polyacantha	87.5	2.0
Orobanche corymbosa	.	.
Orobanche uniflora	.	.
Orthocarpus tenuifolius	12.5	0.1
Pediocactus simpsonii	.	.
Penstemon deustus	.	.
Penstemon humilis	.	.
Penstemon perpulcher	37.5	0.1
Petradoria pumila	12.5	10.0
Phacelia hastata	12.5	0.1
Phlox hoodii	12.5	5.0
Phlox pulvinata	.	.
Polygonum douglasii	.	.
Sedum lanceolatum	.	.
Senecio canus	.	.
Senecio integerrimus	25.0	1.0
Senecio multilobatus	12.5	0.1
Silene douglasii	12.5	0.1
Sisymbrium altissimum	.	.
Tragopogon dubius	.	.
Wyethia amplexicaulis	.	.
Zigadenus elegans	.	.
Zigadenus venenosus	.	.
Grasses and Sedges		
Agropyron spicatum	100.0	31.3
Agropyron spp.	.	.
Bromus brizaeformis	12.5	1.0
Bromus carinatus	.	.
Bromus japonicus	.	.
Bromus tectorum	87.5	7.0
Carex douglasii	.	.
Carex geyeri	.	.
Carex pachystachya	12.5	1.0
Carex rossii	12.5	1.0
Danthonia unispicata	.	.
Elymus cinereus	50.0	0.9
Festuca idahoensis	.	.
Koeleria cristata	.	.
Leucopoa kingii	25.0	0.1
Melica bulbosa	12.5	0.1
Oryzopsis hymenoides	.	.
Poa bulbosa	.	.
Poa cusickii	25.0	3.0
Poa secunda	62.5	2.2
Sitanion hystrix	25.0	0.3
Stipa comata	12.5	1.0
Stipa occidentalis	12.5	1.0
Stipa spp.	.	.
Stipa thurberiana	12.5	1.0
Ferns		
Woodsia oregana	.	.

LIST OF FIGURES

LIST OF TABLES

Table 1. Juniper woodland study sites. Sites visited during the 1996 field season are listed with the designation (Research Natural Area, RNA; REF, reference area) and the managing agency or ownership. Trapper Creek was visited in 1995.

Site	Designation	Agency/Ownership
Big Juniper Kipuka	RNA	USDI BLM
Burton Canyon	RNA	USDA NFS
City of Rocks	RNA	ID DOR/USDI NPS
Gibson Jack	RNA	USDA NFS
Goose Creek Mesa	RNA	USDI BLM
Jim Sage Canyon	RNA	USDI BLM
Pine Knob	REF	USDI BLM and Private
Sand Kipuka	RNA	USDI BLM
Slide Canyon	REF	USDA NFS and Private
Trapper Creek	RNA	USDA NFS
Two Mile Canyon	REF	USDA NFS
West Fork Mink Creek	RNA	USDA NFS

Table 2. The distribution of pinyon-juniper woodland plant associations by site. The number of plots observed for each association is shown by association and site.

Plant Association	Site											
	Big Juniper Kipuka	Burton Canyon	City of Rocks	Gibson Jack	Goose Creek Mesa	Jim Sage Canyon	Pine Knob	Sand Kipuka	Slide Canyon	Trapper	Two Mile Canyon	W Fork Mink Creek
CELE/SYOR/BASA/AGSP		4										
JUOS-CELE/SYOR/AGSP		1		1								
JUOS/ARAR/AGSP				16	1	3						4
JUOS/ARAR/FEID					8					2		
JUOS/ARNO/AGSP				1		4						
JUOS/ARNO/POSE										4		
JUOS/ARTRV/AGSP				4	1						4	
JUOS/ARTRV/FEID					6					1		
JUOS/ARTRV/ORHY					7							
JUOS/ARTRW/STCO					4							
JUOS/SYOR/AGSP					1	6					1	
JUSC-CELE/SYOR/AGSP		7										
JUSC/ARTRV-SYOR/ELCI												4
JUSC/ARTRW								2				
JUSC/ARTRW-CHMI								6				
JUSC/HANA	7							8				
JUSC/HODU	5							2				
PIMO-CELE/HODU/ELCI			7									
PIMO-CELE/POSE			16						2			
PIMO-CELE/SYOR-BERE/AGSP			2						3			
PIMO-JUOS/AGSP						7						
PIMO-JUOS/ARNO/POSE						2	7					
PIMO-JUOS/ARTRV/AGSP						5	3		1			

Table 3. Summary of slope aspect and exposure and elevation. The mean (M) and standard deviation (SD) of slope gradient, elevation, and north, east, south, and west horizon height is listed by plant association.

Plant Association	N	Slope		Elevation		N horizon		E horizon		S horizon		W horizon	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
CELE/SYOR/BASA/AGSP	4	55	10	7286	63	25	10	14	6	4	2	2	2
JUOS-CELE/SYOR/AGSP	2	28	14	6741	23	6	8	8	10	5	0	4	3
JUOS/ARAR/AGSP	24	38	13	6577	292	11	7	8	9	2	1	11	7
JUOS/ARAR/FEID	10	9	8	6312	110	3	2	1	1	1	2	3	2
JUOS/ARNO/AGSP	5	20	18	7120	211	8	6	5	9	1	1	8	7
JUOS/ARNO/POSE	4	23	25	6430	89	5	4	5	9	1	1	3	2
JUOS/ARTRV/AGSP	9	45	15	6350	290	12	6	14	11	1	1	11	10
JUOS/ARTRV/FEID	7	23	13	6178	150	3	2	4	4	7	8	5	4
JUOS/ARTRV/ORHY	7	56	10	6070	106	11	10	31	9	1	1	2	1
JUOS/ARTRW/STCO	4	9	6	5318	62	20	4	7	4	2	1	3	1
JUOS/SYOR/AGSP	8	36	13	6798	413	16	9	8	5	2	2	11	9
JUSC-CELE/SYOR/AGSP	7	53	6	6907	234	21	4	17	5	6	2	4	5
JUSC/ARTRV-SYOR/ELCI	4	48	5	6359	161	26	3	22	5	3	4	5	3
JUSC/ARTRW	2	1	1	4358	4	2	0	2	1	1	0	2	1
JUSC/ARTRW-CHMI	6	4	6	4368	12	4	3	3	2	2	3	2	2
JUSC/HANA	15	4	6	4663	335	2	3	2	2	1	2	2	2
JUSC/HODU	7	9	15	4858	316	2	3	1	0	1	0	0	0
PIMO-CELE/HODU/ELCI	7	55	16	6873	249	23	13	18	14	13	15	16	18
PIMO-CELE/POSE	18	43	16	6738	234	22	8	19	9	2	2	11	14
PIMO-CELE/SYOR-BERE/AGSP	5	50	5	7090	298	12	7	16	7	3	1	12	18
PIMO-JUOS/AGSP	7	29	8	7001	142	11	5	13	3	2	1	5	6
PIMO-JUOS/ARNO/POSE	9	37	12	5811	313	18	11	10	10	8	4	7	9
PIMO-JUOS/ARTRV/AGSP	9	54	11	6420	589	8	9	13	10	17	12	8	12

Table 4. Frequency distribution of slope aspect by pinyon-juniper woodland plant association.

Plant Association	Aspect							
	North	Northeast	East	Southeast	South	Southwest	West	Northwest
CELE/SYOR/BASA/AGSP					75	25		
JUOS-CELE/SYOR/AGSP		50			50			
JUOS/ARAR/AGSP			21	13	29	17	21	
JUOS/ARAR/FEID	20		10	60	10			
JUOS/ARNO/AGSP				20	20		60	
JUOS/ARNO/POSE	25	25		25			25	
JUOS/ARTRV/AGSP				22	22		56	
JUOS/ARTRV/FEID		57		14			14	14
JUOS/ARTRV/ORHY						57	43	
JUOS/ARTRW/STCO				25	50	25		
JUOS/SYOR/AGSP				38	25	25	13	
JUSC-CELE/SYOR/AGSP				14	14	71		
JUSC/ARTRV-SYOR/ELCI					75	25		
JUSC/ARTRW				50				50
JUSC/ARTRW-CHMI		33	33		17			17
JUSC/HANA	7	7		7	20	20	20	20
JUSC/HODU				29	43		14	14
PIMO-CELE/HODU/ELCI	29	14	14		43			
PIMO-CELE/POSE		6	17	11	44	22		
PIMO-CELE/SYOR-BERE/AGSP			20	20		40	20	
PIMO-JUOS/AGSP					14	43	29	14
PIMO-JUOS/ARNO/POSE			22	22	22	33		
PIMO-JUOS/ARTRV/AGSP	22		22	11	11			33

Table 5. Summary of topographical position. The frequency distribution of the macro- and micro-topographical position is summarized by plant association.

Plant Association	Macro-topographical Position					Micro-topographical Position					
	Ridgetop	Upper slope	Mid-slope	Lower slope	Plain	Ridgetop	Upper 1/3	Middle 1/3	Lower 1/3	Toe of Slope	Basin
CELE/SYOR/BASA/AGSP		100					75		25		
JUOS-CELE/SYOR/AGSP		100					50	50			
JUOS/ARAR/AGSP		100				29	42	17	13		
JUOS/ARAR/FEID	20	80				50	50				
JUOS/ARNO/AGSP		100				60	40				
JUOS/ARNO/POSE	100					75	25				
JUOS/ARTRV/AGSP		100				22	44	11	22		
JUOS/ARTRV/FEID	14	86				29	71				
JUOS/ARTRV/ORHY		100					57	43			
JUOS/ARTRW/STCO				100			75			25	
JUOS/SYOR/AGSP		100				13	25	50	13		
JUSC-CELE/SYOR/AGSP		100						86	14		
JUSC/ARTRV-SYOR/ELCI		100						75	25		
JUSC/ARTRW					100		50				50
JUSC/ARTRW-CHMI					100	17			17		67
JUSC/HANA					100	33			20		47
JUSC/HODU					100	71					29
PIMO-CELE/HODU/ELCI		100					71	29			
PIMO-CELE/POSE		89	11				44	56			
PIMO-CELE/SYOR-BERE/AGSP		40	60				60	40			
PIMO-JUOS/AGSP		100				14	29	43	14		
PIMO-JUOS/ARNO/POSE		11	89				11	78	11		
PIMO-JUOS/ARTRV/AGSP		56	44			22	44	33			

Table 6. Summary of micro-topographical position. The frequency distribution of horizontal and vertical micro-topographical configuration and topographic moisture classes is summarized by plant association.

Plant Association	Horizontal Micro-configuration				Vertical Micro-configuration				Topographic Moisture				
	Convex	Straight	Concave	Undulating	Convex	Straight	Concave	Undulating	Dry, well drained	Dry, sloped	Mesic, lower slope	Mesic, toe of slope	Well watered bottom
CELE/SYOR/BASA/AGSP		100			25	75				75	25		
JUOS-CELE/SYOR/AGSP	50	50			50	50			50	50			
JUOS/ARAR/AGSP	46	29	8	17	29	42	4	25	25	75			
JUOS/ARAR/FEID	10	80	10		10	80	10		80	20			
JUOS/ARNO/AGSP	60	20	20		20	60	20		80	20			
JUOS/ARNO/POSE	25		75		50	25	25		25	75			
JUOS/ARTRV/AGSP	33	22	33	11	22	44		33	22	78			
JUOS/ARTRV/FEID	14	57	29		14	57	29		43	57			
JUOS/ARTRV/ORHY		57	29	14		71	29		14	71	14		
JUOS/ARTRW/STCO	25	75				75	25				25	50	25
JUOS/SYOR/AGSP	13	75	13			88	13		13	50	25	13	
JUSC-CELE/SYOR/AGSP	29	57		14	29	57		14		100			
JUSC/ARTRV-SYOR/ELCI		25	75			50	50			25	50	25	
JUSC/ARTRW			50	50			50	50				100	
JUSC/ARTRW-CHMI	17		17	67	17		17	67	17			67	17
JUSC/HANA	20	20	7	53	27	20	7	47	40	7		47	7
JUSC/HODU	100				100				86	14			
PIMO-CELE/HODU/ELCI	57	14	29		57	29	14			71	29		
PIMO-CELE/POSE	33	28	11	28	17	61	6	17	6	72	11	11	
PIMO-CELE/SYOR-BERE/AGSP	80	20			40	60			20	80			
PIMO-JUOS/AGSP	14	57	29		14	57		29	29	57	14		
PIMO-JUOS/ARNO/POSE		67	11	22		56	22	22		89		11	
PIMO-JUOS/ARTRV/AGSP	22	33	22	22	33	44		22	22	78			

Table 7. Summary of surface substrate and organic material. The mean (M) and standard deviation (SD) of the percent cover of substrate (bedrock, boulder, cobble, stone, gravel, or soil) and organic (leaf litter, moss, and lichen) materials is summarized by plant association.

Plant Association	Bedrock		Boulder		Cobble		Stone		Gravel		Soil		Litter		Moss		Lichen	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
CELE/SYOR/BASA/AGSP	1	1	0	0	5	7	1	1	5	4	5	4	44	21	0	0	0	0
JUOS-CELE/SYOR/AGSP	0	0	0	0	5	7	3	1	3	3	5	0	8	4	0	0	1	0
JUOS/ARAR/AGSP	2	3	5	7	5	5	9	7	8	9	3	2	9	6	1	1	4	6
JUOS/ARAR/FEID	2	5	1	1	9	8	7	5	16	5	2	1	12	10	7	11	4	4
JUOS/ARNO/AGSP	0	0	0	0	12	8	8	8	6	3	2	2	5	6	0	0	2	3
JUOS/ARNO/POSE	1	3	0	0	14	9	13	9	30	11	0	1	10	11	1	1	13	25
JUOS/ARTRV/AGSP	5	9	0	0	6	4	5	5	8	7	6	5	16	8	1	2	1	2
JUOS/ARTRV/FEID	0	0	0	0	2	2	1	2	7	7	4	5	8	6	7	7	1	1
JUOS/ARTRV/ORHY	0	1	1	1	15	8	9	8	11	6	12	6	11	9	6	8	1	0
JUOS/ARTRW/STCO	0	0	0	1	1	1	1	3	2	1	18	10	11	6	13	9	0	0
JUOS/SYOR/AGSP	0	0	0	0	4	5	9	8	6	5	3	3	26	10	1	1	0	0
JUSC-CELE/SYOR/AGSP	4	5	0	1	5	6	2	2	10	3	7	3	22	6	1	1	1	1
JUSC/ARTRV-SYOR/ELCI	0	0	0	0	3	5	8	9	1	1	2	1	7	5	0	0	1	1
JUSC/ARTRW	0	0	0	0	0	0	0	0	0	0	5	0	33	11	3	4	0	0
JUSC/ARTRW-CHMI	73	19	2	4	0	0	2	3	0	0	1	2	17	17	53	16	26	21
JUSC/HANA	89	8	0	0	2	5	1	1	0	1	1	1	4	4	48	22	29	12
JUSC/HODU	94	2	0	0	1	2	1	2	1	1	0	0	1	1	23	17	44	8
PIMO-CELE/HODU/ELCI	3	6	21	14	0	0	1	2	0	0	3	4	48	23	2	4	11	11
PIMO-CELE/POSE	4	12	12	13	2	4	3	4	1	2	12	16	45	17	2	2	5	7
PIMO-CELE/SYOR-BERE/AGSP	0	0	5	9	0	0	2	2	1	2	4	6	42	13	1	0	1	0
PIMO-JUOS/AGSP	0	0	0	0	3	2	15	10	3	3	2	1	19	12	1	1	3	4
PIMO-JUOS/ARNO/POSE	4	5	2	2	9	6	27	17	7	6	4	5	24	10	11	7	5	3
PIMO-JUOS/ARTRV/AGSP	1	2	4	10	2	2	21	18	9	19	3	3	22	16	5	7	9	12

Table 8. Summary of geological parent material. The frequency distribution of plots within general lithographic classes is summarized by plant association.

Plant Association	Lithography						
	Carbonate	Felsic pyroclastic	Granite	Mafic volcanic flow	Mixed carbonate	Mixed miogeo-synclinal	Sandstone
CELE/SYOR/BASA/AGSP						100	
JUOS-CELE/SYOR/AGSP						50	50
JUOS/ARAR/AGSP		13			17		71
JUOS/ARAR/FEID		90					10
JUOS/ARNO/AGSP		60					40
JUOS/ARNO/POSE		100					
JUOS/ARTRV/AGSP	44	11					44
JUOS/ARTRV/FEID		57					43
JUOS/ARTRV/ORHY		29					71
JUOS/ARTRW/STCO							100
JUOS/SYOR/AGSP	13	75					13
JUSC-CELE/SYOR/AGSP						100	
JUSC/ARTRV-SYOR/ELCI					100		
JUSC/ARTRW				100			
JUSC/ARTRW-CHMI				100			
JUSC/HANA				100			
JUSC/HODU				100			
PIMO-CELE/HODU/ELCI			100				
PIMO-CELE/POSE	11		89				
PIMO-CELE/SYOR-BERE/AGSP	60		40				
PIMO-JUOS/AGSP		100					
PIMO-JUOS/ARNO/POSE	78						22
PIMO-JUOS/ARTRV/AGSP	44	22					33

Table 9. Summary of fuel status. The frequency distribution of plots by fuel class is summarized by plant association

Plant Association	Fuel Class[2]					
	0	1	2	4	5	6
CELE/SYOR/BASA/AGSP				25		75
JUOS-CELE/SYOR/AGSP			50			50
JUOS/ARAR/AGSP	4	70	26			
JUOS/ARAR/FEID		100				
JUOS/ARNO/AGSP	25	75				
JUOS/ARTRV/AGSP		22	44			33
JUOS/ARTRV/FEID		40	60			
JUOS/ARTRV/ORHY		100				
JUOS/ARTRW/STCO			100			
JUOS/SYOR/AGSP		38	38			25
JUSC-CELE/SYOR/AGSP			57			43
JUSC/ARTRV-SYOR/ELCI				50	25	25
JUSC/HANA	83	17				
JUSC/HODU	100					
PIMO-CELE/HODU/ELCI				29		71
PIMO-CELE/POSE	17	22	50	6		6
PIMO-CELE/SYOR-BERE/AGSP			60	40		
PIMO-JUOS/AGSP		100				
PIMO-JUOS/ARNO/POSE		67	33			
PIMO-JUOS/ARTRV/AGSP		75	25			

[2] Fuel Classes:

0 Unable to assess.
1 Fine, porous and continuous herbaceous fuels.
2 Fine herbaceous fuel with some litter and dead stemwood.
4 Forest and shrub stands with a continuous overstory and much flammable woody material.
5 Forest and shrub stands with light surface fuels little flammable woody material.
6 Open forest with shrubs or shrublands that have moderate flammable woody material.

APPENDIX 1: Annotated Bibliography

Introduction: Citations of literature on pinyon-juniper woodland ecology, and related topics, are listed followed by (indented) (1) the source abstract code (this is useful for requesting literature from Idaho Conservation Data Center) and (2) the abstract.

Aldon, E. F. and D. W. Shaw, technical coordinators. 1993. Managing Pinon-Juniper Ecosystems for Sustainability and Social Needs; proceedings of the symposium 1993 April 26-30; Sante Fe, New Mexico. Gen. Tech. Rep. RM-236. U. S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experimental Station, Fort Collins.

U93ALD01IDUS

The purpose of this symposium was to assist the USDA Forest Service, other federal land management agencies, and the New Mexicio State Land Office in the future development and management of the pinon-juniper ecosystem in the Southwest. Authors assessed the current state of knowledge about pinon-juniper resource and helped develop future research and management goals. Numerous papers are presented. See papers by Pieper, Van Pelt and Johnson, Ladyman et al., Rogers, Suminski, and Goodloe.

Anderson J. E., K. T. Ruppel, J. M. Glennon, K. E. Holte, and R. C. Rope. 1996. Plant communities, ethnoecology, and flora of the Idaho National Engineering Laboratory. Environmental Science and Research Foundation Report Series, Number 005. Environmental Science and Research Foundation, Idaho Falls. 111 p., map.!B96AND01IDUS

The document provides a summary of the vegetation, prehistoric human occupation, ethnobotany, and flora of the INEL reserve. Vegetation is summarized through a relatively classification of existing vegetation. Ten cover types are described and mapped for the area. Ethnobotanical and floristic information is summarized in tabular form. The document provides an extensive plant species list for the area. Appendix 1 provides an annotated bibliography of vegetation studies conducted in the area. Utah juniper woodlands within the area are delineated as a discrete mapping unit.

Anderson, J. E. 1991. Vegetation Studies Support the NPR Environmental Impact Statement, Final Report. Unpublished report prepared for Idaho National Engineering Laboratory by Department of Biological Sciences, Idaho State University, Pocatello. 171 pp.

U91AND02IDUS

The purpose of this vegetation study was to provide information needed for preparation of an Environmental Impact Statement concerning construction of a New Production Reactor (NPR) at the Idaho National Engineering Laboratory (INEL). The study addressed two major objectives: (1) to quantify and characterize the vegetation at the NPR site, and (2) to collect vegetation data needed for refinement and verification of the INEL surface feature map produced by the Idaho Department of Water Resources (IDWR). In addition samples were taken from a subset of the INEL long-term vegetation monitoring sites to link current NPR-site samples to the long-term data base. Juniper-dominated vegetation is classified within one type, Juniper Woodland. The plots appear to represent a range of different juniper communities similar to those observed at other sites in Idaho.

Arno, S. F. 1985. Ecological effects and management implications of Indian fires. Pages 81-86 in J. E. Lotan, B. M. Kilgore, W. C. Fischer, and R. W. Mutch, technical coordinators, Proceedings-Symposium and Workshop on Wilderness Fire. USDA Forest Service General Technical Report INT-182. Intermountain Forest and Range Experiment Station, Ogden, UT.

A85ARN01IDUS

Current evidence suggests Indian fires substantially augmented those set by lightning in grassland, shrubland, and certain low-elevation forest types for a millenium before settlement by Euro-Americans. In some large areas Indian fires apparently had a marked and continuing influence on vegetation. Managers of wilderness and other natural areas should assess the probable effects of past Indian fires on their ecosystems and consider this information in developing management alternatives. The paper includes a section on fire in pinyon-juniper vegetation.

Barney, M. A., and N. C. Frischknecht. 1974. Vegetation changes following fire in the pinyon-juniper type of west-central Utah. Journal of Range Management 27(2): 91-96.

A74BAR01IDUS

The stages of succession following fire began with weedy annuals that reached a peak within 3 to 4 years. Juniper woodlands were well developed 85 to 90 years following fire. Intermediate stages of succession varied, but followed a general pattern of perennial grasses, perennial grasses-shrubs, and perennial grasses-shrubs-trees. The percentage of dead sagebrush was positively correlated with density of junipers. 33 years was the average minimum age at which Utah juniper produced seed.

Beiswenger, J. M. 1991. Late Quaternary vegetational history of Grays Lake, Idaho. Ecological Monographs 61(2): 165-182.

A91BEI01IDUS

Pollen contained in sediment cores from Grays Lake, Idaho, indicate cold, dry conditions from ca 70,000 to 30,000 yr BP when an Artemisia steppe surrounded Grays Lake and extended into the nearby mountains. From ca 30,000 until 11,500 yr BP, moist conditions supported a conifer woodland. Pinus and other conifers grew in the foothills among Artemisia on the open plains. Increases in Picea, Abies, and Artemisia signaled the onset of a cool transitional climate ca 11,500 yr BP. *Juniperus* and members of the Chenopodiaceae/Amaranthaceae and Compositae families all became more abundant as climate became warmer and drier. Xeric conditions persisted from ca 10,000 to 7,100 yr BP, reaching a maximum ca 8,200 yr BP. Subsequently, the climate of the Grays Lake Basin has been cooler and more moist, with increases in conifers and decreases in *Juniperus* and steppe plants.

Blackburn, W. H., P. T. Tueller and R. E. Eckert Jr. 1968a. Vegetation and soils of the Mill Creek Watershed. Nevada Agricultural Experiment Station Bulletin R-43. Reno. 69 pp.

U68BLA02IDUS

The authors provide a classification and description of Utah juniper- and singleleaf pinyon pine-dominated plant communities observed in the Mill Creek Watershed, located in north-central Nevada. Associated plant communities are dominated by serviceberry, low sagebrush, big sagebrush, and shadscale. The Juniperus osteosperma/Artemisia tridentata, Pinus monophylla/Juniperus osteosperma, and Pinus monophylla/Juniperus osteosperma/Artemisia tridentata communities described for the watershed appear similar to Utah juniper- and singleleaf pinyon pine-dominated plant communities observed in Idaho.

Blackburn, W. H., P. T. Tueller and R. E. Eckert Jr. 1968c. Vegetation and soils of the Duckwater Watershed. Nevada Agricultural Experiment Station Bulletin R40. Reno. 76 pp.

U68BLA01IDUS

The authors provide a classification and description of Utah juniper- and singleleaf pinyon pine-dominated plant communities observed in the Duckwater Watershed, located in central Nevada. They describe associated plant communities dominated by low sagebrush, big sagebrush, and shadscale. The Juniperus osteosperma/Artemisia nova, Juniperus osteosperma/Artemisia tridentata community described for the watershed appears similar to Utah juniper-dominated plant communities observed in Idaho.

Blackburn, W. H., P. T. Tueller and R. E. Eckert, Jr. 1969. Vegetation and soils of the Cow Creek Watershed. Nevada Agricultural Experiment Station Bulletin R-49. Reno. 80 pp.

U69BLA01IDUS

The authors provide a classification and description of Utah juniper-dominated plant communities observed in the Cow Creek Watershed, located in northwestern Nevada. They describe associated plant communities dominated by low sagebrush, big sagebrush, and shadscale. The Juniperus osteosperma/Artemisia arbuscula/Poa secunda and Juniperus osteosperma/Artemisia tridentata/Poa secunda communities they describe for the watershed appear similar to Utah juniper-dominated plant communities observed in Idaho.

Blackburn, W. H., P. T. Tueller, and R. E. Eckert Jr. 1971. Vegetation and soils of the Rock Springs Watershed. Nevada Agricultural Experiment Station Bulletin R-83. Reno. 116 pp.

A71BLA01IDUS

The authors provide a classification and description of Utah juniper-dominated plant communities observed in the Rock Springs Watershed, located in northeastern Nevada. Associated plant communities are dominated by serviceberry, low sagebrush, black sagebrush, big sagebrush, Baltic rush, and aspen. Composition is summarized by synthesis tables and descriptive text. Their Juniperus osteosperma/Chrysothamnus viscidiflorus/Bromus tectorum community is similar to Utah juniper-dominated plant communities observed in Idaho. The Juniperus osteosperma, Juniperus osteosperma/Artemisia nova, Juniperus osteosperma/Artemisia nova/Agropyron spicatum, Juniperus osteosperma/Artemisia tridentata/Agropyron spicatum, and Juniperus osteosperma/Artemisia tridentata/Stipa comata communities described for the watershed appear similar to Utah juniper-dominated plant communities observed in Idaho.

Blackburn, W. H., R. E. Eckert Jr. and P. T. Tueller. 1969. Vegetation and soils of the Crane Springs Watershed. Nevada Agricultural Experiment Station Bulletin R-55. Reno. 63 pp.

A69BLA03IDUS

The authors provide a classification and description of Utah juniper-dominated plant communities observed in the Crane Springs Watershed, located in northeastern Nevada. Associated plant communities are dominated by low sagebrush,

black sagebrush, big sagebrush, and shadscale. Composition is summarized in synthesis tables and descriptive text. Their Juniperus osteosperma/Chrysothamnus viscidiflorus/Bromus tectorum community is similar to Utah juniper-dominated plant communities observed in Idaho.

Boccard, B. 1980. Important Fish and Wildlife Habitats of Idaho: An Inventory. USDI Fish and Wildlife Service, Oregon-Idaho Area Office, Boise, ID. 165 pp.

B80BOC01IDUS

The report provide an inventory and evaluation of sites for the conservation of fish and wildlife populations and habitats. The report identifies juniper - mountain mahogany woodland and juniper woodland as “Idaho Habitats” (Idaho Department of Fish and Game, 1976). These vegetation units and associated wildlife habitat values are described. Priority ranking criteria for the identification of conservation sites are identified. The areal extent and priority ranking of each habitat, or vegetation, unit is estimated.

Bradley, A. F., W. C. Fischer, and N. V. William. 1992. Fire ecology of forest woodlands in Utah. General Technical Report INT-287. Ogden, UT: USDA Forest Service, Intermountain Research Station. 128 pp.

B92BRA02IDUS

Information on fire as an ecoloical factor in forest habitat types, in pinyon-juniper woodland, and oak-maple brushland communities occurring in Utah is summarized. Fire Groups are identified on the basis of the role of fire in forest succession. The publication describes forest fuels and suggests considerations for fire management. Pinyon-juniper woodlands are described as Fire Group 1.

Brown, D. E., ed. 1982. Biotic communities of the American Southwest - United States and Mexico. Desert Plants, Special Issue 4(1-4): 342 pp.

B82BRO01IDUS

The biotic communities of Southwestern North America are described. Chapters on tundra, forest and woodland, scrubland, grassland, desertlands, and wetland vegetation are presented.

Bruner, A. D. and D. A. Klebenow. 1979. Predicting success of prescribed fires in pinyon-juniper woodlands in Nevada. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT. Research Paper INT-219. 12 pp.

U79BRU01IDUS

Thirty prescribed burns were attempted in pinyon-juniper woodlands from fall 1974 to fall 1976. These attempts were made at different times in the fire season, during varied atmospheric conditions, and in a range of different pinyon-juniper communities. An analysis of the successful burns provided researchers with a method for predicting burning success from windspeed, air temperature, and vegetation cover. An igniting technique is also discussed.

Bunting, S. C. 1994. Effects of fire on juniper woodland ecosystems in the Great Basin. Page 53 in S. B. Monsen and S. G. Stanley, compilers, Proceedings-ecology and management of annual rangelands. USDA Forest Service General Technical Report INT-GTR-313. Intermountain Research Station, Ogden, UT. 416 pp.

A94BUN01IDUS

Juniper has invaded adjacent vegetation types throughout much of its worldwide range and is characteristic of these woodlands. In the Western United States this vegetation change has affected millions of hectares. Fire history studies for juniper-dominated areas indicate that fire-free intervals of 50 years or less would probably have checked this advance during the pristine period. However, the number of fire ignitions we currently receive does not seem adequate given the dissected nature of the topography and the discontinuous fuels of these areas. Alternative scenarios are suggested to explain this inconsistency.

Burkhardt, J. W., and E. W. Tisdale. 1969. Nature and successional status of western juniper vegetation in Idaho. Journal of Range Management 22: 264-270.

A69BUR01IDUS

The similarities and differences of invasive versus climax stands of *Juniperus occidentalis* are described.

Burkhardt, J. W., and E. W. Tisdale. 1976. Causes of juniper invasion in southwestern Idaho. Ecology 57: 472-484.

A76BUR01IDUS

The relationship of fire to western juniper invasion into vegetation dominated by mountain big sagebrush and

bunchgrasses is discussed.

Caicco, S. L. 1987. National Natural Landmark evaluation for the Hell's Half Acre Lava Field (Idaho). Report prepared for the Department of Interior-National Park Service, Seattle, WA. 23 pp.

U87CAI02IDUS

The National Natural Landmark site evaluation provides a description of the vegation and flora of Hell's Half Acre Lava Field (Idaho Falls District, BLM). Both Juniperus osteosperma and Juniperus scopulorum are identified as occurring on the site. The report includes a plant species list.

Caicco, S. L., J. M. Scott, B. Butterfield, and B. Csuti. 1995. A gap analysis of the management status of the vegetation of Idaho. Conservation Biology 9(3): 498-511.

A95CAI01IDUS

Researchers compiled a 1:500,000 scale map of the actual vegetation of the state of Idaho from existing vegetation maps, LANDSAT MSS satellite imagery, and aerial photography. An accuracy assessment showed 92.7% of the polygons to be correctly classified. The map was digitized as a layer in a Geographic Information System (GIS) using ARC/INFO software. Land ownership was also digitized from existing maps. Ownership tracts were assigned a protection level based on opportunities provided for management for conservation of biological diversity. Vegetation and management status layers were then compared to assess the extent and degree of protection afforded to 71 vegetation and land-use categories. Six vegetation complexes were identified with no protection and five vegetation complexes for which protection is less than 1000 ha each. An additional 18 vegetation types have total protection in the ranges between 1001-5000 ha and 5001-10,000 ha. Most of these 29 vegetation types are shrub-steppe complexes or conifer/steppe mosaics. Economically valuable montane forests of western redcedar, western hemlock, and grand fir, as well as subalpine woodlands and forests of mountain hemlock, are also poorly represented in protected areas. Most opportunity for increasing protection of these types lies on land managed by federal agencies. Other trends in the data include poor geographic representation, small area of individual protected occurrences, relatively good protection in Idaho but less outside of the state, and protection poor in Idaho but widespread elsewhere. The major limitation of the analysis is a lack of detail on the ecological status of vegetation types. Information on the structure of forest types as well as data on the understory composition of the shrub-steppe complexes is lacking. The study shows gap analysis to be an efficient and useful method of assessing the extent and degree of protection of land-cover types and associated biodiversity over an area exceeding 200,000 sq km.

Covington, W. W., R. L. Everett, R. W. Steele, L. L. Irwin, T. A. Daer, and A. N. D. Auclair. 1993. Historical and anticipated changes in forest ecosystems of the Inland West of the United States. Pages 1-55 in R. N. Sampson, and D. Adams, editors. Assessing forest ecosystem health in the Inland West. Proceedings of the American Forests Scientific Workshop. November 15-19, 1993, Sun Valley, ID. Journal of Sustainable Forestry.

A93COV01IDUS

Euro-American settlement of the Inland West has altered forest and woodland landscapes, species composition, disturbance regimes, and resource conditions. Public concern over the loss of selected species and unique habitats (e.g. old-growth) has caused us to neglect the more pervasive problem of declining ecosystem health. Population explosions of trees, exotic weed species, insects, diseases, and humans are stressing natural systems. In particular, fire exclusion, grazing, and timber harvest have created anomalous ecosystem structures, landscape patterns, and disturbance regimes that are not consistent with the evolutionary history of the indigenous biota. Continuation of historical trends of climate change, modified atmospheric chemistry, tree density increases, and catastrophic disturbances seems certain. However, ecosystem management strategies including the initiation of management experiments can facilitate the adaptation of both social and ecological systems to these anticipatd changes.

Daubenmire, R. F. 1943. Vegetational zonation in the Rocky Mountains. The Botanical Review 9(6): 325-393.

A43DAU02IDUS

The article summarizes literature on, and observations of, relationships between physical environmental factors and the distribution of vegetion in the Rocky Mountains. The author describes juniper-pinyon vegetation as occurring at the lower tree-limit within the Rocky Mountains.

Daubenmire, R. F. 1952. Plant geography of Idaho. Pages 1-17 in Davis, R. J. Flora of Idaho. Brigham Young University Press, Provo.

A52DAU02IDUS

Daubenmire provides a summary of the plant geography of Idaho. Juniper-pinyon is identified as a vegetation zone of southern Idaho. This vegetation is described as occurring on rocky hills and low mountains projecting above the sagebrush plain. The distibution of the vegetation type is described as “very spotty”. Cercocarpus leifolius, Juniperus

osteosperma, and Pinus monophylla are identified as species which appear to have entered Idaho as a result of migration northward along the Rocky Mountains.

Dealy, J. E., D. A. Leckenby, and D. M. Concannon. 1981. Wildlife habitats in managed rangelands - the Great Basin of southeastern Oregon: plant communities and their importance to wildlife. USDA Forest Service General Technical Report PNW-120, Pacific Northwest Forest and Range Experiment Station, Portland, OR. 66 pp.

U81DEA01IDUS

Plant communities in the Great Basin of southeastern Oregon are described, and a field key is provided. The value of vertical and horizontal structure and the seasonal availability of forage are examined in relation to wildlife habitat in managed rangelands. The importance of individual and combined plant communities to wildlife in managed rangelands is discussed.

Dealy, J. E., J. M. Geist, and R. S. Driscoll. 1978. Communities of western juniper in the Intermountain North- west. Pages 11-29 in Proceedings of the Western Juniper Ecology and Management Workshop, Bend, OR, Jan. 1977. USDA Forest Service General Technical Report PNW-74.

A78DEA01IDUS

The authors summarize work on the ecology of western juniper communities. Information on the relationships between the distribution of juniper and soil/site factors are described. The authors suggest that sites occupied by mountain big sagebrush are particularly susceptible to juniper expansion.

Driscoll, R. S. 1964. Vegetation-soil units in the central Oregon juniper zone. USDA Forest Service Research Paper PNW-19. Pacific Northwest Forest and Range Experiment Station, Portland, OR. 60 pp.

U64DRI01IDUS

This investigation provides a classification scheme in which the vegetational and soil components of nine ecosystems and variants of two are named and characterized on the premise that they exist as demonstrable entities with both independent and intergrading characteristics. Each plant association of the central Oregon juniper zone is classified and described together with its related soil and topographic characteristics.

Eddleman, L. E., P. M. Miller, R. F. Miller, and P. L. Dysart. 1994. Western juniper woodlands (of the Pacific Northwest) - science assessment. Unpublished report prepared for the Eastside Ecosystem Management Project. 131 pp.

U94EDD01IDUS

This report summarizes current knowledge of western juniper woodlands in the Pacific Northwest. Included are discussions of current and historic distribution, species biology, physiological ecology of western juniper and associated species, ecology of western juniper woodlands, hydrologic cycle, wildlife in the woodlands, conversion of the woodlands, and grazing management in the woodlands.

Evans, R. A. 1988. Management of pinyon-juniper woodlands. USDA Forest Service General Technical Report INT-249. Intermountain Research Station, Ogden, UT. 34 pp.

U88EVA01IDUS

The author provides a summary and compilation of information on the ecology and management of pinyon-juniper woodlands. Pinyon-juniper woodlands are extensive in the western United States and are a valuable renewable resource for many uses. Past use and misuse has left many of these woodlands in a degraded condition. Wildlife habitat needs improvement in specific areas of the pinyon-juniper woodlands, but criteria need to be applied as to what areas to improve and what methods to use. More information is needed on watershed characteristics and how the use and management of the woodlands is affecting them.

Everett, R. L., compiler. 1986. Proceedings--pinyon-juniper conference; 1986, January 13-16; Reno, NV. General Techinical Report INT-215. Ogcen, UT: U. S. Department of Agriculture, Forest Service, Intermountain Research Station; 1987. 581 p.

B86EVE01IDUS

Compilation of ninety papers concerning the ecology and management of pinyon-juniper ecosystems. The volume contains numerous papers regarding the following subject areas: synecology, fire, inventory and classification, silvics and silviculture, nutrient cycling, plant-water relations, and woodland wildlife.

Everett, R. and W. Clary. 1985. Fire effects and revegetation on juniper-pinyon woodlands. Pages 33-37 in K. Sanders et al., editors, Rangeland Fire Effects: a Symposium. USDI Bureau of Land Management, Idaho State Office, Boise.

A85EVE01IDUS

Fire is a natural phenomenon in juniper-pinyon-sagebrush ecosystems, but fire may now produce plant communities different from what occured before the influence of man. Lack of indigenous understory species and the invasion of alien annual weeds now create new postfire community types. Mechanically created firebreaks disturb the soil surface and set back plant succession. Whether chained and seeded strips can be used as firebreaks in closed stands to improve burn success and postfire response is unknown. Adverse impacts of burning slash on soil nutrients, understory productivity, and watershed characteristics make this practice of dubious value. The "Initial Floristics" successional model typifies postfire succession. Most species in the sere are present on the site shortly after disturbance. Many annual and perennial forb species have only a short period in which to recharge soil seed reserves and provide seed to other disturbed sites. Seeeding burns may be the only way to restore the grass successional stage to many of the overgrazed woodlands. Broadcast seeding success following fire has been variable, but could be improved by considering slope, aspect, and elevational effects. Postfire cultural treatments drilling and chaining increase seeded species establishment over that of aerial braodcast seeding alone. Seeded plant establishment was directly proportional to the intensity of postharvest cultural treatment. In a wildfire seeding study aerial seeding produced the least seeded plant cover (0.1%) and double drilling the greatest (13.8%).

Everett, R. L. and S. H. Sharrow. 1983. Response of species to three harvesting and fire in pinyon-juniper woodlands. In: Monsen, S. B., and N. Shaw, compilers. Managing Intermountain rangelands - improvement of range and wildlife habitats: proceedings; 1981, September 15-17; Twin Falls, ID; 1982, June 22-24; Elko, NV. General Technical Report INT-157. Ogden, UT: USDA Forest Service, Intermountain Forest and Range Experimental Station. 194 pp.

B83MON01IDUS
In pinyon-juniper woodlands, the abundance of understory species declines with succession due to intense tree competition for soil moisture, light, and nutrients. Fire and tree harvesting have been used successfully to increase understory production of pinyon-juniper woodlands when applied at the proper seral stage. Natural response is variable among sites and exhibits multiple entrance points into the successional model. Burning and tree harvesting stimulate reestablishment of early- to mid-successional species within the pinyon-juniper successional process. The response of understory species is most favorable when desirable species already present are capable of utilizing released resources and occur in sufficient quantities to do so.

Ffolliott, P. F., et al., technical coordinators. 1996. Effects of fire on Madrean province Ecosystems - a symposium proceedings. 1996, March 11-15; Tucson, AZ. General Technical Report RM-GTR-289. Fort Collins, CO. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. 277 pp.

B96FFO01IDUS

This second conference on the Madrean Archipelago/Sky Island ecosystem brought together scientists, managers, and resource specialists from government, universities, and private organizations in the United States and Mexico to explore the effects of fire on Madrean Province ecosystem, and how fire can be incorporated in an ecosystem approach to both research and management. See the articles by Kruse et al. (regarding the role of fire in pinyon-juniper woodland development) and Ganey et al. (regarding the effects of fire on birds of pinyon-juniper woodlands).

Gottfried, G. J., and K. E. Severson. 1994. Managing pinyon-juniper woodlands. Rangelands 16(6): 234-236.

A94GOT01IDUS

Conflict and confusion over managing pinyon-juniper woodlands, coupled with an ecosystem approach to management adopted by some federal agencies, suggest that attitudes towards woodlands be re-evaluated. Multi resource goals have been legally mandated on most public lands. Although single resource goals may often be targets on private lands, decisions attempt to ensure maximum return without jeopardizing site productivity. The differences among pinyon-juniper sites must be recognized during development and implementation of management strategies. More scientific information is needed for developing holistic strategies for pinyon-juniper woodlands. The authors briefly describe management options and discuss informational shortcomings that could affect implementation, particularly in the Southwest.

Grossman, D. H., K. L. Goodin, and C. L. Reuss, editors. 1994. Rare plant communities of the coterminous United States - an initial survey. Prepared for the USDI Fish and Wildlife Service. The Nature Conservancy, Arlington, VA. 620 pp.

B94GRO01IDUS

This preliminary list was compiled by evaluating all communities reported by the Heritage Programs to be rare at the state level. Each rare state type was reviewed by inter-regional teams and reclassified within the standards of the Conservancy's national classification system. The ecological communities were then assigned a global rank, and descriptions of the nationally rare types were completed using existing information. A total of 371 globally rare terrestrial vegetated communities within the coterminous United States are described in this report. An additional 482 types have been identified that require further research before their classification, ranks or description can be completed. State and regional information gaps have also been documented. The rare community types are reported for each region of The Nature Conservancy. Several pinyon-juniper communities are identified as both most rare and most poorly understood. A

number of these “rare” pinyon-juniper communities are described as only occurring in Idaho.

Hall, F. C. 1973. Plant Communities of the Blue Mountains in Eastern Oregon and Southeastern Washington. USDA Forest Service R6-8200-1. Pacific Northwest Region. 46 pp.

B73HAL01IDUS

The publication provides a classification and description of fourty-three communities in eastern Oregon and southeastern Washington. Range condition guides are included. The dominant species, productivity, physical sites attributes are summarized.

Holmgren, N. H. 1972. Plant geography of the Intermountain region. Pages 77-161 in A. R. Cronquist, A. H. Holmgren, N. H. Holmgren, and J. L. Reveal. Intermountain Flora: Vascular Plants of the Intermountain West, USA. Volume 1. Hafner Publishing Company, Inc., New York.

A72HOL01IDUS

A discussion of the plant geography of the Intermountain west is presented with a classification of floristic divisions and a discussion of vegetation zones. The author provides a map of pinyon-juniper vegetation within the Intermountain region. The distribution, structure, and species composition of pinyon-juniper woodlands within the region are described.

Jensen, M. E. 1984. Some edaphic relations of southeastern Idaho wildlands. Great Basin Naturalist 44(2): 265-271.

A84JEN01IDUS

Soil samples from the A1 horizon and dominant subsoil horizon at 190 sites were analyzed for Ca, Mg, K, P, and organic matter contents in conjunction with a soil resource inventory of the Caribou National Forest. Vegetation composition and production data were compared to the edaphic factors to derive relationships useful to the land manager. Organic matter was effective in distinguishing between soil orders and was positively correlated to vegetation production. Vegetative cycling of the nutrients P and K was most pronounced in soils of the order Mollisols, to a lesser degree in the Allisols, and not at all in the Entisols. The K/Mg ratio of the soil showed a negative correlation to grass production and a positive correlation with shrub production. An interpretive table is provided to aid determination of high versus low values for the edaphic factors studied. Juniper woodland vegetation occured on 36 sites. Soils at these sites where classified as Typic Argixerolls, Typic Hpaloxerolls, and Xerorthents.

Johnson, B. C. 1989. Woodland classification: the Pinyon-Juniper Formation. Pages 160-166 in Ferguson, D. E., P. Morgan, and F. D. Johnson, compilers, Proceedings-Land classifications based on vegetation: applications for resource management. USDA Forest Service General Technical Report INT-252. Intermountain Research Station, Ogden, UT.

A89JOH03IDUS

The climax stands in the Pinyon-Juniper Formation (woodland) can be divided into two subformations: Juniper-Pinyon Woodland, with nine series; and Juniper Steppe Woodland, with two series. Plant associations (habitat types) have been described for most of these series. Challenges of woodland classification include lack of relict stands, properly accounting for codominance without complicating nomenclature, invasion of junipers and pinyons into adjacent ecosystems, and coordination of plant association classification with soils and landform associations.

Johnson, C. G., Jr., R. R. Clausnitzer, P. J. Mehringer, and C. D. Oliver. 1994. Biotic and abiotic processes of eastside ecosystems: the effects of management on plant and community ecology, and on stand and landscape vegetation dynamics. USDA Forest Service General Technical Report PNW-GTR-322. Pacific Northwest Research Station, Portland, OR. 66 pp.

U94JOH02IDUS

Paleovegetation studies have shown that vegetation has changed in composition and extent in the intermountain Pacific Northwest over the past 20,000 years. Today, both natural and human-induced disturbances have long-term influence on the structure and composition of eastside vegetation. Disturbance may enhance landscape diversity; therefore, the scale of modifying events and activities needs to shift from species and stand to the andscape level. Knowledge of plant succession is the foundation of a sound vegetation management program where the primary goal is to retard, arrest, or accelerate the natural forces of vegetation change. The study of fossil-plant assemblages from woodrat middens of northwestern Nevada provide evidence for a thirty thousand year presence of Utha juniper and the arrival of pinyon pine only 1700 to 1000 years ago.

Johnson, K. L. 1986. Sagebrush over time: a photographic study of rangeland change. Pages 223-252 in E. D. McArthur and B. L. Welch, compilers, Proceedings- Symposium on the Biology of Artemisia and Chrysothamnus. USDA Forest Service General Technical Report INT-200. Intermountain Research Station, Ogden, UT.

A86JOH01IDUS

The nature of the big sagebrush zone in presettlement times is an enduring question that cannot be answered definitively. Comparison of presettlement photographs with modern retakes of the same sites, however, provides useful information. This study compares 20 current photographs of Rocky Mountain sagebrush rangeland with those taken by William H. Jackson during the 1870's as a member of the US Geological and Geographical Survey of the Territories (Hayden Expedition). The photographs were selected to illustrate different site responses: 1) sagebrush decrease or destruction, 2) sagebrush stability, 3) sagebrush increase or establishment, and 4) combination effects. Comparative analysis indicates that: 1) the reaction of big sagebrush to use and management is highly site-specific and a function of the kind of use and site characteristics; 2) shifts in composition and density of species have occured but their magnitude cannot be assessed, although they probably range from slight to major change; 3) there has been no major shift in sagebrush distribution as a result of use; and 4) the appearance of the landscape today is a fair indication of its appearance in presettlement times. Many of the images show changes in juniper woodland vegetation.

Knight, D.H., G.P. Jones, Y. Akashi, and R.W. Myers. 1987. Vegetation ecology in the Bighorn Canyon National Recreation Area. Unpublished report prepared for the USDI National Park Service and the Univ.of Wyoming-Nat. Park Service Research

U87KNI02IDUS

The ecology of terrestrial vegetation in the Bighorn Canyon National Recreation Area (BCNRA) was studied during the period 1984 - 1986. A classification of the vegetation was developed from data collected within seventy-five stands distributed throughout the area. Fourty percent of the area is dominated by juniper/curlleaf mountain mahohany woodland. This woodland vegetation typically occurs on shallow soils and fractured bedrock. Rock fissures may serve to increase moisture availability to Utah juniper and curlleaf mountain mahohany due to rapid infiltration and reduced evaporation. Utah juniper and curlleaf mountain mahohany communities are classified on the basis of the abundance of the respective species.

Krammes, J. S., technical coordinator. 1990. Proceedings - Symposium on the effects of fire management of Southwestern natural resources. November 15-17, 1988, Tuscon, AZ. USDA Forest Service General Technical Report RM-191. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 293 pp.

B90KRA01IDUS

The proceedings is a collection of papers and posters presented at the Symposium on Effects of Fire Mangement of Southwestern Natural Resources held in Tuscon, AZ, November 15-17, 1988. Included are papers, poster papers, and a comprehensive list of references on the effects of fire on: plant succession, cultural resources, hydrology, range and wildlife resources, soils, recreation, smoke management, and monitoring techniques pertinent to prescribed fire management in the southwestern United States. See papers by Covington and DeBano (effects of fire on pinyon-juniper soils), Wittie and McDaniel (herbicide and fire treatments), Klopatek et al. (effect of fire on microbial processes in pinyon-juniper woodland), and Weise (survival of singleleaf pinyon after wildfire).

LaRoe, E. T., G. S. Farris, C. E. Puckett, P. D. Doran, and M. J. Mac, editors. 1995. Our living resources: a report to the nation on the distribution, abundance, and health of U.S. plants, animals and ecosystems. U.S. Department of the Interior, National Biological Service, Washington, D.C. 530 pp.

B95LAR01IDUS

The first in a series of reports by the NBS on the status and trends of the nations plants, animals, and ecosystems. The report is broken into three parts: an introduction; distribution, abundance, and health; and special issues. The introduction provides an overview of the entire report and discusses biodiversity and gives background on the role and history of the NBS. The section on distribution, abundance and health is split into sections: species (with subsections on: birds, mammals, reptiles and amphibians, fishes, invertebrates, and plants); ecosystems (with subsections on: terrestrial, aquatic, coastal and marine, and riparian); and ecoregions (with subsections on: The Great Plains, Interior West, Alaska, and Hawaii). The section on special issues includes the following topics: global climate change, human influences, non-native species, and habitat assessments. Articles throughout the report range from a broad scale overviews to specific case studies. The section, “Altered Fire Regimes within Fire-adapted Ecosystems (Ferry et al., page 222) includes a brief discussion of juniper woodlands.

Ladyman, J. A. R., E. Muldavin. Terrestrial cryptogams of pinyon-juniper woodlands in the southwestern United States: a review. USDA Forest Service General Technical Report RM-GTR-280. 33pp.

U96LAD01IDUS

Terrestrial cryptogams are comprised of algae, lichens, mosses, fungi, and liverworts. Because they are small and inconspicuous, they are commonly overlooked, yet they are important components of pinyon-juniper ecosystems of the Southwest. Terrestrial cryptogams provide soil structure, reduced soil erosion, contributes to nutrient cycling, and enhance nutrient status and ecosystem productivity. There is evidence that cryptogams occupy land that would otherwise be bare in pinyon-juniper communities. Research results do not support the belief that cryptogamic crusts compete with grass and other vascular plants. Fire and grazing are destructive to crusts. Technology to innoculate land to encourage recolonization by cryptogams is being developed. This review of literature indicates that there is a substantial amount of

quantitative evidence, both casual and correlative, that supports the premise that cryptogams in crusts perform important ecological functions. This is particularly true with respect to soil stabilization and nutrient cycling in the Southwest.

Lanner, R. M. 1971. Conifers of the Bear Lake area and mountains south of the Great Salt Lake. Great Basin Naturalist 31(2): 85-89.

A71LAN01IDUS

The article describes the distribution of coniferous tree species in the Bear Lake Plateau area (and other locations to the south). The author reports that Juniperus osteosperma occurs on north- and west-facing slopes of Bear Lake Plateau and in South Eden Canyon. Juniperus scopulorum is reported to occur with Pseudotsuga menziesii in North Eden Canyon.

Losensky, B. J. 1994. Historical vegetation types of the Interior Columbia River Basin. Unpublished report prepared for Systems for Environmental Management INT-94951-RJVA. 108 pp.

U94LOS01IDUS

The purpose of this paper is to provide a systematic assessment of vegetation in respect to the extent of each major cover type and, where appropriate, the age structure associated with the cover type. The historic distribution of pinyon-juniper woodland cover type within ecoregional sections of the Interior Columbia River Basin is described. Quantitative estimates are provided.

McBride, R., N. French, A. Dahl, and J. Detmer. 1978. Vegetation types and surface soils of the Idaho National Engineering Laboratory site. U.S. Department of Energy IDO-12084. Idaho Operations Office, Idaho Falls, ID. 29 pp.

B78MCB01IDUS

The authors provide a description of soils and vegetation of the Idaho National Engineering Laboratory reserve. Descriptions of vegetation accompany a vegetation map. The authors describe the community, Juniperus osteosperma/Artemisia tridentata/Agropyron spicatum, as supporting dense stands of Juniperus osteosperma, with Artemisia tridentata, Agropyron spicatum, and Oryzopsis hymenoides in varying degrees of abundance.

Mehringer, P. J. Jr., and P. E. Wigand. Comparison of late Holocene environments from woodrat middens and pollen: Diamond Craters, Oregon. Pages 294-325 in J. L. Betancourt, T. R. Van Devender, and P. S. Martin, eds., Packrat middens: The last 40,000 years of biotic change. The University of Arizona Press, Tucson.

B90MEH01IDUS

The study emphasizes the relationships of three kinds of information bearing on the vegetation history of southeastern Oregon - macrofossils from woodrat middens, pollen from woodrat middens, and pollen from cores. The most detailed information for a single time and location comes from woodrat midden macrofossils. This series of data indicate a landscape with juniper more widespread (but otherwise little different) than today. Analysis of pollen from middens confirmed the preeminence of juniper and sagebrush, though this data had limited utility due to uncertainty of the source of pollen. Pollen cores from Diamond Pond revealed the pace and regional consequences of environmental change. Together, midden macrofossils and Diamond Pond microfossils suggest a cycle of periodic juniper expansion to a lower elevational limit during episodes of favorable climatic conditions.

Mehringer, P. J., and P. E. Wigand. 1987. Western juniper in the Holocene. Pages 1-11 in R. L. Everett, compiler, Proceedings of the Pinyon-Juniper Conference, Reno, NV. USDA Forest Service General Technical Report INT-215. Intermountain Research Station, Ogden, UT.

A87MEH01IDUS

Macrofossils from woodrat middens and lake sediments, and fossil pollen reveal prehistoric variability in relative importance of grass, sagebrush and western juniper. The spectacular historic expansion of western juniper is matched by similar events of the last 4000 years when episodes of plentiful precipitation favored its spread at lower elevations.

Miller, R. F., and J. A. Rose. 1995. Historic expansion of Juniperus occidentalis (western juniper) in southeastern Oregon. Great Basin Naturalist 55(1): 37-45.

A95MIL01IDUS

The chronology of Juniperus occidentalis expansion in eastern Oregon, the effect of plant canopy and interspace on J. occidentalis seedling establishment and growth rates, and the age of J. occidentalis maximum reproductive potential were determined. Measurements were recorded in 22 0.4 ha plots established in sagebrush-grassland communities and 6 0.1 ha plots in Populus tremuloides communities. J. occidentalis began increasing during the 1880's in stands containing trees >130 yr old. Relatively steady establishment ensued into the 1950's and then began to progress at a geometric rate in the 1960's. J. occidentalis encroachment into aspen stands began between 1910 and 1920. The largest portion of

juvenile trees established beneath Artemisia species in sagebrush-grassland communities. J. occidentalis trees appeared to reach full reproductive potential at >50 yr of age. The ratio of male-female trees increased from 1.7 in scattered J. occidentalis stands to 3.8 in closed stands. The initiation of J. occidentalis encroachment during the late 1800's coincides with optimal climatic conditions for Juniperus berry production and establishment, reduced fire return intervals, and heavy livestock grazing. The accelerated increase in J. occidentalis expansion since 1960 may be due to the continued absence of fire, abundant woody plant cover, and the large increase in J. occidentalis seed production.

Miller, R. F., and P. E. Wigand. 1994. Holocene changes in semiarid pinyon-juniper woodlands - response to climate fire, and human activities in the US Great Basin. BioScience 44(7): 465-474.

A94MIL01IDUS

Since settlement, juniper woodlands have significantly increased both in density and distribution throughout the West and are still expanding into adjacent shrub steppe communities, grasslands, aspen groves, and riparian communities. However, evidence strongly suggests that juniper woodlands in the West increased and decreased during prehistoric times. In this article, the researchers look at prehistoric and historic expansions of juniper, with an emphasis on western juniper, and the environmental conditions in which these expansions occurred. A brief description of possible impacts of currently expanding woodlands on the landscape is also given.

Noss, R. F., E. T. LaRoe, and J. M. Scott. 1995. Endangered ecosystems of the United States: a preliminary assessment of loss and degradation. USDI National Biological Service Biological Report 28. Washington, D.C. 58 pp.

U95NOS01IDUS

The authors report estimates of declines of natural ecosystems in the United States, provide a rationale for ecosystem-level conservation, discuss decline and threat as criteria for conservation, and relate ecosystem losses to endangerment at species and population levels. Ecosystems are defined generally and at various spatial scales and include vegetation types, plant associations, natural communities, and habitats defined by floristics, structure, age, geography, condition, and other ecologically relevant factors. The methodology for this report consisted of a literature review and a survey of conservation agencies and professionals. The results of this preliminary study indicated significant losses of biodiversity at the ecosystem level in the United States. The most significant losses were summarized by listing ecosystems as critically endangered (>98% decline), endangered (85-98% decline), and threatened (70-84% decline). 30 critically endangered, 58 endangered, and more than 38 threatened ecosystems are identified. Losses of all kinds of ecosystems have been most pronounced in the South, Northeast, and Midwest, and in California. The researchers suggest that integrated conservation plans for all ecosystems be developed in each ecoregion of the United States, starting with types and regions that sustained the greatest losses and are at greatest risk of further loss. Conservation plans could be based on detailed studies of ecosystem status and trends and include quantitative analyses of ecosystem decline, ecological consequences of loss and degradation, and current and potential threats to each ecosystem. Ecosystem conservation need not be restricted to pristine sites, which are now almost nonexistent. Rather, management and, where possible, restoration plans for native biodiversity in partially disturbed sites should be considered.

Nowak, C. L., R. S. Nowak, R. J. Tausch, and P. E. Wigand. 1994. Tree and shrub dynamics in northwestern Great Basin woodland and shrub steppe during the late-Pleistocene and Holocene. American Journal of Botany 81(3): 265-277.

A94NOW01IDUS

During the last 12,000 to 30,000 years, a large proportion of the dominant trees and shrubs in modern assemblages of woodland and shrub steppe vegetation in the northwestern Great Basin have undergone relatively small changes in their geographic ranges. A woodland tree, Juniperus osteosperma, has an extensive temporal and spatial fossil record from 11 woodrat midden locales that were sampled in the northwestern Great Basin. Above 1,300 m elevation, J. osteosperma has been continuously present in that fossil record for at least the last 30,000 years. However, J. osteosperma was lost at elevations below 1,300 m sometime during the last 10,000 years, during the Holocene. Although the elevational ranges of six shrub taxa show changes during the Holocene, geographic ranges of 11 other shrub taxa have been largely static. Of the woodland and shrub steppe species examined, Pinus monophylla has experienced the greatest change in its geographic range during the late-Pleistocene and Holocene. Pinus monophylla has migrated northward across the Great Basin from Pleistocene refugia in the southern portions in this region. The rate of latitudinal migration was more rapid along the eastern side of the Great Basin than on the western side. Thus, the species that comprise modern woodland and shrub steppe communities of the northwestern Great Basin appear to have two strategies to cope with climate change. First are species, as explempified by J. osteosperma, whose geographic ranges were relatively insensitive to climate change and are termed orthoselective species. High genetic variation within species and the formation of coenospecies likely allowed these species to cope with climatic change by genetic adaptation. Secondly, other species, as exemplified by P. monophylla, have experienced shifts in their geographic range during the past climatic changes and more clearly fit the migration model of species response to climate change.

O'meara, T. E., J. B. Haufler, L. H. Stelter, and J. G. Nagy. 1981. Nongame wildlife responses to chaining of pinyon-juniper woodlands. J. Wildlife Management 45: 381-389.

A81OME01IDUS

Nongame wildlife responses to chaining of pinyon-juniper woodland were studied in 1977 in the Piceance Basin, Colorado. Vegetation and small-mammal populations were sampled on a mature pinyon-juniper woodland (control) and areas chained 1, 8, and 15 years previously. Breeding-bird populations were studied on the areas chained 8 and 15 years previously, the control area, and on the edge between a mature woodland and an area chained 10 years previously. Ten species of breeding birds were observed on the unchained area, whereas only 3 and 4 species were observed on the 8- and 15-year-old chained areas, respectively. Bird densities on the unchained area (29 territories/10 ha) were more than double those on the chained areas (11/10 ha). Five of 17 species breeding on the edge area used both vegetation types. Only 1 species was found exclusively on the edge area. Small mammals were more abundant on chained than unchained areas. Species composition of the catch varied among the chained and unchained areas; species diversity was greatest on the unchained area. Adverse effects on nongame wildlife could be minimized by favoring survival of shrubs and young trees, retaining selected cavity trees, and limiting widths of clearings when chaining pinyon-juniper.

Quigley, T. M., H. R. Sanderson, and A. R. Tiedemann. 1989. Managing interior Northwest rangelands: The Oregon Range Evaluation Project. USDA Forest Service General Technical Report PNW-GTR-238. Pacific Northwest Research Station, Portland, OR. 207 pp.

B89QUI01IDUS

This report is a synthesis of results from an 11-year study of the effects of increasing intensities of range management strategies on herbage production, water resources, economics, and associated resources - such as wood fiber and recreation - in Grant County, Oregon. Four intensities of management were studied on Federal land (19 grazing allotments) ranging from no grazing to intensive management aimed at improving livestock distribution and forage production by applying cultural treatments. On private land (21 cooperating ranches), an additional strategy aimed at maximizing commodity improvement practices were installed on 350,000 acres. Baseline herbage production information was developed for 51 resource units that comprise 10 major ecosystems. Effects of increasing intensities of management were determined. The resultant increase in carrying capacity was determined, and the allocation - by ecosystem - of animal unit months within pastures was determined. The most intensive strategy on both Federal and private land was generally the economically optimal strategy. Effects of increasing intensity of management on water resources was tested only on Federal land. Baseline information on water yield and timing, storm runoff, pollution indicator bacteria, dissolved chemicals, and temperature was generated. Changes in the measured water parameters in response to increasing intensity of management were measured. The only parameter that could be directly related to increasing intensity of management and increased cattle use was bacterial quality. More than 100 publications and reports were developed. Predictive models for water yield, stream temperature, and animal unit months were developed. A handbook on specification for range improvement practices was produced, and costs of these practices were determined. Results provide state-of-the-art information for managing rangelands in the interior West, with understanding of the economic consequences and effects on related resources. Discussion pertinent to western juniper woodlands occur throughout the publication.

Rust, S. K. 1996. Classification and inventory for the conservation and management of pinyon-juniper ecosystems. Summary of 1996 field season sampling effort. Unpublished report prepared by Idaho Conservation Data Center, Department of Fish and Game, for USDI Bureau of Land Management, Burley Resource Area, and USDA Forest Service, Intermountain Research Station. 20 pp.

U96RUS05IDUS

Juniper woodland field sampling completed in 1996 is summarized. Data on woodland stand composition and structure was collected during June - September, 1996, on nearly 200 plots, at 11 sites. Plot locations are listed and mapped by site. At a number of sites, woodland composition was different than expected, based on prior records of plant community occurrence.

Sanders, K., et al., editors. 1985. Rangeland Fire Efects: a Symposium. Proceedings of a symposium sponsored by Bureau of Land Management and University of Idaho at Boise,ID, November 27-29, 1987. USDI Bureau of Land Management, Idaho State Office, Boise. 124 pp.

B85SAN01IDUS

Proceedings of a symposium on rangeland fire effects, primarily as applied to the sagebrush-grass ecosystem of the Northern Great Basin/Snake River country. Examination of the impact of fire not only on vegetation but also on wildlife habitat, soil and air. Articles of note include: the ecological setting and successional changes in sagebrush-grass ecosystems; effects on grasses and forbs; effects on sagebrush and bitterbrush; effects and revegetation on juniper-pinyon woodlands; prescribed fire in aspen; and vegetation changes following 2,4-D application and fire in a mountain big sagebrush habitat type.

Sawyer, J. O., and T. Keeler-Wolf. 1995. A manual of California vegetation. California Native Plant Society. 471 pp.

B95SAW01IDUS

This book is the result of the collective effort of 64 scientists. Their data has been used to describe the vegetative series of California. Instructions on how to use each of the keys are provided along with selective photos. Each key contains a short

description of the series, distribution, elevation, and other important comments pertaining to that series. A Utah juniper series is described for California.

Scoggan, A. C., and M. A. Brusven. 1973. Grasshopper-plant community associations in Idaho in relation to the natural and altered environment. Melanderia 12: 22-33.

A73SCO01IDUS

Ecological ranges of selected species and subfamilies of Idaho grasshoppers are discussed, with information on response to altered environment included. Some trends are noted with respect to seral versus stable plant communities. The paper describes grasshopper species associations with juniper woodland and environmentally related vegetation.

Sedgwick, J. A. 1987. Avian habitat relationships in pinyon-juniper woodland. Wilson Bulletin 99(3): 413-431.

A87SED02IDUS

Habitat relationships of breeding birds were examined in northwestern Colorado pinyon-juniper woodland and in openings where most overstory trees had been knocked down by anchor chaining. Vegetation characteristics and physical habitat features were measured in 233 0.04-ha circular plots around singing males of 13 species of birds from 15 May to 15 July 1980. Thirteen-group discriminant function analysis ordinated bird species along three habitat dimensions described by 1) canopy height; 2) slope, shrub size, and shrub species diversity; and 3) percentage canopy cover, large tree density, distance from a habitat edge, litter cover, and green cover. Woodland, open-area, and intermediate edge species were clearly segregated along the first discriminant axis, and species' associations with shrubs, inclination, ground cover, and edges were revealed by the ordinations along the second and third discriminant axes. Two-group discriminant analyses comparing occupied and available plots identified additional and more specific habitat associations. For example, hermit thrushes were associated with mature forested habitats and forest interiors, Virginia's warblers favored steep, oak-covered draws, rock wrens selected areas where percentage log cover and small tree density were high, and dusky flycatchers preferred shrubby slopes with scattered trees near woodland edges.

Sharp, L. A., and K. D. Sanders. 1978. Rangeland resources of Idaho. Idaho Rangeland Committee Miscellaneous Publication No. 6. University of Idaho College of Forestry, Wildlife and Range Sciences, Moscow, ID. 74 pp.

B78SHA01IDUS

The publication provides an overview of physical and vegetation features of Idaho, Idaho land ownership and use, and issues and problems associated with rangeland use and management in the state. The authors provide a brief description of Utah juniper woodlands of southern Idaho. A map of natural potential vegetation is reproduced well from Tisdale et al. (1969). The area of land within natural areas is summarized by owner and status.

Shaw, D. W., E. F. Aldon, and C. LoSapio, coordinators. 1995. Desired future conditions for pinon-juniper ecosystems; proceedings of the symposium. 1994 August 8-12, Flagstaff, AZ. USDA Forest Service General Technical Report RM-258. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 226 pp.

B95SHA01IDUS

The purpose of this symposium was to assist the USDA Forest Service, other federal land management agencies, and the Arizona State Land Office in managing pinon-juniper ecosystems in the Southwest. Authors assessed the current state of knowledge about the pinon-juniper resource and helped develop desired future conditions. See papers by Baker et al. (soil loss in pinyon-juniper ecosystems), Tausch and West (composition patterns), Gottfried and Ffolliott (stand dynamics), Klopatek et al. (decomposition), Albert et al. (deer, small mammal, and songbird use), Tausch and Tueller (mule deer winter range use), Rumble and Gobeille (wildlife associations), Kruse (small mammal populations), and Ellenwood (silvicultural systems).

Shiflet, T. N., editor. 1994. Rangeland cover types of the United States. Society for Range Management, Denver, CO. 152 pp.

B94SHI01IDUS

Described here are the rangeland cover types of the United States (exclusive of Hawaii). The classification is based on existing vegetation. They describe what one finds on the ground and must deal with. The descriptions do recognize the ecological influences that contributed to their present structure and will continue to affect their development. The type descriptions will be useful for making broad-scale inventories of rangelands, in aggregating the inventory information, and to those who need to relate rangeland vegetation from one area to another. They should be of utility to range managers, other land managers, ecologists, wildlife scientists, teachers and students. The Juniper - Pinyon Woodland (412) rangeland cover type is described for the Great Basin region.

Society of American Foresters. 1967. Forest cover types of North America (exclusive of Mexico). Society of American Foresters, Suite 300, 1010 Sixteenth Street NW, Washington, D.C. 20036

B67SAF01IDUS

Society of American Foresters cover types are listed and described. The distribution and ecological relations of the Pinyon-Juniper (239) cover type are described.

Tausch, R. J., C. L. Nowak, and R. S. Nowak. 1995. Climate change and plant species responses over the Quaternary: implications for ecosystem management. Pages 14-19 in R. W. Tinus, technical editor, Interior West global change workshop. USDA Forest Service General Technical Report RM-GTR-262. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 134 pp.

A95TAU01IDUS

Analysis of past vegetation change or stasis, during the past climatic oscillations is proving to be one of the most productive methods to aid in understanding current and future ecosystem changes. Ecosystems need to be managed to retain resilience necessary to cope with what ever changes the future may bring. This will require management paradigms that do not forclose on future options. This paper discusses the paleoecology of singleleaf pinyon and Utah juniper. The northward migration of singleleaf pinyon is described.

Tausch, R. J., N. E. West, and A. A. Nabi. 1981. Tree age and dominance patterns in Great Basin pinyon-juniper woodlands. Journal of Range Management 34(4): 259-264.

A81TAU01IDUS

Tree ages and dominance relationships of singleleaf pinyon and Utah juniper in the Great Basin show definite geographical, elevational, and historical trends. Populations have been expanding in both upslope and downslope directions from intermediate elevation.

The Nature Conservancy, Idaho Natural Heritage Program, and Oregon Natural Heritage Database. 1987. Final Report, Phase I, 1987 National Natural Landmark Project, Pacific Northwest Region, National Park Service; Including classification of the following ecological themes: Western Juniper, Utah and Rocky Mountain Juniper Woodlands, Lowland and Valley Grassland, Canyon Grasslands, and Montane Coastal Refugium Forest. Unpublished report prepared for the U.S. Department of the Interior, National Park Service, Pacific Northwest Region, Seattle, WA. 47 pp.

U87TNC01IDUS

The distribution and ecology of Utah and Rocky Mountain juniper-dominated woodlands of the Columbia River Plateau are described. Two subthemes are identified and described: Utah and Rocky Mountain juniper lava flows and Rocky Mountain juniper woodland on sand dunes.

Thomas, J. W., and C. Maser, technical editors. 1986. Wildlife habitats in managed rangelands - the Great Basin of southeastern Oregon. USDA Forest Service General Technical Report PNW-160, Pacific Northwest Forest and Range Experiment Station, Portland, OR.

B86THO01IDUS

The need for a way by which rangeland managers can account for wildlife in land-use planning, in on-the-ground management actions, and in preparation of environmental impact statements is discussed. Principles of rangeland-wildlife interactions and management are described along with management systems. The Great Basin of southeastern Oregon was selected as a well-defined area for which to develop and display the rangeland-wildlife management principles. This publication contains several sections interaction of wildlife and vegetation. Articles within the compendium describe wildlife use of juniper (primarily Juniperus occidentalis-dominated) woodlands.

Tiedemann, A. R., and J. O. Klemmedson. 1995. The influence of western juniper development on soil nutrient availability. Northwest Science 69(1): 1-8.

A95TIE01IDUS

The objective of the research reported here was to assess the effect of western juniper (Juniperus occidentalis Hook.) invasion and tree aging on soil nutrient availability in sagebrush/grass ecosystems of central Oregon. Barley was used as a bioassay test plant to determine availabilities of N, P, K, and S. The surface 15 cm of soil from beneath juniper canopies (canopy soil) and intercanopy area (intercanopy soil) was collected for five age classes of trees ranging from 36 to 160 yr. Nutrient availability determined by bioassay in these soils was compared to an area where juniper had not invaded. Phosphorus availability of the intercanopy souls was significantly reduced for the two oldest tree classes. This result suggested an alteration of P availability by the lateral root system of western juniper in the intercanopy areas that is linked to juniper maturity. In canopy soils, juniper did not influence N availability. Advancing juniper was associated with increasing then decreasing P availability with the oldest tree class. The most striking effect of juniper was increased S availability in canopy soils with advancing juniper maturity. Differential responses of N and S availability in canopy soils may reflect the fact that N mineralization is cheifly a biological process whereas S mineralization is both biological and biochemical. Low inherent availabilities of N and S suggest that productivity enhancement measures should include

fertilization with these elements.

Tisdale, E. W., M. Hironaka, and M. A. Fosberg. 1969. The sagebrush region in Idaho: A problem in range resource management. University of Idaho Bulletin No. 512. Agricultural Experiment Station, Moscow, ID. 15 pp.

A69TIS01IDUS

The publication provides a summary of the sagebrush-grassland vegetation of Idaho. Relationships of vegetation to environmental factors are described. The authors raise concerns about the degradation of sagebrush-grass rangeland resource. An important undertone of the paper is the importance of undisturbed areas for use as ecological reference areas. The paper provides an early mapping of natural potential vegetation of Idaho. Woodlands dominated by Utah juniper are identified as a mapping unit.

Tisdale, E. W. 1986. Native vegetation of Idaho. Rangelands 8(5): 202-207.

A86TIS01IDUS

The author describes the vegetation of Idaho using series, which represent easily recognized and fairly extensive communities groupings. Utah juniper woodlands of Idaho are identified as a major vegetation type. The author suggests that juniper invasion of sagebrush grasslands is due to fire suppression and change toward more moist climatic conditions. Invasion is more extensive in western juniper, compared to Utah juniper.

Trout, L. E., and J. L. Thiessen. 1973. Physical condition and range relationships of the Owyhee deer herd. Job completion report, Idaho Fish and Game Department Big Game Range Investigations. Project W-141-R-2. 37 pp.

B73TRO01IDUS

During a 3-year period, 1964-66, a total of 127 mule deer were systematically collected in Owyhee County, Idaho. Examination of the collected animals revealed that the overall health of the herd was relatively poor with 80% being classified in the poor physical condition category. Productivity of the Owyhee herd appeared good and closely paralleled that of other deer herds. Harvest records indicate that a substantial loss of fawns occurs post-partum and probably during the winter periods. Analysis of the deer food habits showed that sagebrush and juniper were important winter forage species making up 60% of the diet during January and February. A range survey revealed that these two species make up over 50% of the available forage on the winter range, with nearly 45% of the land area producing no vegetation of any kind. Nutrient analysis of deer forage species indicated that the nutrient content of the forage was sufficiently high to maintain the deer in a healthy condition. It is concluded that the poor physical condition of the herd and low fawn survival probably is not due to lack of nutrients in the forage but shortage of desirable forage species both on the summer and winter ranges.

Tueller, P. T., C. D. Beeson, R. J. Tausch, N. E. West, and K. H. Rea. 1979. Pinyon-juniper woodlands of the Great Basin: distribution, flora, vegetal cover. USDA Forest Service Research Paper INT-229. Intermountain Fororest and Range Experiment Station, Ogden, UT.

A79TUE01IDUS

The distribution of the pinyon-juniper woodlands of the Great Basin is mapped from LANDSAT-1 satellite imagery. The distribution map was field checked and sampled at 482 stands on 66 of 200 mountain ranges in the study area. A list of vascular plant species encountered is provided. Vegetation cover increases with elevation and slightly with latitude. Elevation is the primary determinant in the distribution of tree species. Junipers occupy the lower, drier elevations; pinyon is more abundant at higher elevations. Pinus edulis is more abundant in the southeastern Great Basin where more rainfall occurs in summer.

Wangler, M. J. And R. A. Minnich. 1996. Fire and succession in pinyon-juniper woodlands of the San Bernardino Mountains, California. Madrono 43(4): 493 - 514.

A96WAN01IDUS

Pinyon-juniper woodlands of the San Bernardino Mountains were examined for modern and historical fire patterns, post-fire succession, and changes in mature woodlands under 20th century fire suppression management. Thirty-eight burns consisting mostly of high intensity canopy fires were identified, giving an estimated fire rotation period of 480 years. Burns were primarily colonized by Great Basin sagebrush shrub vegetation (Purshia tridentata, Artemisia tridentata, and Chrysothamnus nauseosus) at high elevations (> 2000 m) and a mix of California desert chaparral (Ceanothus gregii, Fremontodendron californicum) and Great Basin sagebrush shrub at lower elevations (< 2000 m). Chronosequence sampling shows that conifer species were absent on all burns < 18 years. Shrubs increased in cover and density for 30 - 50 years, and were joined by Pinus monophylla recruits 25 - 40 years after fire. Mature shrubs acting as nurse plants appear to aid in the re-establishment of Pinus monophylla by providing a favorable microclimate for seedling survival and early growth. After 50 years, pinyon-juniper woodland development was phased with a declining shrub layer, ultimately leading to the return of a mature woodland at 100 - 150 years. Replication of the 1929 - 1935 California Vegetation Type

Map survey shows only minor changes in this forest type under 20th century fire suppression management.

Wells, P. V. 1983. Paleobiogeography of montane islands in the Great Basin since the last glaciopluvial. Ecological Monographs 53: 341-382.

A83WEL01IDUS

The author discusses recent paleobiogeography of the Great Basin. Macrofossil evidence suggests that late Halocene northern migration of pinyon-juniper conifer species occurred across dispersal barriers. Moderately long-range transport of seeds by birds is deduced on the basis of major latitudinal shifts in species ranges of 500 - 640 km during the Holocene. A 640 km migration in 8000 yr (80 m/yr) is indicated for Pinus monophylla. This is compared to an estimated wind/gravity dispersal rate of 3.2 km per 8000 yr (0.4 m/yr). These observations are related to the theory of island biogeography.

West, N. E. 1983. Approaches to synecological characterization of wildlands in the Intermountain West. Pages 633-642 in In-place Resource Inventories: Principles and Practices, A National Workshop, University of Maine, Orono.

A83WES01IDUS

The Intermountain West is largely an arid region of divers topography and low productivity. These circumstances have impeded development of sophisticated synecological classifications. Early divisions were based on single natural variable or use characteristics. The most common early stratifications were based on vegetation types. Much controversy has raged over interpretation of potential vegetation. Differences of opinion on the length of time necessary for stability to be attained are at the root of the controversy. The degree of importance of correlation among landform, climate, vegetation and soils has also been vigorously debated. These problems have led to divergent ways of describing wildland sites, especially on large scales. Many are now challenging the scientific validity of intuitive and typological approaches. Adoption of more objective methods and multipurpose stratifications is impeded by the higher costs and administrative inertia. Increasing value of wildland resources and expanded use of remote sensing and computer storage and retrieval technology are bound to eventually alter the ways in which synecological stratification is done in the Intermountain West. The author provide an initial classification of formations, associations, and seral states thought to occur in the Intermountain West. Pinus-Juniperus is identified as a formation which includes the Pinyon-Juniper Woodland: Pinus-Juniperus association.

West, N. E. 1988. Intermountain deserts, shrub steppes, and woodlands. Pages 209-230 in M. G. Barbour and W. D. Billings, editors. North American Vegetation. Cambridge University Press, New York.

A88WES01IDUS

This chapter discusses the vegetation types on the intermountain region of North America. These include (generally following Kuchler 1970): sagebrush steppe, Great Basin sagebrush, saltbrush-greasewood, blackbrush galleta-three-awn shrub steppe, juniper-pinyon woodland, and mountain mahogany-oak scrub.

West, N. E., R. J. Tausch, K. H. Rea, and P. T. Tueller. 1978. Phytogeographic variation with juniper-pinyon woodlands of the Great Basin. Pages 119-136 in S. L. Wood, editor. Great Basin Naturalist Memoirs number 2. Brigham Young University, Provo, UT.

A78WES02IDUS

Vegetation, landform, geology, and soils data obtained from 463 systematically placed stands on a randomly chosen set of 66 mountain ranges have been used to derive patterns of latitudinal, longitudinal, and altitudinal variation in the floristic diversity in juniper-pinyon dominated woodlands across the Great Basin. The latitudinal-longitudinal patterns show greatest environmental and floristic diversity on the higher mountain ranges on the souhtern end of the Central Plateau portion of the study area where the Great Basin-Mojave Desert transition occurs. This is also where the elevational breadth of the woodland belt is greatest. Juniper-pinyon woodlands are largely lacking from northwestern Nevada. The lowest elevations for the type are found in the Dixie corridor centered in southwestern Utah. The general elevation of these woodlands is highest in the west-central part of the Great Basin and declines both toward the Sierra Nevada on the west and the Wasatch Front-High Plateaus on the east. Use of the equilibruium theory of island biogeography gave incomplete explanations of the diversity patterns observed. Certain conceptual and methodical problems forced by this overly simplistic theory are discussed. The best correlations obtained were between species richness and an index of ecotopic diversity. The instability of temperature inversions is a likely determinant of the position of woodlands along the northern boundary of the type. The Pacific frontal systems break the inversions most readily and are thought to be the major cause for the lack of this vegetation in northwestern Nevada and on exposed mountain ranges along the northern boundary of the type. Broad-scale, phytogeographical variations in these woodlands are closely associated with climatic differences.

West, N. E., R. J. Taush, K. H. Rea, and P. T. Tueller. 1978. Taxonomic determination, distribution, and ecological indicator values of sagebrush within the pinyon-juniper woodlands of the Great Basin. Journal of Range Management 31: 87-92.

A78WES01IDUS

Various sagebrush taxa are major understory components of most Great Basin pinyon-juniper woodlands. Improved understanding of their identificaiton, distribution, and ecological indicator significance is necessary to interpret site differences for these ranges. Morphology within sagebrush taxa is so variable that chromatographic determiniation is more easily and objectively relied upon for identification. Big sagebrush is so widespread and likely genetically diverse that sub-specific designations are more helpful in reading site conditions. The various sagebrush taxa are found in particular situations in Great Basin woodlands. Climatic differences explain the basin-wide distributions much more than geologic, landform, or soil conditions. Soils and exposure become more important on the local scale. Presence of a particular sagebrush taxon within pinyon-juniper woodlands can be used for comparisons of site favorableness provided one undersands the general distribution of the other sagebrush taxa.

Wight, J. R. and H. G. Fisser. 1968. Juniperus osteosperma in northwestern Wyoming: their distribution and ecology. University of Wyoming Agricultural Experiment Station Science Monograph 7. Laramie. 28 pp.

A68WIG01IDUS

This study was conducted to determine the taxonomy and distribution of juniper species and the ecology of juniper-dominated communities in the Big Horn and Owl Creek ranges of northwest Wyoming. Both Juniperus osteosperma and Juniperus scopulorum occur in the study area. Juniperus osteosperma is most abundant; J. scopulorum is primarily restricted to riparian areas within the study area. Soil depth exerts an influence on juniper distribution primarily through its effect on growth of competing plant species. It controls the available moisture and provides support for the roots of grasses and forbs. An adequate amount of soil is necessary for the grasses and forbs to become established. In contrast, juniper is well adapted for establishment in the cracks and crevices of exposed and broken bedrock strata.

Wood, S. L., ed. 1978. Intermountain biogeography: a symposium. Great Basin Naturalist Memoirs, Number 2. Brigham Young University, Provo, UT. 268 pp.

B78WOO01IDUS

This book presents the first major overview of biogeographical research being conducted in the intermountain region. Topics discussed include distribution patterns for fishes, reptiles, amphibians, birds, small mammals and plants within the intermountain region. Special reviews are presented on Artemesia, Atriplex, and the genus Eriogonum and its relatives. Several broad biological problem areas are reviewed, including the nature of the floristic transition zone between the Mojave and Great Basin deserts, the endeminc flora of the Colorado Plateau, the distribution of the juniper-pinyon community in the Great Basin, and the evolutionary development of the alpine biota of the intermountain region. Special considerations are given to the problems of managing native plant and animal populations in the area.

Wright, H. A. 1972. Synecology: shrub response to fire. Pages 204-217 in McKell, C. M., J. P. Blaisdell, and J. R. Goodin, editors, Wildland shrubs - their biology and utilization: Proceedings. USDA Forest Service General Technical Report INT-1. Intermountain Forest and Range Experiment Station, Ogden, UT.

A72WRI01IDUS

Fire generally suppresses shrubs in grasslands, promote shrub growth in forested vegetation, and stimulate shrub growth in chaparral communities. However, one should always evaluate the effect of fire on shrubs in relation to age of plants, soil moisture at time of burn, intensity of the fire, season of the burn, health of herbaceous plants (particularly grasses in grasslands), and the frequency of droughts. All of theses factors can, and usually do, affect the response of plants to fire. If one wishes to maintain healthy plant communities, plant dormancy and good soil moisture before burning are essential to minimize damage to plants. In the management of shrubs, total production is of less interest than a maximum sustained forage that is usable by game animals. For this reason, the burning of many shrubs is necessary for the most productive ecosystems that will be of maximum benefit to mankind. Juniperus osteosperma, Juniperus scopulorum, and Juniperus occidentatis are described as intolerant of fire. The author provides numerous citations regarding the relationship of juniper expansion to grazing and changes in fire disturbance regime.

Wright, H. A., L. F. Neunschwander, and C. M. Britton. 1979. The role and use of fire in sagebrush-grass and pinyon-juniper plant communities: a state of the art review. USDA Forest Service General Technical Report INT-58. Intermountain Forest and Range Experiment Station, Ogden, UT. 48 pp.

U79WRI01IDUS

The publication summarizes current knowledge of the effects of fire on vegetation in sagebrush-grass and pinyon-juniper communities. Data are presented from an ecological prespective and by individual species. The paper includes sections on prescribed burning, management implications, and state-of-the-art knowledge for sagebrush-grass and pinyon-juniper vegetative types.

BIG JUNIPER KIPUKA

Biological and Physical Characteristics

Site Description:

The Big Juniper Kipuka site encompasses undisturbed examples of several major habitat types representative of the eastern Snake River Plain of southern Idaho, including: Wyoming big sagebrush/bluebunch wheatgrass, Wyoming big sagebrush/Thurber's needlegrass, and threetip sagebrush/bluebunch wheatgrass. Surrounding lavas contain a sparse woodland cover dominated by Rocky Mountain juniper with a mixed shrub layer. The site also contains the state record Rocky Mountain juniper.

Key Environmental Factors:

The site is within a large mafic volcanic flow. The highly fissured and mounded olivine pahoehoe basalt is of late Pleistocene origin. Soils are poorly developed and consist of wind-blown sand or decompose plant litter. Existing vegetation is the result of primary succession. The surface of the pahoehoe basalt is hot and dry. However, ameliorating effects of the thick basalt slabs on soil moisture and temperature result in relatively mesic growing environments in the numerous massive fissures.

Climate:

The nearest weather station is located at Minidoka Dam, approximately 18 air miles southwest of the kipuka at an elevation of 4210 ft. Temperature and precipitation data are available for the period 1947 - 1981. Maximum temperatures occur in July (88.3 F); minimum in January (33.8 F). Average annual minimum and maximum temperatures are 61.1 and 35.9, respectively. July is the driest month with 0.34 inches precipitation; May is the wettest with 1.15 inches. The site receives approximately 9 inches of precipitation annually. The frost free growing season is approximately 140 days.

Landuse History:

The lava flow was historically used as an aerial firing range. The site has never been grazed. There is no evidence of tree cutting.

Protection and Stewardship

Designation: RESEARCH NATURAL AREA
AREA OF CRITICAL ENVIRONMENTAL CONCERN

Protection Comments:

The site is an established RNA/ACEC.

Information Needs:

Protection Urgency: P4

No current threats to the biological or physical values of the area are observed.

Management Needs:

No management needs are identified.

Management Urgency: M4

No management is currently needed to maintain the biological or physical values of the site.

Current Landuse:

Onsite: The site is an established RNA/ACEC. Recent stewardship visits indicate little recreational use of the area.

Offsite: The site is surrounded by an extensive lava flow and is relatively inaccessible.

Exotic Species Comments:

Bromus tectorum has become established on the kipuka.

Pests/Pathogens Comments:

No pest or pathogens have been identified within or adjacent the site.

BURTON CANYON

Biological and Physical Characteristics

Site Description:

Burton Canyon RNA comprises a small watershed on the west slope of the Bear River Range and contains a diversity of habitat types, largely on a calcareous substrate. The geology of the area is complex, containing rocks of Cambrian, Tertiary, and Quaternary ages. The vegetation of the area displays an elevational zonation pattern with mountain big sagebrush (Artemisia tridentata ssp. vaseyana), mountain-mahogany (Cercocarpus ledifolius), and mixed shrub communities at lower elevations, aspen (Populus tremuloides) and Douglas-fir (Pseudotsuga menziesii) communities at mid-elevations, and subalpine fir (Abies lasiocarpa) and subalpine big sagebrush (Artemisia tridentata ssp. spiciformis) types at higher elevations. A red-osier dogwood/sweetscented bedstraw (Cornus stolonifera/Galium triflorum) riparian community occupies the valley bottom in the lower portion of the drainage.

Key Environmental Factors:

Burton Canyon encompasses a small watershed on the west slope of the Bear River Range. The general orientation of the drainage is east-west, however, a complex series of ridges with intervening drainages result in high topographical diversity. Parent materials are primarily calcareous rocks.

Climate:

The nearest weather station is located at Grace, Idaho, 2.5 miles west of the site at 5550 ft. elevation. Precipitation and temperature data for Grace are summarized by Johnson (1981) for the period 1931 - 1981. Mean January and July maximum, minimum, and average temperatures are 28.8, 10.0, and 19.4; and 83.2, 48.4, and 65.8 (degrees F.), respectively. Precipitation is relatively evenly distributed throughout the year. July and August are the driest months. April - June is the wettest period of the year. Mean annual precipitation is 14.4 inches.

Landuse History:
Parts of the RNA were grazed at one time, but the vegetation of the area is in good condition. A minor amount of timber harvest may have occurred within the RNA as well.

Protection and Stewardship

Designation: RESEARCH NATURAL AREA

Protection Comments:
Burton Canyon is an established RNA.

Information Needs:
A more thorough botanical, faunal, and community inventory needs to be completed. The status of the oil/gas leases needs to be checked to see that no surface occupancy restrictions are in place or will be.

Protection Urgency: P4
Burton Canyon is an established RNA.

Management Needs:
The use of recreation campfires in the site should be monitored.

Management Urgency: M2
The fence and gate on the western boundary of the site need regular maintenance. Dyer's woad, a weed occurring near the western boundary of the RNA, needs to be monitored annually to determine if control action is practical and/or necessary.

Current Landuse:
Onsite: The area is leased for oil and gas. The potential for surface drilling and impacts will exist until new leases are issued with no surface occupancy restrictions. Recreation use is minimal at present; no new roads or trails are planned for within the RNA. The trail along the ridge at the east end of the RNA may experience increased use, but this use is unlikely to have a significant impact on the RNA. A water transmission line and concrete intake box are under a Special Use permit dated 02/17/87, and have little effect on the RNA. The RNA is within Management Area 013/015, Grace - Cub River. This area is managed for multiple uses including recreation, range, timber, and mineral production.

Offsite: Burton Canyon RNA is all reserved National Forest land and is surrounded by National Forest land except on the western boundary which is private land. The private land has previously or currently been used for grazing, timber production, recreation and/or mining, and is now owned by the Lowe's. Surrounding Forest land falls within Management Area 013/015, Grace - Cub River which is managed for multiple uses including recreation, timber, range, and mineral production.

Exotic Species Comments:
Dyer's woad occurs near the western boundary of the RNA.

Pests/Pathogens Comments:
Much of the Douglas-fir is old-growth which has been infested with Douglas-fir beetle (Dendroctonus pseudotsugae). Single trees and patches of Douglas-fir killed by this beetle are common within the RNA.

GIBSON JACK CREEK

Biological and Physical Characteristics

Site Description:
Gibson Jack Creek RNA contains several shrub types in unusually fine condition. These include mountain sagebrush (Artemisia tridentata ssp. vaseyana) types, a black sagebrush (Artemisia nova) type, a Utah juniper (Juniperus osteosperma) type and chokecherrry-serviceberry (Prunus virginiana-Amelanchier utahensis) communities. The area also contains several forest types, including bigtooth maple (Acer grandidentatum), aspen (Populus tremuloides), Douglas-fir (Pseudotsuga menziesii), and subalpine fir (Abies lasiocarpa). It includes a small drainage basin complete with streams, beaver dams, and ponds. The mountainous country provides geologic, elevational, slope, and aspect variation. These result in great differences in vegetation. Forests cover most of the north-facing slopes while shrubs and grass dominate on southern slopes. Boundaries between vegetation communities are sharp and easily distinguished. The RNA is part of a city watershed, and as such, the area has been protected from most uses for over 75 years.

Key Environmental Factors:
Parent materials are primarily quartzites of Upper Precambrian and Lower Cambrian origin. Rocks are mapped as Camelback Mountain Quartzite and Mutual Formation quartzite and argillite. The principly south-facing slope of the site is highly discected, giving rise to relatively high topographic diversity. Slopes are steep to gentle; with aspects ranging from southeast to southwest.

Climate:
The climate is dominated by Pacific marine air masses moving easterly across the Snake River Plain. The nearest weather station is located in Pocatello (Station No. 1C-7211), at 4454 ft. elevation. Precipitation and temperature data are summarized by Johnson (1981) for the period 1939 - 1976. Mean January and July high, low, and average temperatures are 32.3, 14.5, and 23.4; and 88.8, 54.2, and 71.5, respectively. Precipitation is greatest in the months March - June. A dry period typically occurs in July - September. Mean annual precipitation is 11.3 inches.

Landuse History:
Prior to the 1890's, the Gibson Jack Creek area was part of the Fort Hall Indian Reservation. In 1892, the Pocatello citizens were given permission to use the water for culinary purposes. The land was returned to public domain status in 1898, and became part of the Forest Reserve in 1903. At that time grazing was prohibited in most of

the watershed. Elk were introduced in 1916, but eventually hunters depleted the herd, and only a few elk remain today. Idaho Department of Fish and Game stocks some of the beaver ponds in the area with trout. Currently, a small amount of grazing occurs but is being phased out. Because of the importance of this watershed to the city of Pocatello, actions to maintain water quality would take precedence over using the area as a research natural area.

Protection and Stewardship

Designation: RESEARCH NATURAL AREA

Protection Comments:
Gibson Jack Creek is an established RNA. The area is within the Pocatello Forest Reserve, an area designated to protect the watersheds that supply the municipal water system.

Information Needs:
Plant community composition data is needed to verify element occurences.

Protection Urgency: P5
Gibson Jack Creek is an established RNA. The area is within the Pocatello Forest Reserve, an area designated to protect the watersheds that supply the municipal water system.

Management Needs:
Recreational use, forest stand structure, and livestock use should be monitored.

Management Urgency: M2
The site is located within an urban interface. Protocols for monitoring recreational use of the site should be developed. A plan for the management of fire and noxious weeds in and adjacent the site should be developed within the next five years.

Current Landuse:
Onsite: Approval for establishment of Gibson Jack Creek as an RNA occurred on April 1, 1982. The RNA is all National Forest land within the Pocatello Ranger District on the Caribou National Forest. The area is also part of the Pocatello water supply watershed. Recreational use of the area is significant and may include hiking, hunting, horseback riding, snowmobile use, and trail cycle use. The RNA falls within Management Area 020/021, Lower Portneuf - Rattlesnake. Within this management area, the RNA also falls within the Mink Creek Recreation Area Special Management Unit, a unit designed to provide coordination for the numerous special designations and activities that cover mountains just south of Pocatello.

Offsite: Land immediately adjacent to the RNA is also within the Caribou NF's Mink Creek Recreation Area Special Management Unit. The nearby West Fork Mink Creek (which is also part of the Pocatello water

supply watershed) is also established as an RNA. Land ownership in adjacent sections includes private, state, and BLM.

Exotic Species Comments:
No information is available regarding the occurrence of exotic species.

Pests/Pathogens Comments:
No pest or pathogens have been identified as occurring within the area.

GOOSE CREEK MESA

Biological and Physical Characteristics

Site Description:
Goose Creek Mesa contains unusual range types in relatively undisturbed condition. The predominant vegetation throughout much of the area is a low sagebrush steppe in which Sandberg's bluegrass and Idaho fescue are the predominant bunchgrass species. Scattered Utah juniper trees occur throughout most of the mesa. In some areas they occur in sufficient numbers to create a woodland setting with low sagebrush, Sandberg's bluegrass, and Idaho fescue as the dominant understory species. Mountain big sagebrush and bluebunch wheatgrass occur in swales. All of the habitat types in the area are characterized by a rich occurrence of shrubs and forbs. The substrate in the area is volcanic, with soils ranging from moderately deep to virtually absent.

Key Environmental Factors:
The topography of the site is characterized by the relatively narrow, nearly flat mesa top, which curves in the shape of a horseshoe with the open side to the southeast. Slopes on the south and west drop off quickly with rim rock cliffs and talus. Slopes on the interior of the cresent-shaped mesa are more gentle, though rock-outcroping is common. Exposed rocks on the mesa are rhyolite and latite. These rocks are underlain by tuffaceous sedimentary rocks.

Climate:
Precipitation and temperature data are available for Oakley (Station No. 10-6542), which lies 16 air miles north-northwest of the site, at an elevation of 4600. This record is summarized by Molnau (1983, as cited by Caicco and Wellner 1983) for the period 1931 - 1983. Mean January and July minimum and maximum temperatures are 18.3 and 37.7, and 86.6 and 54.6, respectively. Precipitation is relatively evenly distributed throughout the year, with peaks in winter and spring. One third of the annual precipitation typically occurs in the period April - June. Mean annual precipitation is 10.8 inches. The frost free growing season is 122 days.

Landuse History:
The area has been grazed historically by sheep and cattle. There is no evidence of cutting within the site.

Protection and Stewardship

Designation: RESEARCH NATURAL AREA

Protection Comments:
The site is an established RNA. Enlargement of the RNA would enhance the protection status of the mesa top and incorporate a greater range of the diversity of biological and physical features within the area.

Information Needs:
Recreational and livestock use of the area needs to be documented.

Protection Urgency: P5
The site is an established RNA.

Management Needs:
To protect resource values, the jeep trail which passes up through the northeast corner of Section 17 and through the site should be considered for closure.

Management Urgency: M2
Unauthorized vehicle access to the site should be monitored and evaluated. Livestock grazing of the site is reducing the value of the site as a representative, reference area.

Current Landuse:
Onsite: The site is grazed by cattle.

Offsite: The site is within an area of non-intensive to intensive rangeland management.

Exotic Species Comments:
Noxious weeds are not known to occur at the site.

Pests/Pathogens Comments:
No pests or pathogens have been observed at the site.

JIM SAGE CANYON

Biological and Physical Characteristics

Site Description:
Jim Sage Canyon RNA/ACEC is a volcanic ridge containing undisturbed woodlands dominated by Utah juniper and single-leaf pinyon pine. Mountain big sagebrush and bluebunch wheatgrass are dominate species in the shrub and understory layers. A portion of the area was burned in 1985, creating an excellent fire mosaic pattern in which juniper appears to be slowly reestablishing itself. Shallow soils along the ridge support the black sagebrush/bluebunch wheatgrass habitat type. This type normally occurs on limestone at lower elevations in eastern Idaho, but at this site it occurs at moderate elevation on volcanic substrates. Low sagebrush is also found within this habitat type in moderate abundance.

Key Environmental Factors:
Topography within the site consists of a single major ridge that forms the west valley wall of Jim Sage Canyon. An abrupt rimrock occurs within the area between approximately 6400 ft. and 7000 ft. elevation. The west facing slope of the ridge is moderately steep and drained by

several intermittent streams. The east-facing slope of the ridge is very steep. Parent materials are predominantly Tertiary lavas of Miocene age. Underlying these rocks are sedimentary strata which include air-fall tuffs, siltstones, sandstones, and conglomerates. These older sedimentary rocks are exposed locally at lower elevation within Jim Sage Canyon. The east-facing slope of the ridge burned prior to (approximately) 1930. The west-facing slope burned in 1985 (Cliff Hollow Fire, #F 419, 08/07/85).

Climate:

Weather data from Strevell, ID (located at an elevation of 5290 ft., 17 mi. southeast) provides the closest approximation of climatic conditions at the site. Precipitation and temperature data are available for 1948 - 1981. Maximum temperatures occur in July (88.6 F); minimum in January (30.8 F). Over half the annual precipitation occurs in April - August. The driest months are January and November. Mean annual precipitation is 11.0 inches. The frost free growing season is 95 days.

Landuse History:

The entire area was grazed by wild horses and sheep until approximately the 1950's. Some cutting of juniper and pine has occurred in the past.

Protection and Stewardship

Designation: RESEARCH NATURAL AREA
AREA OF CRITICAL ENVIRONMENTAL CONCERN

Protection Comments:

The site is an established RNA/ACEC.

Information Needs:

No information needs are currently identified.

Protection Urgency: P5

The site is an established RNA/ACEC.

Management Needs:

Eliminating use of the area by livestock should be investigated.

Management Urgency: M3

Livestock grazing is occurring in the bottom of Jim Sage Canyon. This reduces the value of the site as a representative, reference area.

Current Landuse:

Onsite: The site is within a grazing allotment. Most of the area is not accessed by cattle due to steep topography and distance from water.

Offsite: The site is within an area of intensive rangeland management.

Exotic Species Comments:

Bromus tectorum occurs within the site.

Pests/Pathogens Comments:

Moderate mortality in Pinus monophylla is occurring in stands on the southwest portion of the area. This is likely due to black stain root disease (Ophiostoma wagneri).

SAND KIPUKA

Biological and Physical Characteristics

Site Description:

Sand Kipuka encompasses extensive vegetation dominated by Wyoming big sagebrush or basin big sagebrush and needle-and-thread grass. A Rocky Mountain juniper woodland is well developed on the surface of the lava flows that surround the kipuka. The woodland approaches a closed canopy locally, and has a mixed shrub layer of moderate density. The kipuka is a depression surrounded by smooth, gently rolling pahoehoe basalt lava flows with little soil cover.

Key Environmental Factors:

The site is within a large mafic volcanic flow. The highly fissured and mounded olivine pahoehoe basalt is of late Pleistocene origin. Soils are poorly developed and consist of wind-blown sand or decompose plant litter. Existing vegetation is the result of primary succession. The surface of the pahoehoe basalt is hot and dry. However, ameliorating effects of the thick basalt slabs on soil moisture and temperature result in relatively mesic growing environments in the numerous massive fissures.

Climate:

The nearest weather station is located at Minidoka Dam, approximately 13 air miles southwest of the kipuka at an elevation of 4210 ft. Temperature and precipitation data are available for the period 1947 - 1981. Maximum temperatures occur in July (88.3 F); minimum in January (33.8 F). Average annual minimum and maximum temperatures are 61.1 and 35.9, respectively. July is the driest month with 0.34 inches precipitation; May is the wettest with 1.15 inches. The site receives approximately 9 inches of precipitation annually. The frost free growing season is approximately 140 days.

Landuse History:

Grazing of domestic livestock was most likely heavy in the past. Juniper cutting was also common along the edges of the kipuka, and on the lava flows. Remnants of an old trail over which the timber was transported are identifiable. Although these factors have influenced the vegetation of the site, it is unlikely that any of them have occurred for some time, perhaps 50 or more years.

Protection and Stewardship

Designation: RESEARCH NATURAL AREA

Protection Comments:

The kipuka is an established RNA.

Information Needs:

Information is needed to document recreational use of the area.

Protection Urgency: P4
The area is an established RNA.

Management Needs:
Site management should be directed at improving the quality of the vegetation in disturbed areas.

Management Urgency: M4
No management activities have been identified as needed to maintain the biological and physical values of the site.

Current Landuse:
Onsite: The site is an established RNA. Recent stewardship visits indicate little use of the area.

Offsite: The site is surrounded by an extensive lava flow and is relatively inaccessible. The site is within the Great Rift Wilderness Study Area.

Exotic Species Comments:
Bromus tectorum has become established within the kipuka.

Pests/Pathogens Comments:

SLIDE CANYON

Biological and Physical Characteristics

Site Description:
The Slide Canyon site encompasses a lower-slope ridge spur within the west-central Albion Mountains. Mountain mahogany-dominated woodlands occur on south- and west-facing upslope positions. Douglas-fir plant associations occur on north-facing upslope positions. Juniper-pinyon woodland is in lower slope positions. The site encompasses a small tributary subdrainage of Slide Canyon.

Key Environmental Factors:
The site possesses highly discected physiography. Slopes are predominantly west facing and endulate from north- to south-facing aspects. Parent materials are generally classified as carbonate lithology. Rocks within the site are dolomite of Cassia County.

Climate:
The nearest weather station is located in Burley. Pricipitation and temperature data for Burley are summarized by Johnson (1981) for the period 1962 - 1975. Mean January and July high, low, and average temperatures are: 35.4, 18.2, and 26.8; and 86.9, 53.4, and 70.1, respectively. Precipitation is relatively evenly distributed annually, with peaks in winter and spring. January is the wettest month; July the driest. Mean annual precipitation is 10.2 inches.

Landuse History:
The site has been historically grazed. Harvesting of juniper and mountain mahogany stems and limbs has historically occurred within the site.

Protection and Stewardship

Designation: REFERENCE AREA
PRIVATE LAND - UNPROTECTED

Protection Comments:
The upslope portion of the site is Sawtooth National Forest. The lower portion of the site is unprotected.

Information Needs:
An inventory of the private land within the site is needed to determine stand composition, condition, and quality.

Protection Urgency: P2
The portion of the site on National Forest System lands could be considered for special designation through the Forest Plan revision processes. Threats to the site have not been identified.

Management Needs:
No management needs have been identified.

Management Urgency: M4
No management needs have been identified.

Current Landuse:
Onsite: The site is grazed by cattle. Grazing on the National Forest portion of the site is not intensive. Current use of the private portion has not been determined.

Offsite: Adjacent landuses on downslope portions of the site are intensive rangeland and agriculture. Adjacent landuses on upslope portions are non-intensive to intensive rangeland.

Exotic Species Comments:
Bromus tectorum occurs within the site.

Pests/Pathogens Comments:
Moderate mortality in Pinus monophylla is occurring in stands within the site. This is likely due to black stain root disease (Ophiostoma wagneri).

TRAPPER CREEK

Biological and Physical Characteristics

Site Description:
Trapper Creek RNA encompasses a mesa on the eastern slope of the South Hills. The mesa dips gently from west to east. Short basalt cliffs ring most of the mesa, lying in sharp contrast to the sedimentary tuff deposits of the surrounding area. Elevations in the site range from about 5920 feet (1794 m) to 6400 feet (1939 m). The vegetation of the area is comprised largely of Utah juniper (Juniperus osteosperma) in various mixtures with low sagebrush (Artemisia arbuscula) and Idaho fescue (Festuca idahoensis) occurring on shallow soils. As the stands of Utah juniper become more open, low sagebrush habitat types dominate

the shallow soil sites. In places, low sagebrush occurs in 50:50 mixtures with black sagebrush (Artemisia nova), and occasionally, a few small stands of pure black sagebrush are encountered. Deeper soils in the center of the area are currently dominated by gray rabbitbrush (Chrysothamnus nauseosus) and mountain big sagebrush (Artemisia tridentata ssp. vaseyana) and/or Wyoming big sagebrush (Artemisia tridentata ssp. wyomingensis) with a lush mixture of grasses including Idaho fescue, bluebunch wheatgrass (Agropyron spicatum), and basin wildrye (Elymus cinereus). Most of this area was burned and numerous skeletons of Utah juniper are present, indicating that juniper was more important in this community in the past.

Key Environmental Factors:

Climate:
Winters in the area are primarily influenced by Pacific Maritime weather systems. The period from late fall through the early spring months is moist and warmer than might be expected for mountainous country. Periodically the Pacific weather systems are interrupted by cold, dry systems from Canada. Continental climatic conditions prevail in the summer months resulting in low precipitation and relative humidity. Daily temperature variation can be 40oF to 50oF (22oC to 28oC) or more. Annual precipitation peaks in May and June.

Landuse History:
The site was historically grazed by horses. Grazing has not occurred for many years due to low forage and distance from water.

Protection and Stewardship

Designation: RESEARCH NATURAL AREA

Protection Comments:
The site was included as a candidate RNA in the Sawtooth National Forest Land and Resource Management Plan. 1996: Area established as a RNA.

Information Needs:

Protection Urgency: P4
The site is listed as a candidate RNA in the Sawtooth Land and Resource Management Plan. Portions of a draft establishment record have been written. The boundary description and environmental assessment have not been prepared. 1996: Area established as a RNA.

Management Needs:

Management Urgency: M4
No major threats to the site are reported.

Current Landuse:
Onsite: The RNA is allocated to Mangement Area 2H (Trapper Creek proposed RNA) in the Sawtooth Land and Resource Management Plan. The surrounding land use

is cattle grazing.

Offsite: The site is surrounded by Forest Service lands within Management Area 2A - lands managed for general timber and range production.

Exotic Species Comments:

Pests/Pathogens Comments:

TWOMILE CANYON

Biological and Physical Characteristics

Site Description:
The site encompasses rounded knolls and an associated subdrainage on the northwestern front of the Malad Range. The vegetation is primarily woodlands dominated by Utah juniper and curl-leaf mountain mahogany.

Key Environmental Factors:
The site possesses moderately dissected, steep to moderately steep (70 - 25 percent slope) physiography. Parent materials are generally classified as carbonate lithology. Rocks are Nounan dolomite and Bloomington Formation shale and limestone.

Climate:
Pricipitation and temperature data for Malad are summarized by Johnson (1981) for the period 1931 - 1976. Mean January and July high, low, and average temperatures are: 32.3, 13.4, and 22.9; and 88.6, 53.0, and 70.8, respectively. Precipitation is relatively evenly distributed throughout the year with January the wettest, and August the driest. Mean annual precipitation is 14.38 inches.

Landuse History:
Large juniper stems and branchs were historically harvested on the site, the time period of this activity has not been determined.

Protection and Stewardship

Designation: REFERENCE AREA

Protection Comments:
The site is within Caribou National Forest.

Information Needs:
No information needs have been identified.

Protection Urgency: P4
No threat to the site has been identified. The site serves as a reference simply by virtue of having located ecology plots within it.

Management Needs:
No management needs have been identified.

Management Urgency: M4

The site is managed as non-intensive rangeland.

Current Landuse:
Onsite: The site is managed as non-intensive rangeland.

Offsite: The site is surrounded by National Forest System lands managed for non-intensive rangeland.

Exotic Species Comments:
Bromus tectorum is well established within the site.

Pests/Pathogens Comments:
None have been identified.

WEST FORK MINK CREEK

Biological and Physical Characteristics

Site Description:
West Fork Mink Creek RNA is divided into two units with a buffer strip between the two along the old road/trail that heads up the creek. The two units are quite different and the RNA features a variety of vegetative cover types including Douglas-fir (Pseudotsuga menziesii) and aspen (Populus tremuloides) forests on north-facing slopes and sagebrush-grass types on south-facing slopes. The upper slopes of Slate Mountain have a thin soil mantle with many exposed shale outcrops and support a predominantly black sagebrush-Sandberg's bluegrass (Artemisia arbuscula nova-Poa secunda) association. About 10% of the upper slopes has a Utah juniper (Juniperus osteosperma) tree cover. The lower xeric slopes support the basin big sagebrush/Great Basin wildrye (Artemisia tridentata ssp. tridentata/Elymus cinereus) association and a variety of shrub species. The western portion of the RNA is predominantly timbered with Douglas-fir (Pseudotsuga menziesii) and quaking aspen (Populus tremuloides), with several small dry meadow-like openings. West Fork Mink Creek is formed by numerous springs which rise about 0.5 mile above the RNA.

Key Environmental Factors:
Physiography is steep to moderately sloped, generally southwest- and northeast-facing, but strongly dissected. Parent materials are shale and limestone of the Bloomington Formation and undifferentiated metamorphosed sedimentary rocks.

Climate:
The climate is dominated by Pacific marine air masses moving easterly across the Snake River Plain. The nearest weather station is located in Pocatello (Station No. 1C-7211), at 4454 ft. elevation. Precipitation and temperature data are summarized by Johnson (1981) for the period 1939 - 1976. Mean January and July high, low, and average temperatures are 32.3, 14.5, and 23.4; and 88.8, 54.2, and 71.5, respectively. Precipitation is greatest in the months March - June. A dry period typically occurs in July - September. Mean annual precipitation is 11.3 inches.

Landuse History:
The entire West Fork Mink Creek RNA lies within the Pocatello Forest

Reserve which was established in 1903 for the purpose of providing watershed protection for the city of Pocatello. The area was closed to livestock grazing in the early 1900's and now contains plant communities in a relatively undisturbed state. Research studies have been conducted for about 20 years by students and other individuals from Idaho State University. Studies have been of geological nature, plant communities, and plant-soil relationships. Although some prospecting has occurred, there are no known deposits of valuable minerals in the West Mink drainage. Within the past several years, there has been a sizable increase in trail cycle and snowmobile use, as well as hikers. At one time the city of Pocatello had a special use permit covering the spring developments above the Natural Area and related water transmission lines buried along the old West Mink Creek Road. This permit is no longer in existence, even though the pipeline is still in place. Because of the importance of Mink Creek Watershed to the city of Pocatello, actions to maintain water quality would take precedence over any other use.

Protection and Stewardship

Designation: RESEARCH NATURAL AREA

Protection Comments:
West Fork Mink Creek is an established RNA.

Information Needs:
Plant community composition data is needed to verify element occurrences.

Protection Urgency: P4
West Fork Mink Creek is an established RNA. The RNA is within the Mink Creek Watershed, part of the Pocatello Forest Reserve, an area established to provide watershed protection for the city of Pocatello.

Management Needs:
Recreation use, forest stand structure, and livestock use should be monitored.

Management Urgency: M3
Maintenance of fencing may be needed to prevent tresspass livestock grazing.

Current Landuse:
Onsite: Approval for establishment of West Fork Mink Creek as an RNA occurred on May 8, 1973. The site is all National Forest land on Pocatello Ranger District, Caribou National Forest and is within the Pocatello municipal watershed. The watershed is open to all but motorized recreational uses during the period March 16 - November 30. During the period December 1 - March 15 only nordic skiing, snoeshoeing, and walking are permitted within the watershed (these restrictions are effective 06/15/95 by Special Order 04/05/01). The site is within Management Area 020/021, Lower Portneuf - Rattlesnake. The site is also within the Mink Creek Recreation Area Special Management Unit, a

unit designed to provide coordination for the numerous special designations and activities that cover mountains just south of Pocatello.

Offsite: Land immediately adjacent to the RNA is also within the Caribou NF's Mink Creek Recreation Area Special Management Unit. The nearby Gibson Jack Creek (which is also part of the Pocatello water supply watershed) is also established as an RNA. Land ownership in adjacent sections includes private, state, and BLM.

Exotic Species Comments:
No information is available about exotic species.

Pests/Pathogens Comments:
Old-growth Douglas-fir stands have been infested with bark beetle.