

Twenty Thousand Years of Pinyon and Juniper Woodland History

Purpose

This factsheet is an abbreviated version of the history section of the book [*The Ecology, History, Ecohydrology, and Management of Pinyon and Juniper Woodlands in the Great Basin and Northern Colorado Plateau of the Western U.S.*](#) by Richard Miller and others. The book is a thorough review of the current knowledge of pinyon and juniper ecosystems, both persistent and newly expanded woodlands. This factsheet provides just highlights—the full text draws from a large volume of research on these semi-arid woodlands with reviews and citations from hundreds of sources.

Presettlement

A wide variety of evidence helps us reconstruct prehistorical conditions for temperature, precipitation, and vegetation dynamics over time and space. Glacier footprints, lake shorelines, pollen, volcanic ash, sediments from lakes and ponds; fossils from packrat middens, dry caves, extinct animal remains and isotopic evidence in ice cores, plants, and animal bones all offer clues. Climate has been the primary driver of woodland dynamics, resulting in expansion, contraction, migration, and changes in woodland structure and species composition. Dramatic changes in temperature as well as the abundance and seasonal distribution of precipitation have occurred across the Intermountain Region over the past 100,000 years. During the Glacial Maximum 20,000 years ago (the period when ice sheets extended across the most land surface area and temperatures were coolest), precipitation was 1.5 times greater and temperatures 9.9-12.6 °F cooler in the northern Great Basin, and 5.4 to 7.2 °F cooler in the Colorado Plateau than current conditions. In response to long-term periods of changing climate, pinyon and juniper woodlands moved up and down in elevation by as much as 3,000 ft and individual tree species migrated hundreds of miles latitudinally (fig. 1).

Transitions between cool-wet and warm-dry periods typically resulted in the most rapid changes in woodland distribution, abundance, and structure. Although climate is the primary driver of vegetation dynamics, its effects on woodland dynamics cannot be separated from other disturbance factors including fire, insect infestations, and disease. The transition from the cool-wet Neoglacial period to the warm-dry Medieval Warm period (over 1,000 years ago), resulted in a large reduction of pinyon and juniper woodlands, and was marked by significant increases in ash and large charcoal,



Figure 1. During glacial maximum, Utah juniper dominated the semi-arid woodlands between 3,300 and 5,900 feet on the White Mountains of California. Pinyon was a minor component during the late Pleistocene. Today, pinyon and juniper woodlands occur between 6500 and 9500 feet where bristlecone and limber pine occurred 20,000 years ago. At near 11,000 feet, the limber and bristlecone pines intermingle with mountain big sagebrush communities. (Photo by Rick Miller, Oregon State University.)

suggesting a large increase in fire across the Intermountain West. It is also likely that insect infestations increased during these increasing drought conditions.

Postsettlement

The 1850s marked the end of the Little Ice Age. During the early 1860s, there was a significant rise in modern anthropogenic impacts throughout the Intermountain West. Prior to Eurasian settlement, evidence suggests pinyon and juniper woodlands were slowly expanding and infilling. Based on multiple tree-ring studies across the Great Basin and Colorado Plateau, rates of tree expansion into adjacent sagebrush steppe and shrublands, and infill into established woodlands, significantly increased shortly after Eurasian settlement -- frequently peaking in the early 1900s.

The rapid increase in tree expansion and infill is attributed to climate, grazing, reduced fire occurrence where surface

fuels were once adequate to support surface fires, and increased CO² levels, which increased water-use efficiency in conifers (fig. 2a & b). Climate conditions in the late 1800s and early 1900s were ideal for cone production, tree seedling establishment, and rapid growth rates. This increase in tree establishment most commonly peaked in the early 1900s across both the Great Basin and Colorado Plateau, during a persistently wet period in the West between 1905 through 1917 (fig. 3). However, periods of increased moisture often result in the accumulations of fine fuels increasing the occurrence of widespread fires across the West. But large numbers of livestock in the late 1800s and early 1900s significantly reduced fine fuel loads and coincides

with a significant decline in fire. The sudden decline in fire occurrences in the late 1800s was like no other in the last 3,000 years.

Forest inventories in Nevada, Utah, and eastern California reported over 60 percent of the pinyon and juniper woodlands are less than 150 years old. These are young woodlands that have expanded into other plant communities. The inventories indicate most of the remaining woodlands are well over 150 years old, often showing old-growth traits. However, many of these old-growth woodlands have significantly changed in structure over the past 170 years, resulting from infill.



Figure 2. Many of the post-settlement trees we see today across the Colorado Plateau and Great Basin resulting in both expansion and infill were established during a wet period between 1890 and 1920. (A) There has been a significant increase in tree density in this old-growth woodland on the Kaibab Plateau since the 1900s. (B) The mature trees on this site established during the first part of the 20th Century expanding into mountain big sagebrush and Idaho fescue in central Oregon on moderately deep sandy loams. Presettlement trees, logs, and stumps are present but less than one per acre. (Photos by Rick Miller, Oregon State University.)

Pattern of woodland establishment Infill & Expansion

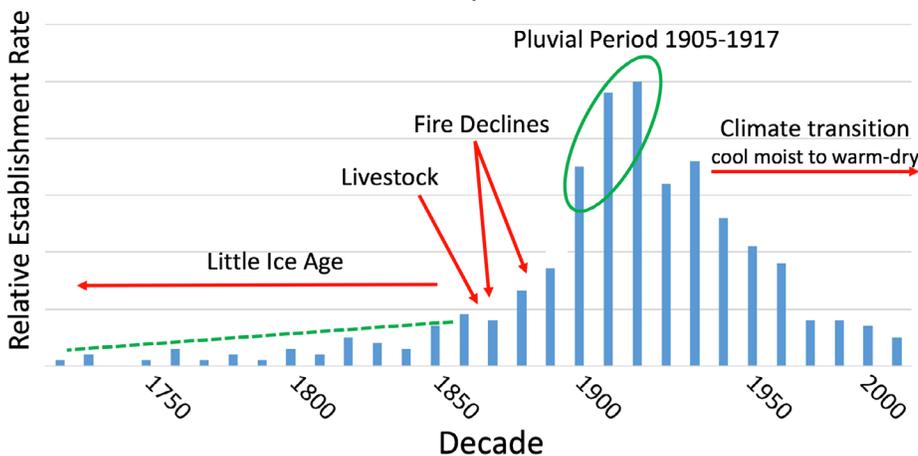


Figure 3. Decadal establishment of pinyon and juniper, which presents a common path shown by many chronologies and tree-ring studies throughout the Great Basin and Colorado Plateau since the 18th Century. Tree expansion into adjacent sagebrush steppe and shrublands, and infill into established woodlands, has been constant for over 300 years, with establishment rates peaking in the early 1900s, a result of climate and anthropogenic influences.

More To see references, specific details and a discussion of many other topics, see the full text of the book available [HERE](#). Refer to section three for a synthesis of ecological history.