Studying arid watershed management in the Pacific Northwest - The effect of Western Juniper control in paired watersheds - Camp Creek, Oregon

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Abstract

In 1993, a paired watershed study was initiated in the Camp Creek drainage, a tributary of the Crooked River of central Oregon, to evaluate the impacts of cutting western juniper on the hydrologic function of those sites. The study involved a paired watershed approach using watersheds of approximately 110 hectares (270 acres) each to evaluate changes in a system's water budget following the reduction of western juniper.

Following 12 years of pretreatment monitoring in the 2 watersheds (Mays and Jensen) all post-European aged juniper (juniper < 140 years of age) were cut from the treatment watershed (Mays). Analysis indicated that juniper reduction significantly increased late season spring flow by 225 percent (alpha > .05), increased days of recorded ground water by an average of 41 days (alpha > .05) and increased the relative availability of late season soil moisture at soil depths of .76 m (27 inches) (alpha > 0.1).

Ephemeral channel flow did not show a predictable trend during 2 years of post treatment measurements. Channel flow is dependent on spring snow melt and severe summer thunderstorm activity. When winter soils were greater than 0 degrees Celsius (32 degrees F), the source of channel flow in Mays was observed to be seepage from the channel banks. Channel flow in Jensen appeared to be a result of rock forcing subsurface flows to the surface.

Vegetative responses showed significant increases in perennial forb canopy cover (alpha > .01) and annual forb and annual grass basal cover (alpha > .05). Increases were also found in reduction of percent bare ground and increase in shrub cover, but were not significant. A statistically insignificant decrease in perennial grass cover was noted in the treated watershed however a large amount of reproductive culms were noted in the treated watershed in 2007 compared to the control watershed.

Hillslope erosion and channel morphology showed no predictable trend following treatment. Inherent differences in channel morphology between the two watershed prior to treatment existed. This difference may be a product of the two channels being at different evolutionary or successional stages relative to each other and thus indicating that channel recovery would be different for each watershed.

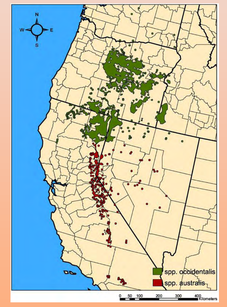
Objective

Study objectives were the following:

- Measure hydrologic changes following juniper removal on a watershed scale;
- Evaluate changes in timing, duration and quantity of water expressed in channel flow, spring output, ground water and soil moisture;
- Calculate changes in hill slope and channel morphology following juniper control;
- Quantify changes in plant community composition following juniper control.

Introduction

Western juniper (*Juniperus occidentalis)* encroachment has been associated with increased soil loss and reduced infiltration resulting in the loss of native herbaceous plant communities and the bird and animal species that rely on them. Hydrologically, however, change in water yield has been linked with the amount of annual precipitation a site received. Studies published in the 1970's and 1980's, suggest that a minimum 4500 mm (18 inches) of annual precipitation was necessary before an increase in water yield manifested itself following vegetation manipulation. In 1993, a paired watershed study was initiated in the Camp Creek drainage, a tributary of the Crooked River of central Oregon, to evaluate the impacts of cutting western juniper on the hydrologic function of those sites.

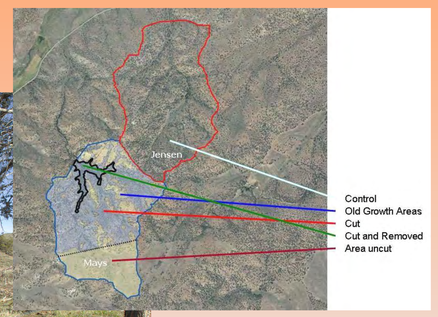


Materials and Methods

The study involved a paired watershed approach using watersheds of approximately 110 hectares (270 acres) each to evaluate changes in a system's water budget following the reduction of western juniper. The 30 year average annual precipitation for the area is 3500 mm (13.75) and during the study period, annual precipitation ranged from 80 percent to 129 percent of average.

In 2005, following 12 years of pretreatment monitoring in the 2 watersheds (Mays and Jensen) all post-European aged juniper (juniper < 140 years of age) were cut from the treatment watershed (Mays).

Each site was measured systematically for precipitation, wind, relative humidity, temperature, ground water levels, stream flows, vegetation, channel erosion, and shallow spring flows.



Results

Analysis indicated that juniper reduction significantly increased late season spring flow by 225 percent (alpha > .05), increased days of recorded ground water by an average of 41 days (alpha > .05) and increased the relative availability of late season soil moisture at soil depths of .76 m (27 inches) (alpha > 0.1). Ephemeral channel flow did not show a predictable trend during 2 years of post treatment measurements. Channel flow is dependent on spring snow melt and severe summer thunderstorm activity. When winter soils were greater than 0 degrees Celsius (32 degrees F), the source of channel flow in Mays was observed to be seepage from the channel banks. Channel flow in Jensen appeared to be a result of rock forcing subsurface flows to the surface.

Vegetative responses showed significant increases in perennial forb canopy cover (alpha > .01) and annual forb and annual grass basal cover (alpha > .05). Increases were also found in reduction of percent bare ground and increase in shrub cover, but were not significant. A statistically insignificant decrease in perennial grass cover was noted in the treated watershed however a large amount of reproductive culms were noted in the treated watershed in 2007 compared to the control watershed.

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Conclusions

The Camp Creek project illustrated that for this system, managing vegetation for water yield may be obtainable at a much lower precipitation threshold than what was previously reported in the literature. Juniper removal had a positive effect on the end of season (lowest recorded reading of the year) soil moisture readings. Juniper removal had a positive effect on the number of days that water was recorded in the wells located in the treatment watershed and on the amount of spring flow in Mays. At the end of the two year post treatment monitoring period, significant changes in vegetative cover attributed to the treatment were increased canopy cover for perennial forbs, annual forbs and an increased basal cover for annual grasses. Hillslope erosion did not show any statistical changes as a result of treatment.

Selected References

Miller, P.F. 1990. Physiological ecology of western juniper (*Juniperus occidentalis* Hook. Subsp. *occidentalis). PhD. Dissertation. Oregon State Univ. Corvallis, OR*. 274 p.

Miller, R.F., J.D. Bates, T. Svejcar, F.B. Pierson and L.E. Eddleman. 2005. Biology, ecology and management of western juniper. Technical Bulletin 152. Oregon State University Agricultural Experiment Station. 77 p.

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