Changes in Piñon-Juniper Vegetation: A Brief History

Reg Ernst and Rex D. Pieper

A major goal in managing piñon-juniper communities is maintaining or reducing tree density and the amount of area occupied by piñon-juniper vegetation (Springfield 1976, West 1984). Eleven piñon species and 6 juniper species occur in the Southwest, but only 2 piñons—single-leaf and Rocky Mountain (*Pinus monophylla* and *Pinus edulis*)—and 3 junipers—alligator, one-seed, and Utah (*Juniperus deppeana, Juniperus monosperma*, and *Juniperus osteosperma*)—are found in woodlands in piñon-juniper communities (Lanner 1981).

The piñon-juniper community, sometimes called the pygmy conifer woodland because of the low stature of the piñon and juniper trees, comprises approximately 76 million acres. This community encompasses areas of the Great Basin (to 42°N), Baja California, the Colorado Plateau, the Rocky Mountains, and the Sonoran and Chihuahuan Deserts. It extends southward to the states of Jalisco and Puebla in Mexico (to 18°N) (Wells 1987). Piñon and juniper trees grow together (Kline 1993) and have a broad ecological amplitude that allows them to compete in a variety of plant communities.

Studies indicate that piñon-juniper communities are encroaching on native grassland and displacing natural meadows and clearings within the piñon-juniper complex. Reasons cited for this increase are heavy grazing, fire suppression, and climatic change (Springfield 1976).

Prehistoric land use by Native Americans caused changes in the piñon-juniper community, but these disturbances were local patches near their settlements (Baker et al. 1988). Spanish explorers introduced livestock to the piñon-juniper community, but livestock grazing during Spanish occupation was limited to areas near settlements and along the trade and travel corridors linking southwestern settlements with Mexico.

The availability of mechanical and labor resources following the Second World War spurred range renovation projects to provide additional grazing for livestock. In the piñon-juniper woodland these projects consisted of chaining or cabling large tracts of land. Many projects failed to provide a long-term source of forage for livestock (Gottfried and Severson 1993) and may have had a negative effect on wildlife habitat (West 1984).

The piñon-juniper region is comprised of morphologically different ecosystems across a heterogenous landscape with a history of natural and induced disturbance regimes. This paper discusses how past climatic, environmental, and anthropogenic factors in these regions have altered and continue to alter the landscape.

Authors are with the Department of Animal and Range Sciences, New Mexico State University, Las Cruces, N.M. 88003. Contribution from the New Mexico Agriculture Experiment Station.

Paleoclimatology

Pines originated during the great drought from 60 million to 30 million years BP (Lanner 1981) and since that time have evolved into various species, tolerant of a wide range of environmental conditions and capable of occupying a variety of habitats. The Paleostructure and historical structure of a piñon-juniper community likely consisted of a matrix of large, open grassland meadows interspersed with savannas and patches of piñon-juniper woodlands restricted to rocky ridges (Wright et al. 1979).

The advancing and retreating ice flows ice during the glacial and inter-glacial periods caused corresponding changes in climatic conditions. During the cooler, more mesic conditions of the glacial periods, piñons occupied areas in what are now the desert regions of the Southwest (Betancourt 1987). They were absent from the Great Basin and Colorado Plateau during full glacial times (West 1984). As the glaciers receded and conditions became warmer and more xeric, the piñons remained extant by migrating above 1,000–1,500 m in elevation and northward 6° of latitude (Betancourt et al. 1993, Lanner 1981, Wells 1987). Juniper likely followed the same general movement pattern (Kline 1993).

Historical drought has altered the abundance, age, and distribution of trees within the piñon-juniper region. The last major drought to cause significant mortality of piñon and juniper trees in New Mexico occurred during the 1950s (Betancourt et al. 1993).

The present-day piñon-juniper community is situated between desert or grassland at lower elevations and ponderosa pine forests at higher elevations, forming broad ecotones along these vegetational and environmental gradients (Evans 1988, Pieper 1977).

Prehistoric Use

Native American people living in the Southwest occupied the piñon-juniper community for the past 10,000 years (Cartledge and Propper 1993) because it provided fuel, food, medicine, and shelter (Lanner 1981). Previous theories suggested indigenous people abandoned some areas because of drought, but recent studies conclude that settlements were abandoned because local piñon and juniper

resources were depleted (Kohler and Matthews 1988). Betancourt et al. (1993) suggest that prehistoric Native Americans may have depleted many piñon-juniper resources near their settlements, and Van Devender (1987) states that prehistoric clearcutting by the Anasazi in Chaco Canyon, New Mexico, may have extirpated the Rocky Mountain piñon from that area.

Prior to the arrival of Spanish explorers in the American Southwest during the 1500s, these native Americans relied heavily on piñon nuts to provide a storable source of protein and energy that could be collected during years of high mast production, occurring every 5–6 years (Betancourt et al. 1993).

Historical dietary evidence shows as Native Americans were introduced to agriculture by the Spanish increased consumption of piñon nuts decreased and consumption of corn and beans increased. As the landscape was altered by agricultural practices, animal species likely shifted with a decrease in interior species (because of reduced woodland) and an increase in edge species favored by a patchy, shrubby environment (Cartledge and Propper 1993).

Spanish Influence

The piñon-juniper community in New Mexico has been grazed continuously since Coronado arrived with livestock in the 1500s (Baker et al., 1988, West 1984). The Spanish continued to introduce livestock to the American Southwest during the next three centuries, and by the end of the 18th century there may have been as many as 2 million sheep in New Mexico (Flores 1993). Other regions of the Southwest were undergoing similar increases in livestock populations. Between 1815 and 1830 sheep exports to Mexico from the U.S. averaged 200,000 head per year (Wentworth 1948). Escaped livestock from Spanish expeditions (particularly horses) formed large herds that had a significant impact on range resources across the West (Evans 1988).

Spain administered pastoral lands in Mexico and Southwestern U.S. according to the Mexican Mesta. One provision of these regulations included punishment to anyone found guilty of burning savannas or fields (Dusenberry 1963). Because reduced fire intensity and frequency is one of the major factors affecting the spread of woodlands (West 1984, Pieper and Wittie 1990), this law may have enabled the early spread of the piñon-juniper community in the Southwest.

Euroamerican Impact

Perhaps the first significant impact on the piñon-juniper community by Euroamericans was by the United States military. Military commanders instructed their men to clear patches around the forts to deprive Indians of cover (Evans 1988). In addition, miners, particularly in Arizona and Nevada, relied almost exclusively on the piñon-juniper community for mine timbers, charcoal for smelting, and firewood for cooking and home heating (Evans 1988, Hattori and Thompson 1987). Railroads also relied on resources from the piñon-juniper community for construction materials, railway ties, and wood for locomotive fuel.

Fire suppression and heavy grazing are the reasons most often cited for the spread of piñon-juniper vegetation since European colonization. Heavy grazing reduces understory competition for piñon and junipers and removes the fuel required to carry a fire hot enough to kill piñon and juniper seedlings. Natural and human-caused fires occurring at frequent intervals were a major factor in maintaining grasslands by suppressing tree and shrub growth (Pieper and Wittie 1990). Fires every 10 to 30 years suppress woodland communities and restrict the ecesis of woody species into grassland communities (Wright et al. 1979).

Burkhardt and Tisdale (1976) state that poor range condition has little to do with juniper ecesis. They found juniper becomes established most readily on productive areas with good ground cover, indicating competition may be less important than fire suppression in controlling juniper. Heavy grazing reduced the protective herbaceous plant cover, allowing severe soil erosion. In 1936, the Secretary of Agriculture reported that 589 million acres of rangeland were suffering serious erosion, and two-thirds of the piñon-juniper type range was either materially or severely depleted. That same year, estimated grazing capacity on the piñon-juniper ranges within the Rio Grande Basin of New Mexico was only about half its original size. Presumably, other areas of the piñon-juniper region were in a similar condition.

As rangelands degraded and became less productive, western livestock owners realized natural ranges required protection and regulation if they were to remain a viable source of forage. Following Word War I, the science of range management was initiated as a curriculum in various universities and colleges. Finally, in 1934 after decades of range disputes, the open range was brought under government control with the Taylor Grazing Act (Krueger 1988).

Large and often expensive range improvement projects were undertaken in the 60, 70s, and 80s. Some projects were successful but others failed for various reasons including poor site selection, inadequate followup procedures, and unfavorable economics. Wildlife managers were concerned about loss of wildlife habitat resulting from range improvement projects. Though some of these projects may have degraded wildlife habitat, installing supplemental water and patch clearing of woodlands may have improved the habitat for other species.

Conclusions

The landscape of the piñon-juniper region has been shaped by various forces since the last ice age (circa 12000 years ago). Climatic change, natural and induced fire, a variety of uses by prehistoric and historic humans, and more recently, the large-scale clearing of piñon-juniper woodlands to increase forage for livestock have all influenced the distribution and structure of the piñon-juniper complex. The current piñon-juniper complex is managed in light of these historical changes.

Increased social awareness and sensitivity to how public lands are used has made natural resource managers include ecological as well as economic goals in management objectives. Biodiversity, preserving sensitive species, and managing wildlife habitat are becoming more important in piñon-juniper management (West 1993). New methods of defining, classifying, analyzing, and displaying ecological information (i.e., landscape ecology, remote sensing, and Geographical Information Systems) may provide the tools to make future management of the piñon-juniper type more efficient.

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