## WATERSHED MANAGEMENT IN THE JUNIPER ZONE

John C. Buckhouse

Visualize an ideal lifeform to exist in a harsh climate and successfully compete for the water, energy, and nutrients frequently found in short supply there. The juniper species in the western United States clearly fulfills that vision.

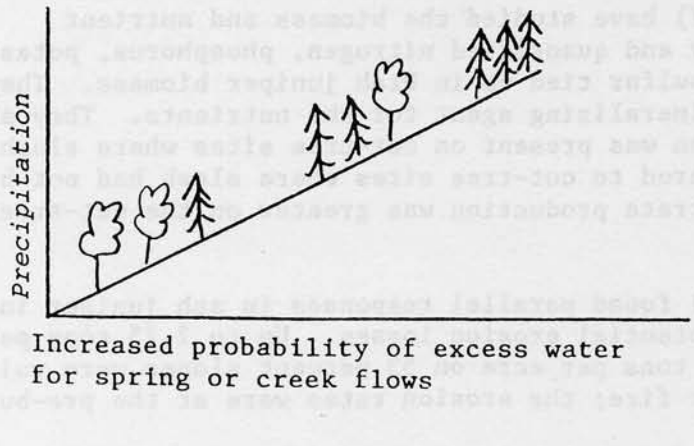
Jeppson (1978) found that Central Oregon sites occupied by western juniper consistenly exhibited lower volumes of water in the soil depths beneath the surface than did similar sites which had been cleared of juniper... even in the winter. He suggested that the physiology of western juniper was such that the plant is able to transpire in any season.

Gifford (1975) working in Southern Utah with Utah Juniper reported similar results. Sites occupied by juniper experienced an early and thorough transpirational extraction of soil moisture. Miller et al. (1987) were able to plot monthly variations of juniper water use and were able to tie the consumption of water to its availability and other environmental characteristics.

Observations by Gifford (1973) indicated that removal of juniper may have positive hydrologic implications on a site. Although range improvement practices inevitably decrease infiltration rates of water into the soil because of compaction and alteration of soil structure, if sufficient retention/detention storage is created, water may remain in contact with the soil longer and result in a greater volume of water actually entering the soil. Field managers frequently cite instances after tree removal and herbaceous plantings where overland flows are decreased, soil moisture is increased, and sometimes springs appear or ephemeral streams flow longer into the dry season.

Yet a study by Williams et al. (1972) in Utah did not offer much hope for semi-arid sites to experience greater flows after removal of the trees. They suggested that herbaceous forage could be dramatically increased, but that increased water yields in the river systems of the area were unlikely.

Most likely, both these conflicting observations are accurate. I suggest that a stylized model such as the one below is operating:



Western juniper in Central Oregon begins to appear at elevation/precipitation zones associated with at least 11 inches of annual precipitation. Ponderosa pine begins to appear somewhere around 15 inches of precipitation and by the time the precipitation level reaches close to 20 inches, the juniper is declining and other conifers dominating.

If juniper were removed at the lower precipitation zone and replaced with herbaceous vegetation, there is likely to be enhanced forage values and possibly a more uniform distribution of vegetation and, therefore, less bare ground and erosion hazard. It is unlikely, however, that creation of new seeps or springs would occur. The vegetation, be it woody or herbaceous, is using it all. As one moves into more favorable precipitation regimes, the likelihood increases that excess water will become available. Excess water would be expected at a 15-inch precipitation level; more at a 20-inch precipitation level. Forest research indicates that in forested areas with precipitation inexcess of 40 inches, as much as a 20 percent increase in the quantity of water which flows from the site may be gained. Obviously, this savings is water which would have been transpired by the trees but instead has been rerouted.

Fire seems to be one of the most effective, and most economical, tools we have to combat juniper encroachment. Fire is the Achilles' Heel in this otherwise wonderfully adapted plant.

From a watershed point of view, fire will have a less dramatic impact leading toward soil compaction than will mechanical removal practices which involve heavy machinery. This is a positive feature.

The calculated risk with fire, however, is the exposed soil. If storms occur on the site before vegetation has time to become established, the site is very vulnerable to erosion. This erosion may have consequences beyond the tragic loss of soil; it may also pollute downstream water with increased phosphorus, sodium, and potassium which are released by the burn. Buckhouse and Gifford (1976) noted that potassium had the potential to be flushed from a burned juniper site at a rate of about 5 ppm immediately after a burn, compared to near zero ppm on unburned sites. Phosporus had a rate of 0.75 ppm after the burn versus near zero ppm before fire; calcium about 15 ppm compared to 5 ppm beforehand. Buckhouse and Gifford noted that within a year, the calcium nutrient losses/release was at pre-burn levels, and the other nutrients maintained their post-burn levels for at least a year.

De Bano et al. (1987) have studied the biomass and nutrient relationships extensively and quantified nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur tied up in Utah juniper biomass. They found fire to act as a rapid mineralizing agent for the nutrients. They also found that less ammonia-nitrogen was present on cut-tree sites where slash had been piled and burned as compared to cut-tree sites where slash had not been burned. In contrast, nitrate production was greater on the cut-tree sites where slash was burned.

Wright et al. (1974) found parallel responses in ash juniper in Texas when they investigated potential erosion losses. Up to 2.75 tons per acre on 15 percent slopes and 22 tons per acre on 53 percent slopes were vulnerable to loss immediately after fire; the erosion rates were at the pre-burn levels within 9 to 15 months on the moderate slopes and within 15 to 18 months on the steep slopes.

## CONCLUSION

Juniper is a competitive plant which transpires precious water from the system. Removal of the tree allows that water to be redirected. In low precipitation zones, the water will be almost entirely consumed by other vegetation. At higher precipitation zones, some excess water is likely. Removal of the tree is not without a watershed cost, however. The cultural practice employed to remove the tree will have some negative impact on infiltration rates of water into the soil. Heavy equipment has the most impact. This impact is ameliorated by retention/detention storage increases which are possible through range improvements. These might be increased herbaceous vegetation or even an increase in juniper debris in contact with the soil.

Fire is an economical and efficient way to remove juniper in some instances. It does, however, leave a window of vulnerability open to the site until such time as revegetation occurs.

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