Long-term hydrologic interactions in juniper woodlands: An update on the 20-year paired watershed study in eastern Oregon.

Carlos G Ochoa, **Grace L Ray***, Tim Deboodt, Michael Fisher, John Buckhouse, Mike Borman

Background

Western Juniper covers an area of approximately nine million acres in the states of Oregon, Nevada, Idaho, and California. Western Juniper woodlands have grown significantly in the last 130 years due to a combination of factors including changes in climate, the introduction of livestock, and the reduction of fire (Miller et al. 2005). Dense stands of Juniper can negatively affect the capacity of the watershed for capturing, storing, and releasing water due to the increased levels of interception, evaporation, and tree water uptake associated with juniper encroachment. Also, reductions in infiltration and increases in runoff and erosion are commonly seen in Juniper dominated landscapes due to the lack of understory cover.

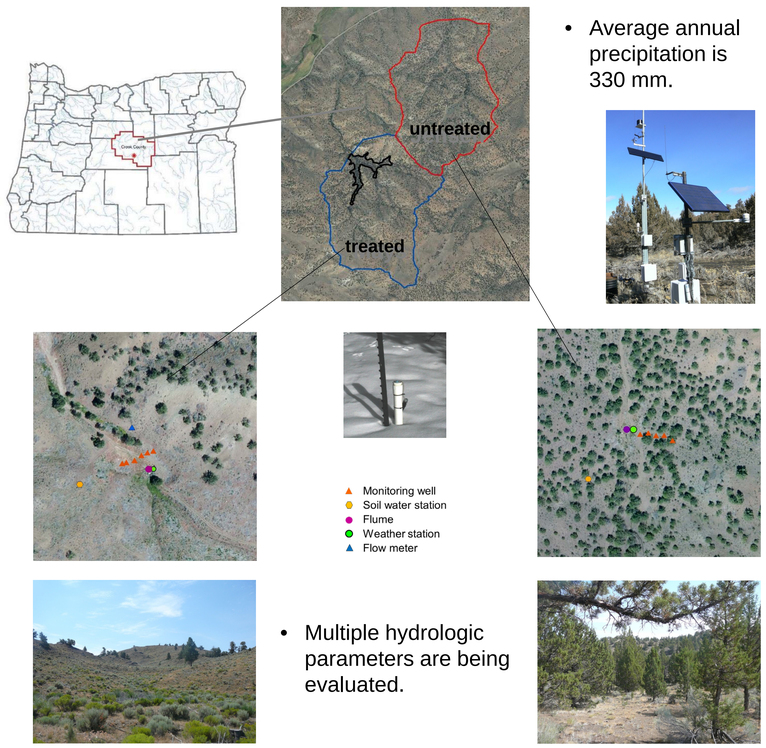
Shallow aquifer systems and subsurface flow processes can be important for groundwater replenishment in arid landscapes of the western United States and other parts of the world. The removal of highly water-consumptive vegetation, such as Western Juniper may have positive impacts on soil water recharge, subsurface flow, and shallow aquifer recharge by reducing evapotranspiration losses and by favoring surface water retention and infiltration due to the establishment of more desirable plant species (e.g., grasses and sagebrush) following Juniper removal. Beginning in 1993, this ongoing paired-watershed study was established with the purpose of enhancing base knowledge regarding hydrologic response following Juniper removal in woodlands of Central Oregon. Previous results showed an increase in late season spring flow and a greater number of days with shallow groundwater present in the treated watershed when compared to the untreated pair (Deboodt et al. 2008).

Objective

We present an update on different hydrologic relationships observed since the last presentation of results in 2008.

Study Area

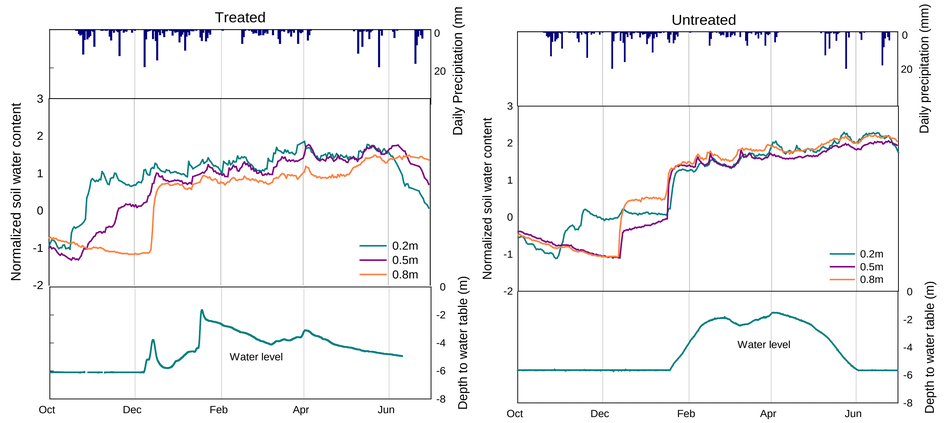
Two watersheds of approximately 100 ha each located in Central Oregon. One watershed was treated in the Fall of 2005.



- Average annual precipitation is 330 mm.
- Multiple hydrologic parameters are being evaluated.

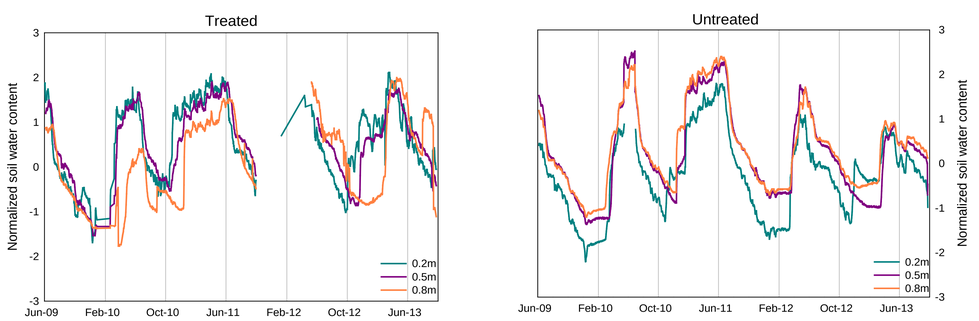
Results

Precipitation-soil water- shallow groundwater interactions (Oct 2010 – June 2011)



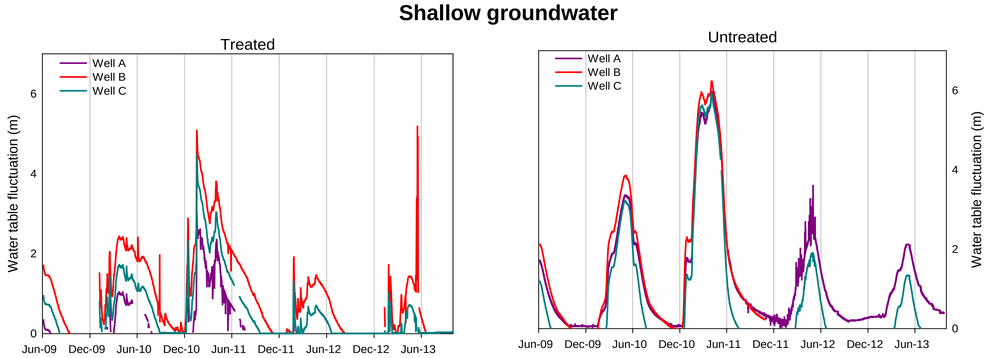
- A gradual response in soil water recharge was observed following the onset of the precipitation season in the treated watershed.
- Percolation to the deeper soil water sensor preceded shallow groundwater level response.

Soil water content



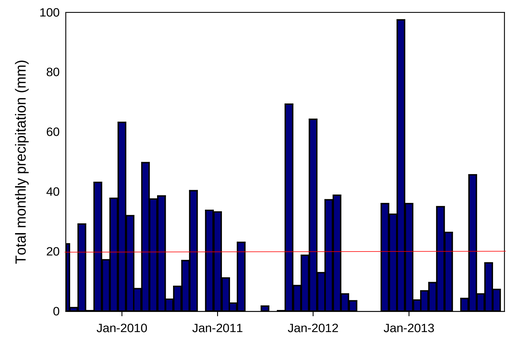
- Seasonal changes in soil water content with maximum durations lasting through spring and winter.
- In general, greater soil water residence time was observed in the treated watershed.

Shallow groundwater



- Seasonal water table fluctuations were observed in multiple wells in response to precipitation percolation inputs, particularly during winter and spring.

Precipitation



- Most precipitation occurred as snowfall.
- Highest amount of total monthly precipitation (98 mm) observed in Dec 2012.

Conclusions

Antecedent soil water content plays an important role in shallow groundwater response.

Spring snowmelt may be the main driver of soil water recharge and shallow groundwater response.

Water table fluctuations reflect the seasonal changes in soil water content.

Future Research

Additional monitoring wells are being added to the study to better understand the magnitude and directionality of shallow groundwater flow.

Ongoing data analysis will provide a better understanding of different hydrologic processes and quantification of water budget components in Juniper woodlands.

Acknowledgments

Crook County Soil Water Conservation District, the Hatfield High Desert Ranch, and the Prineville District BLM.

References

Deboodt, T.L., M.P. Fisher, J.C. Buckhouse, J. Swanson. 2008. Monitoring hydrological changes related to western juniper removal: a paired watershed approach. In Proceedings from the Third Interagency Conference on Research in the Watersheds, 8–11 September 2008.

Miller, R.F., J.D. Bates, T.J. Svejcar, F. Pierson, and L.E. Eddleman. 2005. Ecology, biology, and management of western juniper. Oregon State University Agricultural Experiment Station Technical Bulletin.