# OLD-GROWTH JUNIPER WOODLANDS

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## SUMMARY

Natural resource managers and researchers have generally overlooked semi-arid old-growth woodlands. These ancient woodlands have some of the oldest trees in the Intermountain region, exceeding ages of 1,000 years. Old-growth is typically structurally more complex than postsettlement woodlands adding biological diversity to the landscape and providing an important source of habitat for many organisms. Mapping and inventorying old-growth woodlands is extremely important in developing management and land-use plans. Information is also needed on structure, function, gap dynamics, tree mortality, and succession following disturbance.

## INTRODUCTION

Old-growth juniper and pinyon woodlands in the West generally do not fit the typical image most people have of old-growth coniferous forests. In a recent symposium in the southwest, Swetnam and Brown (1992) stated; "Many peoples' image of old-growth are the stately monarch trees with shafts of sunlight streaming down through tall, dense canopies. However, in the southwest, many of the old-growth stands do not fit this stereotype." Some of the oldest stands throughout the Intermountain West are low statured open semiarid woodlands. Old woodlands usually differ in structure and function from postsettlement woodlands, thus adding diversity at the community and landscape levels. Although considerable research has been conducted in old-growth for other conifer species, work addressing old-growth in juniper and pinyon woodlands is very limited.

We are currently describing the structure and composition of old-growth western juniper stands and contrasting them to postsettlement juniper woodlands. We are also developing a classification system for old-growth woodlands that will help characterized the different stands, which occur across the range of western juniper. Pre- and post-fire regimes, and woodland dynamics and succession are also being investigated. This paper is a shortened version of a paper that defines old growth juniper woodlands and contrasts them to other conifer old-growth systems (Miller et al. 1998).

### Old-growth

Work in old-growth forests in the northwest United States has been focused on the more mesic heavily forested areas. In the Great Basin old-growth work is almost non-existent. Functionally, ecological interrelationships in old-growth forests are more complex than younger forests (Moir 1992). Old-growth detrital food webs are usually more complex than those found in earlier stages of stand development. Structural and functional complexity of old-growth ecosystems increases their biological value. Important values of these old stands include habitat for a variety of plant and animal

species, climate reconstruction, pools of genetic resources (Kaufmann et al. 1992), and wood for dating archeological sites. In addition, esthetic and spiritual values are frequently mentioned in relation to old-growth stands.

Old-growth characteristics listed above may not directly apply to semi-arid woodlands in the Intermountain West. However, like other conifer communities, old-growth semi-arid woodlands should be defined on the basis of tree age, and stand structure and function. Nonetheless little to no information is available on stand structure, rates of mortality and decomposition, gap dynamics, thinning, food webs, and nitrogen fixation for old-growth juniper and pinyon woodlands. Information relating old-growth woodlands to wildlife values is also limited since very few wildlife studies have described stand structure or separated old-growth from postsettlement woodlands.

**Old-Growth Juniper: A Single Tree Perspective**

A frequently asked question is; "What is an old-growth juniper?" One separation may be made on the basis of tree establishment occurring prior to or following Eurasian settlement. In the northeastern Great Basin, the rapid expansion of western juniper coincided with Eurasian settlement in the late 1860s and 1870s (Burkhardt and Tisdale 1976, Young and Evans 1981, Miller and Rose 1995). Woodland expansion for much of this region began in the 1870s. Based on the chronology of past events throughout the northern Great Basin we would define postsettlement trees as having established sometime after 1870 and presettlement trees establishing prior to 1870. However, old-growth can also be based on structural or morphological characteristics of the tree, which develop slowly over time. As juniper age, canopy morphology shifts from cone shaped to a rounded top. As age advances, western juniper may also develop a combination of the following characteristics: broad nonsymmetric tops, deeply furrowed bark, twisted trunks or branches, dead branches and spike tops, large lower limbs, trunks containing narrow strips of cambium (strip-bark), hollow trunks, large trunk diameters relative to tree height, and branches covered with a bright yellow green lichen (*Letharia* sp). Tree size, particularly height, is dependent upon site characteristics.

Tree age within the old-growth stand is an important index in assessing the stage of old-growth development (Swetnam and Brown 1992). Assessing stand age also determines the rarity or uniqueness of the woodland. Western juniper can easily attain ages exceeding 1,000 years (Miller unpublished data). The oldest living western juniper (*Juniperus occidentalis* ssp. *occidentalis*) currently reported is just over 1,600 years old. However, many old trees cannot be aged due to rotten trunk centers.

**Old-Growth Juniper: A Woodland Perspective**

At the community level, old-growth juniper woodlands should be described on the basis of the presence of old trees and structural characteristics such as standing and down dead, decadent living trees, cavities, and branches covered with lichens. Old-growth juniper and pinyon woodlands occur across a wide range of parent materials, soils, aspect, slope, elevation, climate, and disturbance regimes (Kaufmann et al. 1992). To account for some of this variation old-growth juniper woodlands may be characterized into woodland types. Woodland types would be separated out by such factors as

ecological province, major landscape features including geology, parent materials, and landform. In addition to these physical parameters structural characteristics would also be used to classify old-growth woodland types.

Ecological provinces can provide a first separation in the classification of old-growth woodlands accounting for some of the environmental heterogeneity across the Intermountain West (Fig.1). This environmental variation has been divided into ecological provinces based on the floristic regions of Cronquist and others (1972), the Ecoregions described by Bailey and others (1980 and 1994), and soil-plant relationships in Oregon described by Anderson (1956). Ecological provinces differ somewhat in climate, topography, geology and soils, however, similarities and dissimilarities of vegetation between provinces are not always clear. Depending on management objectives, further separation of old-growth woodlands is necessary.

We are currently working on a classification system for old-growth woodlands. In the proposed classification we consider: (1) community type, based on ecological province, landform, the potential dominant shrub and grass, soils, and topography (derived from West and others 1997); (2) tree age composition and structure, and (3) current composition of the understory. The approach allows the composition of the understory and overstory to be evaluated separately, but combined for the classification. In central Oregon, old-growth woodlands are commonly found where the overstory canopy has changed little since settlement, but the understory composition has been largely altered. The age of a stand, plotted along the horizontal axis in figure 1 is based upon the proportion of tree-age classes. Age classes currently proposed are *presettlement;* (1) standing dead, (2) senescent (> 50 percent dead), (3) senescing 5-50 percent dead, (4) late mature (300+yrs), mature (120-300 yrs); *postsettlement*, (5) young mature, (6) sapling (3-10 ft tall), and (7) juvenile (< 3 ft tall). Abundance of down dead trees is also considered. For mapping purposes, Woodgate et al. (1996) suggested old-growth semi-arid stands in Australia consist of a minimum of 10 percent senescent trees and a maximum of 10 percent regrowth or young trees. For juniper woodlands that attain ages exceeding 1,000 years old it may be helpful to separate stands into several old-growth age classes. Stands that are 150 to 300 years old are usually structurally different than stands exceeding ages of 500 years.

## Old-growth Woodland Types

In Oregon, estimates of less than 3 percent of the current 5 million acres of western juniper woodlands are characterized by trees > 100 years old (USDI-BLM 1990). Although not well documented, similar proportions of western juniper old-growth are probably found in northeastern California, northwestern Nevada, and southwestern Idaho. However, the proportion of pre- and post-settlement trees varies across ecological provinces. Acreage of old-growth is not know since mapping and inventory of old-growth western juniper woodlands is limited throughout its range.

Old-growth western juniper stands grow on soils derived from three major parent materials, located in six ecological provinces, the John Day, Mazama, High Desert, Snake River, Klamath, and Humboldt (Fig.1). Old-growth stand structure is typically different among the different provinces and parent materials. The **igneous zone**

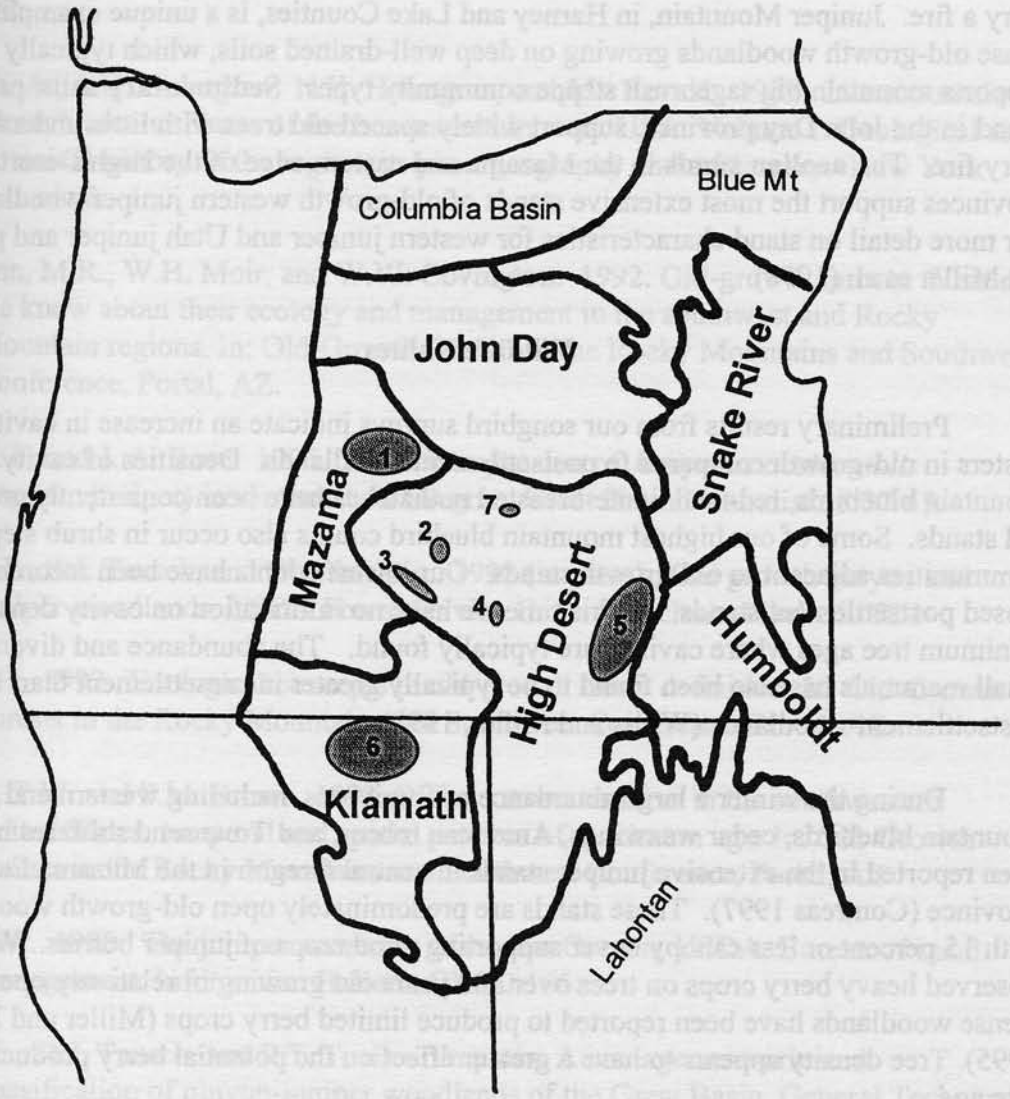


**Figure 1.** Ecological provinces derived from Anderson 1956 and Bailey 1994. Areas where old growth stands are currently being investigated: (1) Bend-Redmond-Powell Butte, (2) Green Mountain, (3) Connely Hills, (4) Juniper Mountain, (5) Steens Mountain, (6) Devils Garden, Norhtern Great Basin Experimental Range.

dominates most of the landscape in the High Desert and Klamath ecological provinces, and the Owyhee Plateau in the Humboldt province. Igneous rock is also the most abundant parent material in the southwestern portion of the Snake River province, where western juniper occurs. In these provinces old-growth juniper typically grows widely spaced on shallow, rocky, heavy clay soils, or rimrock supporting limited fine fuels to carry a fire. Juniper Mountain, in Harney and Lake Counties, is a unique example of dense old-growth woodlands growing on deep well-drained soils, which typically supports mountain big sagebrush steppe community types. **Sedimentary** soils, primarily found in the John Day province, support widely spaced old trees with little understory to carry fire. The **aeolian sands** in the Mazama and eastern edge of the High Desert provinces support the most extensive stands of old-growth western juniper woodlands. For more detail on stand characteristics for western juniper and Utah juniper and pinyon see Miller et al. (1998).

## Wildlife Values

Preliminary results from our songbird surveys indicate an increase in cavity nesters in old-growth compared to postsettlement woodlands. Densities of cavity nesting mountain bluebirds, red- and white-breasted nuthatches have been consistently greater in old stands. Some of our highest mountain bluebird counts also occur in shrub steppe communities adjacent to old-growth stands. Our lowest counts have been recorded in closed postsettlement stands. At this time we have no information on cavity densities or minimum tree ages where cavities are typically found. The abundance and diversity of small mammals has also been found to be typically greater in presettlement than postsettlement woodlands (Willis and Miller, 1998).

During the winter a large abundance of frugivores, including western and mountain bluebirds, cedar waxwings, American robins, and Townsend solitares have been reported in the extensive juniper stands in central Oregon in the Mazama Ecological Province (Contreas 1997). These stands are predominately open old-growth woodlands, with 15 percent or less canopy cover supporting good crops of juniper berries. We have observed heavy berry crops on trees over 500 years old growing in relatively open stands. Dense woodlands have been reported to produce limited berry crops (Miller and Rose 1995). Tree density appears to have a greater effect on the potential berry production than tree age.

## Literature Cited

Anderson, E.W. 1956. Some soil-plant relationships in eastern Oregon. Journal of Range Management 9:171-175.

Bailey, R.B. 1980. Description of the Ecoregions of the United States. USDA Forest Service Misc. Publication 1391.

Bailey, R.B. et al. 1994. Ecoregions and subregions of the United States. Map USDA Forest Service, Washington D.C.

Burkhardt, J.W., and E.W. Tisdale. 1976. Causes of juniper invasion in southwestern Idaho. Ecology 76:2-484.

Contreras, A. 1997. Northwest birds in winter. Oregon State University Press, Corvallis, OR.

Cronquist, A., A.H. Holmgren, N.H. Holmgren, and J.L. Reveal. 1972. Intermountain Flora: Vascular Plants of the Intermountain west, USA. Volume I: Geological and botanical history of the region, its plant geography and a Glossary. New York Botanical.

Kauffmann, M.R., W.H. Moir, and W.W. Covington. 1992. Old-growth forests: What do we know about their ecology and management in the southwest and Rocky Mountain regions. In: Old-Growth Forests in the Rocky Mountains and Southwest Conference, Portal, AZ.

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

Miller, R.F., R.J. Tausch, and W. Waichler. 1998 (in press). Old growth pinyon and juniper woodlands. USDA Forest Service General Technical Bulletin RM- .

Moir, W.H. 1992. Ecological concepts in old-growth forest definition. In: Old-Growth Forests in the Rocky Mountains and Southwest Conference, Portal, AZ.

Swetnam, T.W. and P.M. Brown. 1992. Oldest known conifers in the southwestern United States: temporal and spatial patterns of maximum age. In: Old-Growth Forests in the Rocky Mountains and Southwest Conference, Portal, AZ

USDI-BLM. 1990. The juniper resources of eastern Oregon. USDA, Bureau of Land Management. Information Bulletin OR-90-166.

West, N.E., R.J. Tausch, and P.T. Tueller. In press. A management-oriented classification of pinyon-juniper woodlands of the Great Basin. General Technical Report, USDA Forest Service, Rocky Mountain Research Station, Ogden UT.

Willis, M.J. and R.F. Miller. 1998 (in press). Small mammal response to plant community structure and woodland manipulation. USDA Forest Service General Technical Bulletin RM- .

Woodgate, P.W., B.D. Peel, J.E. Coram, S.J. Farrell, K.T. Riman, and A. Lewis. 1996. Old-growth forest studies in Victoria, Australia concepts and principles. Forest Ecology and Management 85:79-94.

Young, J.A., and R.A. Evans. 1981. Demography and fire history of a western juniper stand. Journal of Range Management. 34:501-506.