

The Historic Expansion of Western Juniper in Southeastern Oregon

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SUMMARY: *Prior to settlement, densities of western juniper were relatively stable. Initiation of the recent expansion of juniper on Steens Mountain began in the 1880's. As densities of trees reaching maximum potential seed production age increased, establishment of new juniper trees has been proceeding at a geometric rate.*

Juniper and pinyon-juniper woodlands are one of the major vegetation types characterizing the Intermountain Region. These woodlands, sometimes described as pygmy forests, currently occupy over 40 million acres in this region. Western juniper is considered the Northwest representative of the pinyon-juniper zone in the Intermountain Region. Western juniper occupies over 2 million acres in eastern Oregon, southwestern Idaho and northeastern California. Western juniper is found primarily north of the polar front gradient (near and parallel to the Oregon and Nevada border) where temperatures are cooler, summer precipitation decreases and winter precipitation increases.

Relict juniper woodlands, tree-age class ratios, fire scars, and historical documents indicate western juniper woodlands were open, savannah-like, or confined to rocky ridges prior to Euro-American settlement. Western juniper began increasing in both density and distribution in the late 1800s. Even though western juniper is long lived, less than 3 percent of the woodlands in Oregon are characterized by trees over 100 years old. In 1825, Ogden observed only occasional junipers (reported as cedars) growing on the hillsides, while traveling through the Crooked River drainage in central Oregon. Today, these hillsides are covered by dense juniper woodlands. In a

nearby area, J.W. Meldrum's 1870 survey notes describe a gently rolling landscape covered with an abundance of perennial bunchgrasses and a wide scattering of juniper trees. Today, juniper densities on this site range between 50 and 100 trees per acre.

Our primary objective was to describe the chronology of western juniper expansion during the past two centuries in southeastern Oregon. Secondary objectives were to evaluate height age relationships across different plant communities, determine the effect of plant canopy and interspace on juniper seedling establishment, and evaluate the relationship of tree age and reproductive potential.

METHODS

The study area was located on Steens Mountain in southeastern Oregon, approximately 50 miles south of Burns. This isolated volcanic fault-block, which lies in the extreme northwest Basin and Range Province is about 50 miles long oriented in a northeast direction. The elevation of Steens Mountain varies from 4,100 to 9,700 ft with a steep east facing escarpment and a gentle west facing slope. The climate is cool and semi-arid, characteristic of the northern Great Basin. Annual precipitation averages 9 to 11 inches at the lower elevations and 20 inches or more at the higher elevations. The majority of moisture is received as snow in November, December and January, and as mostly rain March through June.

The juniper woodlands on Steens Mountain form a discontinuous belt between 4,700 and 6,600 feet. Early observations on Steens Mountain describe a landscape that contained only scattered stands of juniper. Severe winter conditions probably restrict juniper from expanding into higher elevations while the lower limit is controlled by temperature inversion layers (cold air sinks) and drought conditions. Western juniper

cover varies from fairly open with a dominate shrub steppe understory to a well developed woodland (25 to 35 percent cover). Canopy cover in woodlands that have formed on the mesic aspen sites approach 100 percent.

Twenty-two, 1 acre plot locations were selected in an attempt to characterize juniper woodlands on the west slope of Steens Mountain. Old stands on the rocky outcrops were not measured. These plots represented several maturity classes of dispersed, scattered, and closed juniper stands. Dominant understory vegetation in the scattered and dispersed stands were mountain big sagebrush (*Artemisia tridentata* spp. *vasiyana*) and Idaho fescue (*Festuca idahoensis*), and on the rocky shallow soil sites, low sagebrush (*A. arbuscula*) and Idaho fescue. Understory vegetation in the closed stands was composed of a few remanent deep-rooted perennial grasses and 70 percent bare ground.

Juniper density, height, two canopy diameter measurements, and basal area were recorded. Tree canopy cover was estimated by adding crown area measurements for each plot. Current years juniper seedlings were not measured. Position of trees less than 20 inches tall; beneath a juniper canopy, sagebrush canopy, or in the interspace; was also recorded. Reproductive status was determined for each tree by designating one of three classes for berries or cones: (1) berries and/or cones scarce; (2) berries and/or cones obvious but not abundant; and (3) berries and/cones abundant. Ten trees were randomly selected within five size classes. Trees were cut at the base, cross-sectioned and aged.

RESULTS AND DISCUSSION

Prior to settlement western juniper populations appeared to be relatively stable during the past century. We encountered old trees on the rocky outcrops, in several low sagebrush sites, and only a few in mountain big sagebrush communities. The remains of old stumps on most of these sites suggested very open stands of juniper. Densities of juniper over 110 years old on two low sagebrush sites were two per acre. In 1991,

juniper densities on these two sites are 94 and 180 per acre. Canopy cover in the newly formed juniper woodlands averaged 22 percent, ranging from 18 to 28 percent. Density of adult trees on these sites varied from 88 to 201 trees per acre with a mean of 120 trees per acre. Juvenile trees ranged from 88 to 496 per acre. The open juniper stands with a strong understory component of sagebrush and perennial grasses were generally characterized by a canopy cover of less than 10 percent, and adult tree density of less than 50 trees per acre. Densities of juvenile trees in these stands ranged from 40 to 488 trees per acre with a mean of 272 trees per acre.

The first evidence of increased regeneration occurred in the 1880s, with relatively steady establishment ensuing into the 1950s (Fig. 1). In the 1960s juniper establishment began occurring at a geometric rate. Expansion of western juniper in the late 1800s coincided with ideal climatic conditions for seed development and establishment, and reduced fire return intervals. Overgrazing, which reduced the fine fuels, and the reduction fires started by Native Americans dramatically altered the role of fire in these ecosystems.

The largest proportion of juniper seedling establishment occurred beneath the canopies of juniper and sagebrush, with a small percentage establishing in the interspace. In the woodlands, 86 percent of the juveniles were located beneath the canopy of an adult juniper. In sagebrush grassland communities 55 to 64 percent of the juveniles were located beneath sagebrush canopies. Growth rate of young juniper trees growing beneath a sagebrush canopy, was 144 percent greater compared with growth rates beneath a juniper canopy or in the interspace. Based on growth rates of over 200 trees between 10 and 20 years of age, 90 percent of these trees, were or will be, less than 40 inches tall at the age of 15 (64 percent will be less than 20 inches tall). As trees matured, growth rates beneath sagebrush canopies increase from 1.8 to 3.1 inches per year. As tree canopy cover approached or exceeded 20 percent, tree growth rates declined to 2.2 inches per year.

The largest proportion of trees

producing berries or cones were over 50 years old. Trees producing crops of berries and cones between 20 and 25 years old accounted for only 10 percent of the population. Trees producing berries or cones less than 20 years old were rare. Approximately 75 percent of the trees producing heavy crops of berries or cones were over 50 years old. Ratios of male:female trees were varied with dominance of trees on the site.

In conclusion, the expansion of western juniper on Steens Mountain began during the late 1800s when fires became less frequent and climate was ideal for seed

production and seedling establishment. The dramatic increase in tree establishment rates since the 1960s is probably due to lack of fire and a large increase in seed production. Data suggest seedling establishment beneath sagebrush canopies, where growth rates and distribution of seedlings is greater, is a primary mechanism for juniper establishment within shrub grassland communities. Full reproductive potential for most junipers is not reached until trees are over 50 years old.

Figure 1. Years in which all trees measured on Steens Mountain were established (sample size = 1400).

JUNIPER ESTABLISHMENT STEENS MOUNTAIN

