Ecological Restoration Institute

Fact Sheet: Influence of Time Since Fire on Pinyon-Juniper Woodland Structure *February 2013*

NORTHERN ARIZONA UNIVERSITY

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Influence of Time Since Fire on Pinyon-Juniper Woodland Structure

By David W. Huffman

INTRODUCTION

Pinyon-juniper ecosystems presently occur on approximately 50 million acres across the semi-arid landscapes of the western United States. Infrequent, stand-replacing fires characterize both historical and modern fire regimes in southwestern pinyon-juniper woodlands (Huffman et al. 2008, Romme et al. 2009). Fires in these systems are typically wind-driven events that occur under hot, dry weather conditions and result in death of most or all trees on extents that range from small groups of trees to patches hundreds of acres in size. In this study, we were interested in understanding how quantities of important woodland structures (trees, tree seedlings, stand dead snags, dead and down logs, and shrubs) change over time since severe fire (TSF), and how structural complexity changes with TSF. In order to answer these questions, we identified a chronosequence of sites that spanned very recently burned areas to older woodlands that had not experienced significant fire for several centuries (Table 1). We installed plots on these 13 sites and sampled quantities of the important structures. Information concerning long-term changes in structural characteristics allows land managers to formulate treatment strategies that emulate natural processes.

Table 1. Sites comprising 370-year fire chronosequence.

Fire	TSF (y)*	Size (ac)	Site Ɨ	Elevation (ft)	Soil Parent Material
Jacket	3	1,7218	CF	6398-6496	limestone/sandstone
Griffin	6	94	KF	6348-6381	limestone
Lizard	7	5,271	CF	6201-6299	limestone/sandstone
Yellow Jacket	30	524	CF	6332-6430	limestone/sandstone
Dillman	60	54	KF	6316-6463	limestone
Arnold	85	348	CF	6365-6463	limestone/sandstone
Red Butte West	90	521	KF	6365-6463	limestone
Cedar	130	563	CF	6201-6233	limestone/sandstone
Red Butte East	140	143	KF	6480-6529	limestone
Yellow Jacket Control	270	180	CF	6250-6266	limestone/sandstone
Red Butte Control	300	551	KF	6398-6496	limestone
Griffin Control	340	59	KF	6348-6398	limestone
Cedar Control	370	304	CF	6233-6299	limestone

* Time since fire in years
Ɨ National Forest (CF = Coconino; KF = Kaibab)

Figure 1. Representation of development of structural characteristics after fire on pinyon-juniper sites. Top to bottom shows recently burned to developing woodland.

Research Findings

- Live juniper and total tree density increased linearly with TSF. Pinyon tree density and TSF were not significantly related.
- Seedlings were found as early as 6 years TSF. Seedling densities and shrub cover were not significantly related to TSF.
- Live pinyon tree biomass, live juniper biomass, and total tree biomass increased with TSF and followed "s-shaped" functions. Total biomass plateaued at 29 tons per acre around 250 years since fire.
- Juniper snag density decreased with TSF and total snag density followed a "u-shaped" function. Total snag densities were lowest around 240 years since fire. Pinyon snag density and TSF were not significantly related.
- Density of rotten logs increased linearly with TSF whereas sound logs and TSF were not significantly related.
- Although different structural elements (trees, seedlings snags, logs, and shrubs) showed various long-term patterns, on aggregate structural complexity showed a positive linear relationship with TSF.

Management Implications

Results from this study indicate that although individual structural elements show various relationships with TSF, structural complexity increases as sites approach persistent woodland conditions (see Romme et al. 2009) (Fig. 1). These findings provide resource professionals with information that can help in developing management approaches intended to emulate natural structural patterns that correspond with time since fire. For example, canopy openings intended to mimic conditions found immediately after fire should retain relatively high numbers of snags and downed logs. Later stages of development are characterized by all-aged tree diameter structure, tree seedlings, and higher shrub cover. Old-growth conditions are relatively complex with higher tree density and biomass, and shrubs, snags, and downed logs present.

References

Huffman, D.W., Fulé, P.Z., Pearson, K.M., Crouse, J.E. 2008. Fire history of pinyon-juniper woodlands at upper ecotones with ponderosa pine forests in Arizona and New Mexico. *Canadian Journal of Forest Research* 38:2097-2108.

Romme, W.H, Allen, C.D., Bailey, J.D., Baker, W.L., Bestelmeyer, B.T., Brown, P.M., Eisenhart, K.S., Floyd, M. L., Huffman, D.W., Jacobs, B.F., Miller, R.F., Muldavin, E.H., Swetnam, T.W., Tausch, R.J., Weisberb, P.J. 2009. Historical and modern disturbance regimes, stand structures, and landscape dynamics on pinyon-juniper vegetation of the Western United States. *Rangeland Ecology and Management* 62:203-222.

This Fact Sheet summarizes information from the following publication:

Huffman, D.W., Crouse, J.E., Chancellor, W.W., and Fulé, P.Z. 2012. Influence of time since fire on pinyon-juniper woodland structure. *Forest Ecology and Management* 247:29-37.

Contact

David W. Huffman, David.Huffman@nau.edu