



Ecological Restoration Institute



Fact Sheet: Long-term Herbivore Exclusion for Recovery of Buckbrush Populations During Restoration of Ponderosa Pine Forests in Northern Arizona

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INTRODUCTION

Open conditions created by restoration activities in ponderosa pine (*Pinus ponderosa* Laws.) forests of the American Southwest can lead to increases in understory plant productivity but also attract large ungulate herbivores. New plant growth stimulated by tree thinning and prescribed fire can provide greater forage quantity and quality for herbivores, but grazing pressure on the recovering understory may be high. Some management options during the period when understories are recovering include excluding herbivores from the site or protecting individual plants for a number of years following restoration treatments. Short-term protection of grazed species may provide opportunity for their escape through development of mass or structural defenses such as spines or thorns. For example, Huffman and Moore (2003) showed that two years after forest treatments buckbrush (*Ceanothus fendleri* Gray) plants protected from mule deer and Rocky Mountain elk had greater stem number, longer stems, and greater current-year biomass than unprotected plants. In contrast, branches of unprotected plants were heavily browsed and just 8 percent of these plants produced flowers. Herbivory pressure also may be lessened with increasing plant community diversity and as more forage options become available to herbivores. However, it is unclear how long protection of grazed plants is needed. Chancellor et al. (2008) showed that buckbrush plants exposed to herbivores after seven years of protection had similar stem lengths and stem numbers as plants that continued to be protected. Leaf area and leaf biomass, however, were significantly less on the recently exposed plants than on protected plants.



Large herbivores such as mule deer (*Odocoileus hemionus*) and Rocky Mountain elk (*Cervus elaphus nelsoni*) are attracted to open conditions and new plant growth in areas receiving forest thinning and burning treatments. *Photo by Brady Smith, USDA Forest Service, Coconino National Forest*

In this study, we wanted to determine if long-term protection from herbivores was required to restore buckbrush abundance and potential reproduction after forest restoration treatments that were comprised of tree thinning and prescribed fire. Buckbrush is a shrub common in ponderosa pine forests of the southwestern U.S. It is important for soil nutrient budgets, understory structure, and habitat for wildlife. We re-measured buckbrush plots (10.8 ft² (1 m²) in size) in the following groups: 1) unprotected (never protected from herbivores); 2) short-term protection (exclosures installed in 1999, removed in 2006); and 3) long-term protection (exclosures installed in 1999 and maintained throughout the 12-year study period).

The Ecological Restoration Institute is dedicated to the restoration of fire-adapted forests and woodlands. ERI provides services that support the social and economic vitality of communities that depend on forests and the natural resources and ecosystem services they provide. Our efforts focus on science-based research of ecological and socio-economic issues related to restoration as well as support for on-the-ground treatments, outreach and education.

RESULTS

- Survival of buckbrush was significantly lower on unprotected plots compared with plots given short-term protection and those with long-term herbivore protection (Fig. 1)
- Plots with long-term protection had higher stem densities (> 50 stems per plot) than either short-term protection or unprotected plots. Most unprotected plots (90 percent) had less than 10 aerial stems per plot.
- Plots with long-term protection showed greater flowering rates (> 50% of aerial stems flowering) than both short-term protection and unprotected groups.
- We found a strong, positive relationship between probability of flowering and plant height, regardless of protection.

CONCLUSIONS

- Short-term protection following forest restoration treatments marginally improved survival of buckbrush in a northern Arizona ponderosa pine ecosystem.
- Herbivory pressure remained high over 12 years following restoration treatments and detrimentally affected potential reproduction of plants not receiving long-term protection.
- Managers may need to consider controlling large herbivores or their access to restoration sites for a number of years after implementation of tree thinning and prescribed fire.
- Long-term monitoring of populations of preferred browse species such as buckbrush may provide effective indicators of restoration success.

LITERATURE CITED

- Chancellor, W.W., D.W. Huffman, and M.M. Moore. 2008. Characteristics of buckbrush shrubs exposed to herbivores after seven years of protection. Pp. 171-175 in Olberding, S.D., M.M. Moore (tech coords.). Fort Valley Experimental Forest — a century of research 1908-2008. USDA Forest Service Proceedings, RMRS-P-53CD.
- Huffman, D.W., and M.M. Moore. 2003. Ungulate herbivory on buckbrush in an Arizona ponderosa pine forest. *Journal of Range Management*, 56:358-363.



Figure 1. Buckbrush plants receiving long-term (12 years) protection (top) from large herbivores had higher survival, greater stem densities, and higher rates of flowering than plants not receiving protection after restoration treatments (bottom).

This fact sheet summarizes information from the following publication:

Huffman, D.W., J.D. Springer, and W.W. Chancellor. 2015. [Long-term herbivore exclusion for recovery of buckbrush \(*Ceanothus fendleri*\) populations during restoration of ponderosa pine forests in northern Arizona](http://library.eri.nau.edu/gsd/collect/erilibra/index/assoc/D2015023.dir/doc.pdf). *Ecological Restoration*, 33:274-281. (<http://library.eri.nau.edu/gsd/collect/erilibra/index/assoc/D2015023.dir/doc.pdf>)

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