COLORADO FOREST
RESTORATION INSTITUTE
Colorado State University

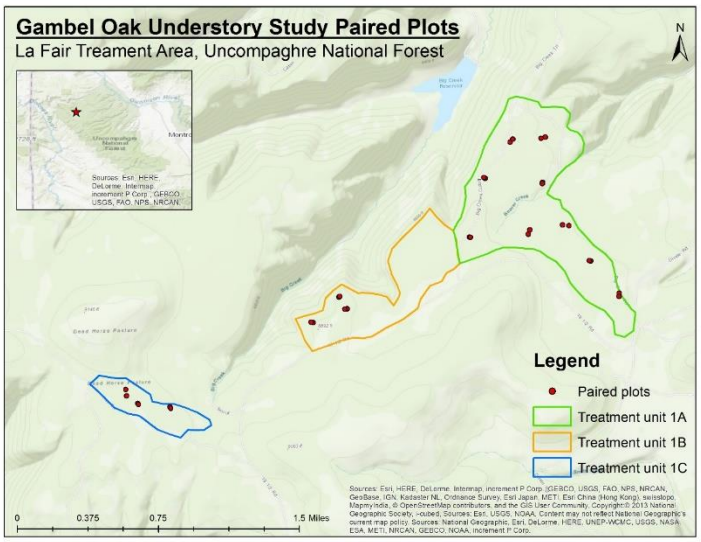
2016-2017 Gambel Oak Understory Study Summary

CFRI-1801

Vegetation management and fuel mitigation treatments are increasingly used to reduce fuel hazard, alter fire behavior, and restore ecosystem structure and function. Regionally, fire mitigation treatments including thinning and/or prescribed fire are often implemented in ecosystems where Gambel oak (*Quercus gambelii)* is a major component species which has contrasting management concerns as it is both important wildlife habitat and a hazardous ladder fuel. Understory vegetation response to the removal of Gambel oak is important for wildlife managers to ensure the overall improvement of browse potential of many understory graminoid, forb, and shrub species. However, little is known about understory vegetation response to Gambel oak treatments (cutting, mowing, or prescribed burning). Thus, treatments aimed at reducing Gambel oak may or may not actually improve wildlife browse potential. Although some information on understory vegetation response to Gambel oak treatments exists, much of this research was developed for the Southwestern U.S., and may not reflect the unique environmental conditions on the Uncompahgre Plateau nor the conditions of the northern extent of Gambel oak's range in Colorado. At the northern extent of its range in the Uncompaghre Plateau and Front Range Mountains, Gambel oak often grows as a low shrub, whereas in the southern extent of its range, oak may grow as tall shrubs or large mature trees. Due to this variability, it is unclear whether information and research on Gambel oak from the Southwestern U.S. applies to the northern extent of its range in Colorado. Locally-relevant information on Gambel oak management is greatly needed to understand understory vegetation response to cutting and prescribed burning treatments in this species.

Figure 1 (below): Photo depicting a common Gambel oak patch surrounded by ponderosa pine in the La Fair treatment unit in the northwest portion of the Uncompaghre Plateau, CO.

Figure 2 (at right): Map of La Fair treatment areas 1A, 1B, 1C, and paired plots (red dots) on the Uncompaghre Plateau.



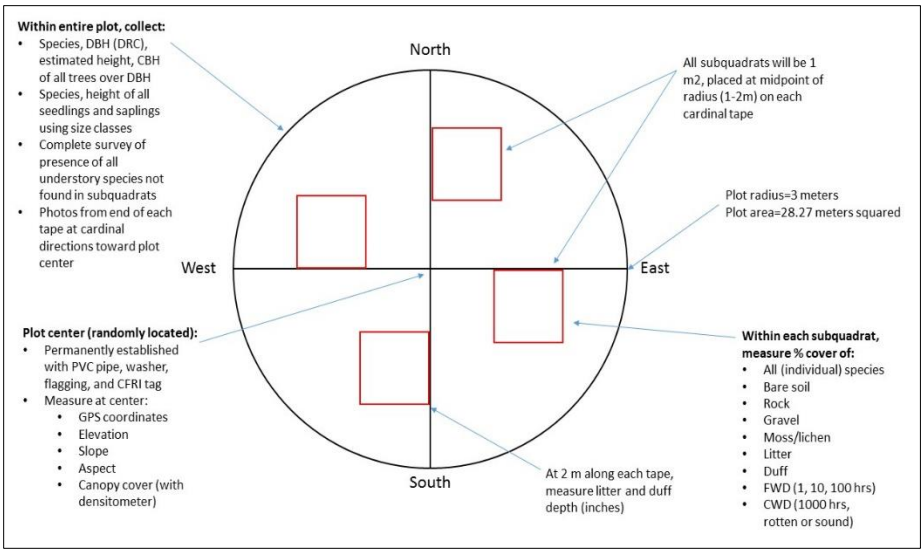


Figure 3: Plot depiction. Transects were placed along cardinal directions 3 m from a permanently established plot center. Tree species height, DBH, CBH; tree seedlings and saplings species and size class; and understory species presence were measured for the entire plot. Within 1 m^2 subplots centered on each transect, understory species and forest floor cover was recorded. Plot-level topographic variables, such as elevation, slope and aspect, were measured at plot center.

In 2016, the Colorado Forest Restoration Institute (CFRI), in partnership with the Uncompaghre Plateau Collaborative Forest Landscape Restoration Program and the US Forest Service, set out to research how Gambel oak treatments such as cutting, mowing, and prescribed fire influence Gambel oak growth and understory vegetation, particularly for the purposes of improving wildlife habitat and browse potential, and to better inform the effectiveness of treatments in Gambel oak on the western slope of Colorado.

Figure 4: Gambel oak patch in the La Fair treatment area prior to treatment (top); patch mowed following treatment (bottom). Study plot is located in the middle of the patch.

CFRI aimed to answer the following research questions:

1) How does understory vegetation respond to treatments (mowing or prescribed burning) of Gambel oak?
2) What is the growth response of Gambel oak following treatments in terms of density and growth of sprouts?
3) What influence does Gambel oak treatment have on other tree regeneration?

CFRI implemented a paired plot study design in randomly located nearby patches of Gambel oak within the La Fair treatment area in the northwestern part of the Uncompaghre Plateau (Figure 2). For each paired patch, one patch was randomly mowed and the other was not (i.e. remained a control plot). Patches were selected that were similar in patch size and size class of Gambel oak within each patch.

CFRI collected pre-treatment data from 15 paired plots (total of 30 plots) in the La Fair treatment unit in July 2016. Paired plots were randomly located within treatment areas. Within 3m radius circular plots, regenerating and overstory stems of Gambel oak and other tree species were measured (Figure 3). Understory vegetation (by species cover and abundance), other ground cover variables, and abiotic conditions of each paired plot were also measured (see plot depiction below). The La Fair treatment area experienced mowing treatments to manage Gambel oak, aspen, and small diameter ponderosa pine in late summer 2016. During 2016 mowing treatments, patches containing one of each paired plot were randomly mowed and the other patches remained as an unmowed control. CFRI returned to relocate and remeasure mowed and control plots in July 2017.

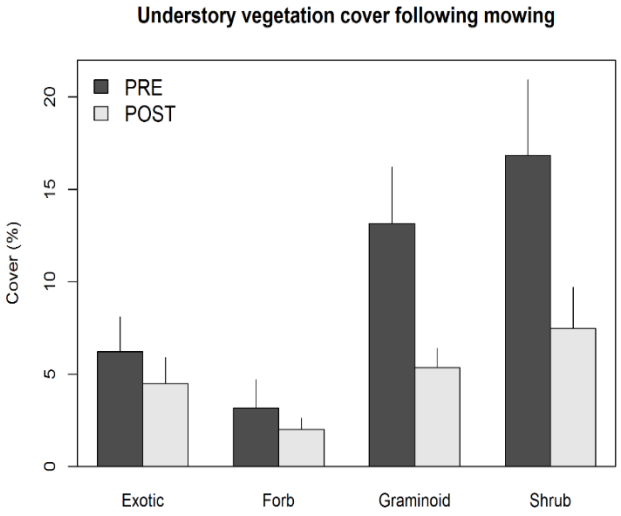


Figure 5: Bar plots depicting mean (±1 standard error of the mean) understory vegetation cover by functional group in mowed stands.

One year post-treatment results:

Preliminary results one year post-treatment in the La Fair treatment area illustrate that understory vegetation cover has declined and that understory species richness has changed little. Mean percent cover of all understory vegetation functional groups declined following mowing (Figure 5); however, vegetation may recover 2-5 years following treatment. The mean cover of Kentucky bluegrass (*Poa pratensis*) and Tracy's bluegrass (*Poa tracyi*) declined one year post-treatment, and mean cover of

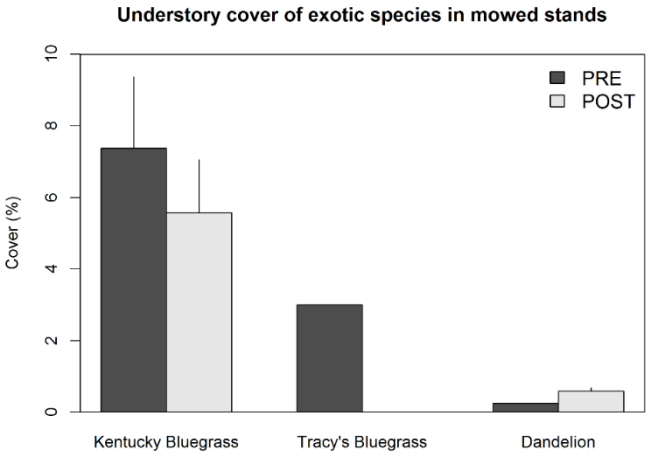


Figure 6: Bar plots depicting mean (±1 standard error of the mean) cover of individual exotic species in mowed stands of Gambel oak.

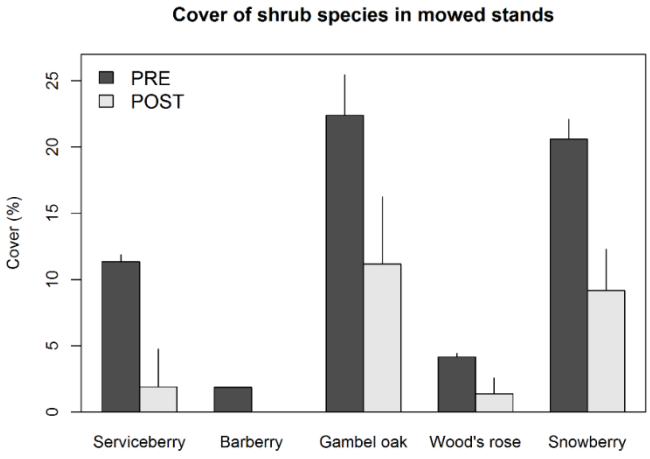


Figure 7: Bar plots depicting mean (±1 standard error of the mean) cover of mountain shrub species in mowed stands; mountain shrub cover declined by >50% in mowed stands for each species.

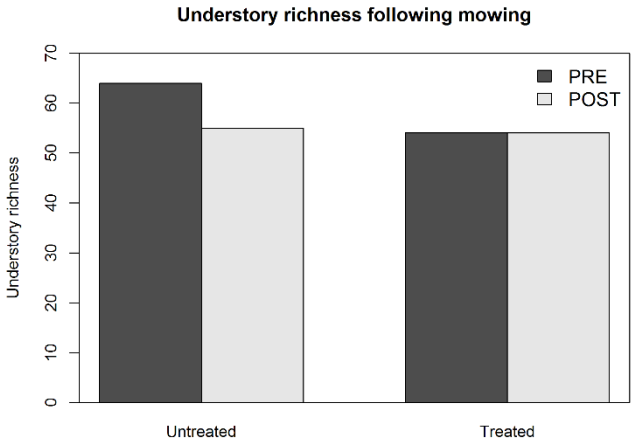


Figure 8: Bar plots depicting total understory vegetation richness in control and mowed stands.

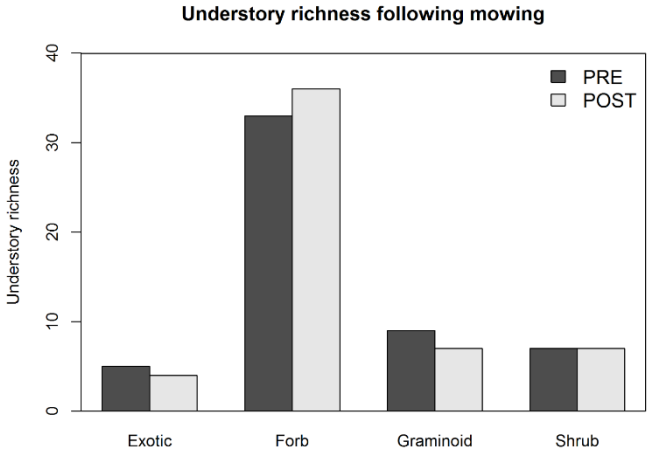


Figure 9: Bar plots depicting understory vegetation richness by functional group following mowing treatments.

common dandelion (*Taraxacum officionale)* increased slightly (Figure 6). Mean percent cover of each mountain shrub species observed in the study area declined by > 50% (Figure 7). Total species richness (the number of different species represented in our study area) declined in control plots one year post-treatment, whereas total species remained constant in treated areas one year following mowing treatments (Figure 8). The decrease in species richness in untreated plots may be explained by the presence and absence of annual or biennial species or by human error (missed species in surveys). Species richness remained constant for shrubs following mowing, whereas exotic and graminoid species richness decreased slightly, and richness of forb species increased following mowing (Figure 9). Species richness and evenness, as assessed by Shannon's and Simpson's Diversity Indices, were nearly constant across mowed and unmowed plots pre- and post- treatment (Table 1), indicating that mowing

treatments did not negatively impact understory species diversity in the La Fair treatment area one year post-treatment.

Gambel oak regeneration remained constant in control plots, but mowed plots observed a 300% increase in regeneration density one year following treatment (Figure 10). Gambel oak regeneration was dominated by regeneration 6-24" tall one year following treatment (Figure 11 & 12), indicating that one year following mowing, Gambel oak sprouts can easily reach heights up to 2 feet tall. However, abundant regeneration occurred that was <6" tall, indicating that Gambel oak regeneration is continuing to occur.

	Unmowed		**Mowed**	
	Pre	**Post**	**Pre**	**Post**
Shannon's Index	3.8062	3.6894	3.6627	3.7211
Simpson's Index	0.9710	0.9683	0.9669	0.9710

Table 1: Results for Shannon's and Simpson's Diversity Index in control and mowed plots pre- and post-treatment. Shannon's Diversity Index values range from 0-4, where 4 indicates a high level of species richness and evenness. Simpson's Diversity Index values range from 0-1, where 1 indicates the highest level of species richness and evenness.

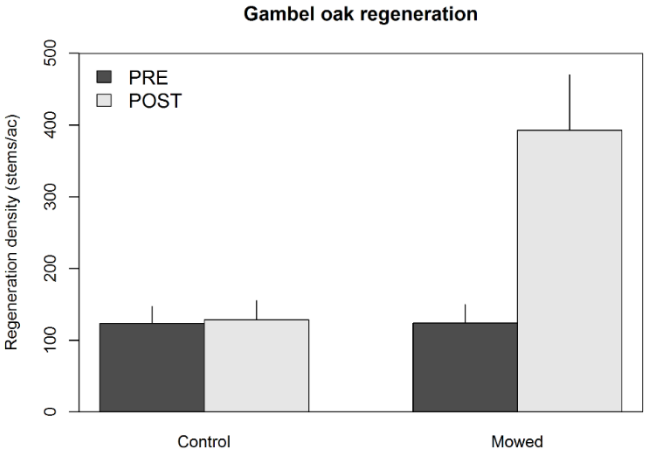


Figure 10: Bar plots depicting mean (±1 standard error of the mean) Gambel oak regeneration density in control and mowed plots pre- and post-treatment.

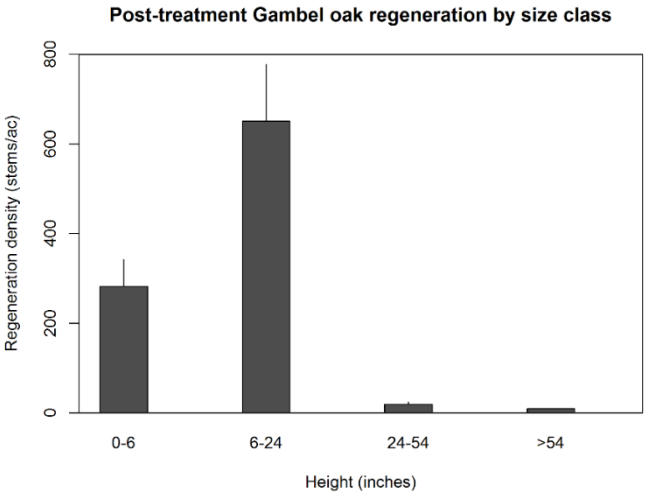


Figure 11: Bar plots depicting mean (±1 standard error of the mean) Gambel oak regeneration density by size class in mowed plots.

Tree and shrub regeneration was dominated by Gambel oak in our study area following mowing treatment, followed by aspen regeneration (Figure 13). Ponderosa pine regeneration occurred in the study area prior to mowing, but likely experienced mortality during mowing treatments; no Ponderosa pine regeneration was found following treatments.

Next steps:

If funding allows, CFRI will remeasure plots in 2019 to examine understory vegetation and Gambel oak resprouting response 3 years after mowing for a longer-term assessment of Gambel oak and understory recovery following treatments. The USFS Grand Mesa Ranger District has plans to follow mowing

Figure 12: Photos illustrating a) Gambel oak regeneration representative of size class 0-6" tall; b) Gambel oak regeneration representative of size class 6-24" tall; c) Gambel oak regeneration representative of size class 6-24" tall and with many stems regenerating from a mowed stump.

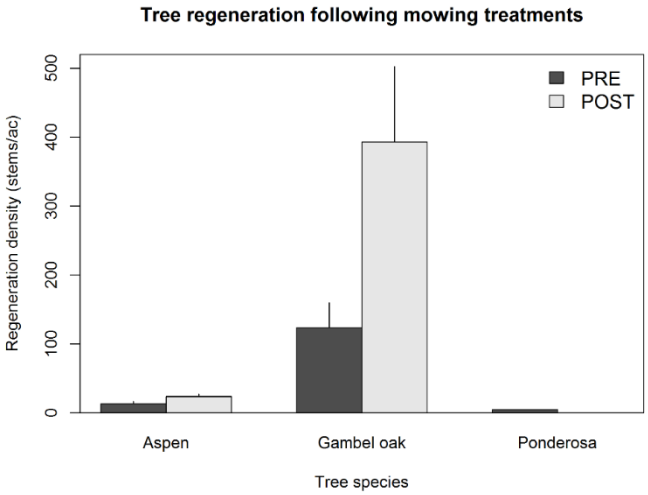


Figure 13: Bar plots depicting mean (±1 standard error of the mean) tree regeneration density in mowed plots pre- and post-treatment.

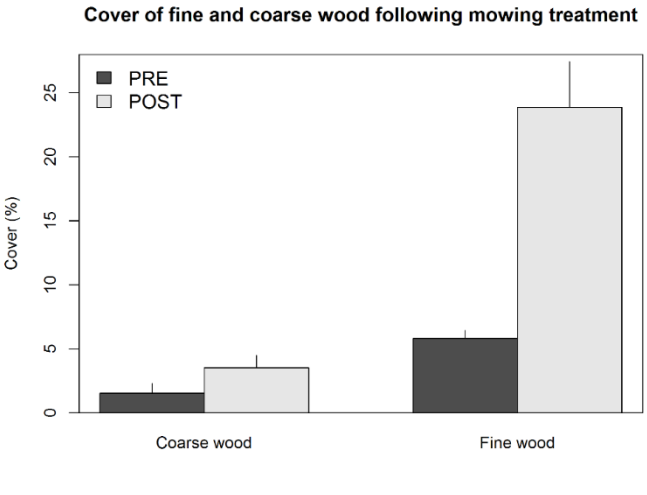


Figure 14: Bar plots depicting mean (±1 standard error of the mean) coarse and fine wood cover pre- and post-mowing treatments.

treatments within the La Fair treatment area with prescribed burning in 2018-2019. Once prescribed burning has taken place, and if funding is available, CFRI will return to remeasure all plots at least once following burning. Short and longer-term results from this study will provide information on how management practices of Gambel oak, including mowing and prescribed fire, affect changes in Gambel oak structure, regeneration, and interactions with understory vegetation within the northwestern portion of the Uncompaghre Plateau, CO.

Acknowledgements: We thank Jack Van Vleet, Tim Koski, Anthony Gilmore, Zack Schuler, Chip Reiber, Casey Flanigan, and Laura Dempsey for their assistance in the field; Eric Freels (USFS Grand Mesa District) for help with study design, implementation, and housing; and Dr. Julia Sharp (Colorado State University) for statistical advice. Funding was provided by the Uncompaghre Plateau Collaborative Forest Landscape Restoration Program.

Figure 15: Photo illustrating subquadrat with Gambel oak regeneration and fine wood cover following mowing treatment.

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Do you have questions or want more details? Contact Marin Chambers at marin.chambers@colostate.edu. Summary prepared by Marin Chambers and Jeff Cannon, January 2018.