Colorado Parks and Wildlife

WILDLIFE RESEARCH PROJECT SUMMARY

Examining the effectiveness of mechanical treatments as a restoration technique for mule deer habitat

Period Covered: July 1, 2015 – July 30, 2016

Principal investigator: Danielle B. Johnston, Danielle.Bilyeu@state.co.us

Collaborators: Colorado Parks and Wildlife, BLM-White River Field Office, Colorado State University, M. Paschke, J. Jonas, ExxonMobil Prod. Co./XTO Energy

The pinyon-juniper (PJ) habitat type has been expanding in the western United States, and understory forage for big game may become reduced in areas where PJ has outcompeted more palatable species. Because prescribed fire is often difficult to implement, managers often rely on mechanical tree removal methods such as ship anchor chaining, roller chopping, and mastication. These methods differ in cost, type of woody debris produced, and soil disturbance (Johnston 2014). We made head-to-head comparisons of understory vegetation changes due to chaining, rollerchopping, and mastication (Figure 1), and also examined how each treatment impacted the success of seeding desirable understory forage species. Half of each treated plot was seeded with a shrub-heavy seed mix including chokecherry (*Prunus virginiana*), Saskatoon serviceberry (*Amelanchier alnifolia*), Utah serviceberry (*Amelanchier utahensis*), mountain mahogany (*Cercocarpus montanus*), bitterbrush (*Purshia tridentata*), and winterfat (*Kraschenninnikovia lanata*). The study was conducted at two sites in the Magnolia region of the Piceance Basin, Rio Blanco County, Colorado. The North Magnolia site (n=4) had higher control plot tree density, lower tree basal area, and higher shrub cover than the South Magnolia site (n=3).

Treatments were implemented in fall 2011, and understory vegetation data (cover, biomass, and shrub density) was collected in 2012 and 2013 through collaboration with Colorado State University. Site visits in 2014 and 2015 indicated significant changes from this initial assessment period, particularly in the cover of cheatgrass (*Bromus tectorum*), an invasive annual grass that reduces wildlife habitat quality. Understory vegetation cover was assessed in July 2016 using about 300 point-intercept hits (arrayed over 13 transects) in each plot.

Five years post-treatment, differences in understory vegetation due to type of mechanical treatment were minimal, but all treated plots differed greatly from controls. Treated plots had 3-5 times higher perennial grass cover than control plots, with bottlebrush squirreltail (*Elymus elymoides*), Indian ricegrass (*Achnatherum hymenoides*), and western wheatgrass (*Pascopyrum smithii*) dominating (Figure 2). In addition, treatment plots had about 10 times higher cheatgrass cover than control plots (Figure 3). Cheatgrass had been present at only 1-3% cover in the 2013 data (Stephens et al. 2016), and was practically undetectable at the South Magnolia site. By 2016, cheatgrass cover in treated plots was about 27% at North Magnolia and about 7% at South Magnolia.

Differences in shrub cover were apparent at North Magnolia only (Figure 4), with chaining and mastication producing higher shrub cover than the control. Much of this increase was due to snowberry (*Symphoricarpos rotundifolius*; Figure 4), which is not a preferred forage species in the study area. A companion study in nearby locations quantified both cover and forage biomass in response to mastication for preferred species including serviceberry, bitterbrush, and mountain mahogany. Although cover 2-

years post-treatment did not differ, forage biomass increased nearly 2-fold in masticated plots. It is reasonable to conclude that forage biomass of preferred species was also higher in treated versus control plots in this study. Even so, a shift in dominance towards snowberry with mechanical treatment is a possible negative consequence which should be noted.

Seeding had effects only on forb cover and cheatgrass cover five years post-treatment. In the absence of seeding, forb cover was similar between treated and control plots, but within treated plots, seeding increased forb cover from 2.4% to 5.4% at South Magnolia and from 3.5% to 7.9% at North Magnolia ($p < 0.006$). Utah sweetvetch (*Hedysarum boreale*) accounted for most of the difference, followed by Lewis flax (*Linum lewisii*). Again, results were similar among each of the three mechanical treatment types. Seeding had no effect on cheatgrass at North Magnolia, but at South Magnolia, cheatgrass cover was 2-3 times higher in seeded subplots within chained ($p < 0.01$) and rollerchopped ($p < 0.008$) plots. We suspect cheatgrass contamination in the seed that was used. This was not apparent in our earlier analysis. Apparently, seed contamination may cause problems which take several years to manifest. We urge practitioners to be cautious when applying seed, especially in areas previously free of cheatgrass.

Seeding did not affect grass or total shrub cover 5 years post-treatment. In the earlier analysis, we found an effect of seeding on density of seeded shrubs at South Magnolia, due largely to bitterbrush. In the 2016 data, we looked at bitterbrush cover specifically, and found that seeding had an effect across sites, increasing it from 2.9% to 3.8% ($p = 0.04$). Again, there was no difference among mechanical treatment types. The seed mix used was very expensive, about $714/ac. If we had seeded only the species which actually responded (bitterbrush, Utah sweetvetch, and Lewis flax), the price would have been $173/ac. Obviously, it is important to choose species judiciously and to limit seeding only to those sites lacking in a desirable plant type. Utah sweetvetch is a species which has performed well at many research sites in northwest Colorado (Johnston 2016).

In the treatments which used bulldozers, chaining and rollerchopping, we planted large-seeded species with a Hansen dribbler (Johnston 2014). This tool dribbles the seed onto the track and facilitates deep planting. Bitterbrush and Utah sweetvetch were both planted this way, and it is interesting to note that bitterbrush established as well in the rollerchop and chaining treatments as it did in the mastication treatment. In the mastication treatment, all species were broadcast-seeding prior to treatment, which required more effort. The dribbler seems to be a useful tool to plant large-seeded species efficiently.

We found little difference in understory cover in 2016 with mechanical treatment type in our study area. This differed somewhat from analysis of 2012-2013 data, which found that undesirable non-natives were somewhat worse with rollerchopping, and native annuals established best with mastication (Stephens et al. 2016). While more years of sampling would be desirable, it seems that the differences in vegetation response are sufficiently small that the choice of mechanical treatment type should be dictated by other factors in this study area.

Among these factors are per-acre cost, mobilization cost, and the ability to create the desired spatial arrangement of treatment patches. More detailed mosaics are possible with mastication than with rollerchopping, and chaining is the least flexible. We used a shorter-than-typical 50-foot smooth chain in our study, which could be a viable and cost-effective option for creating small treatment patches. However, it is not possible to leave isolated trees with chaining. Chaining costs are one-third to one-sixth that of mastication, with rollerchopping having intermediate costs. More detailed cost information is available in a prior report (Johnston 2014).

The increase in cheatgrass with all three treatment types, at both study sites, is somewhat alarming. Recent research has shown that cheatgrass is adapting to higher elevation sites (Merrill et al. 2012), therefore problems with cheatgrass can be expected to worsen. Nevertheless, the substantial amount of perennial grass cover at these sites should prevent cheatgrass from dominating. Wildlife benefits are still possible with PJ removal if enough understory vegetation is present to respond (Miller et al. 2005), but practitioners should consider potential risks as well as benefits when selecting projects (Figure 5).

Figure 1. Looking west from Rio Blanco CR 76 to treatment plots in North Magnolia in fall of 2012. The three rectangular patches in the left, along with a control plot, comprise one of 4 experimental blocks at this site. Each treatment plot received either chaining, mastication, or rollerchopping, and half of each treated plot was seeded with a shrub-heavy seed mix. Plot size is about 2 acres.

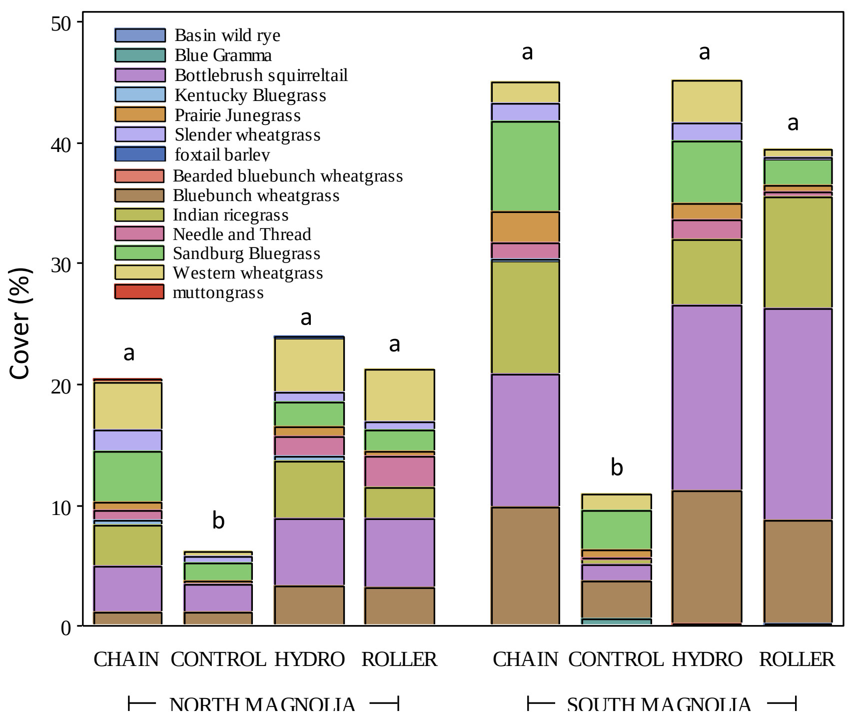

Figure 2. Cover of perennial grasses in response to chaining (CHAIN), mastication (HYDRO), and rollerchopping (ROLLER) at two sites, North Magnolia and South Magnolia. Letters indicate significantly different means among treatments at $\alpha = 0.05$ (Sites considered separately). Seeding had no effect on perennial grasses.

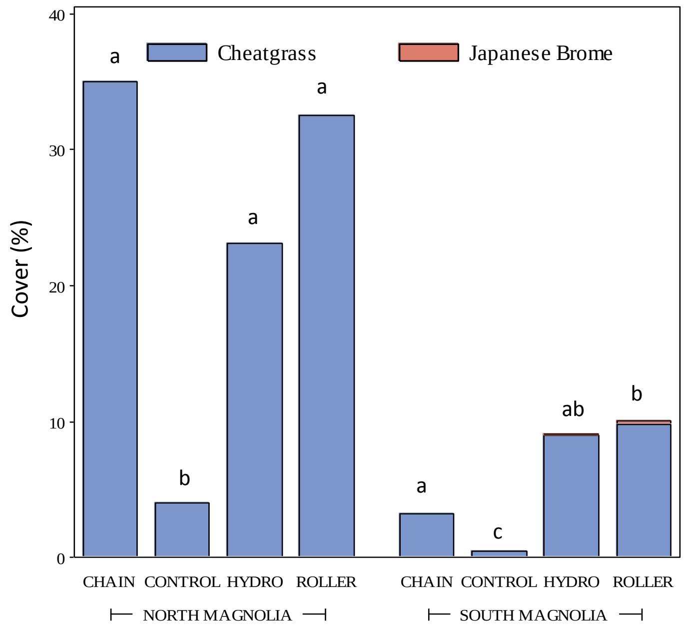

Figure 3. Cover of annual grasses in response to chaining (CHAIN), mastication (HYDRO), and rollerchopping (ROLLER) at two sites, North Magnolia and South Magnolia. Letters indicate significantly different means among treatments at α = 0.05 (Sites considered separately).

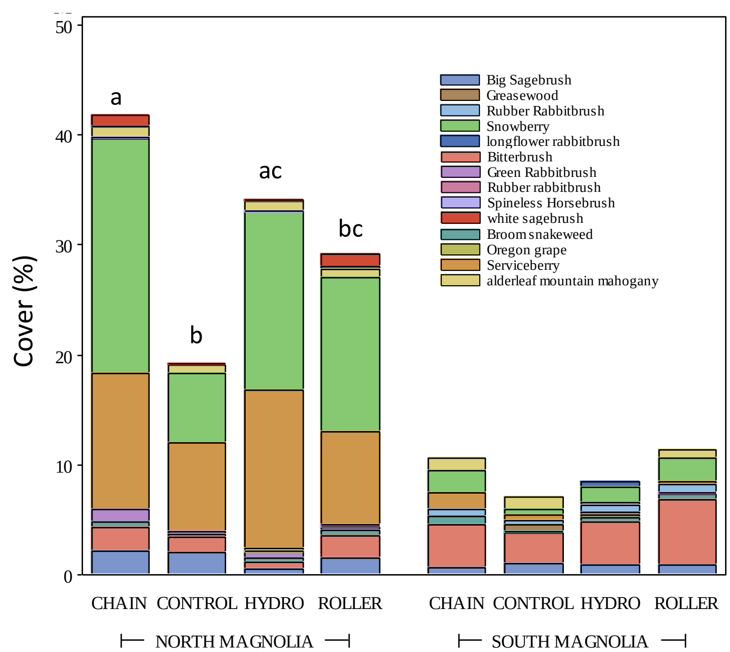

Figure 4. Cover of shrubsin response to chaining (CHAIN), mastication (HYDRO), and rollerchopping (ROLLER) at two sites, North Magnolia and South Magnolia. Letters indicate significantly different means among treatments at α = 0.05 (Sites considered separately). Seeding had no effect on total shrub cover.

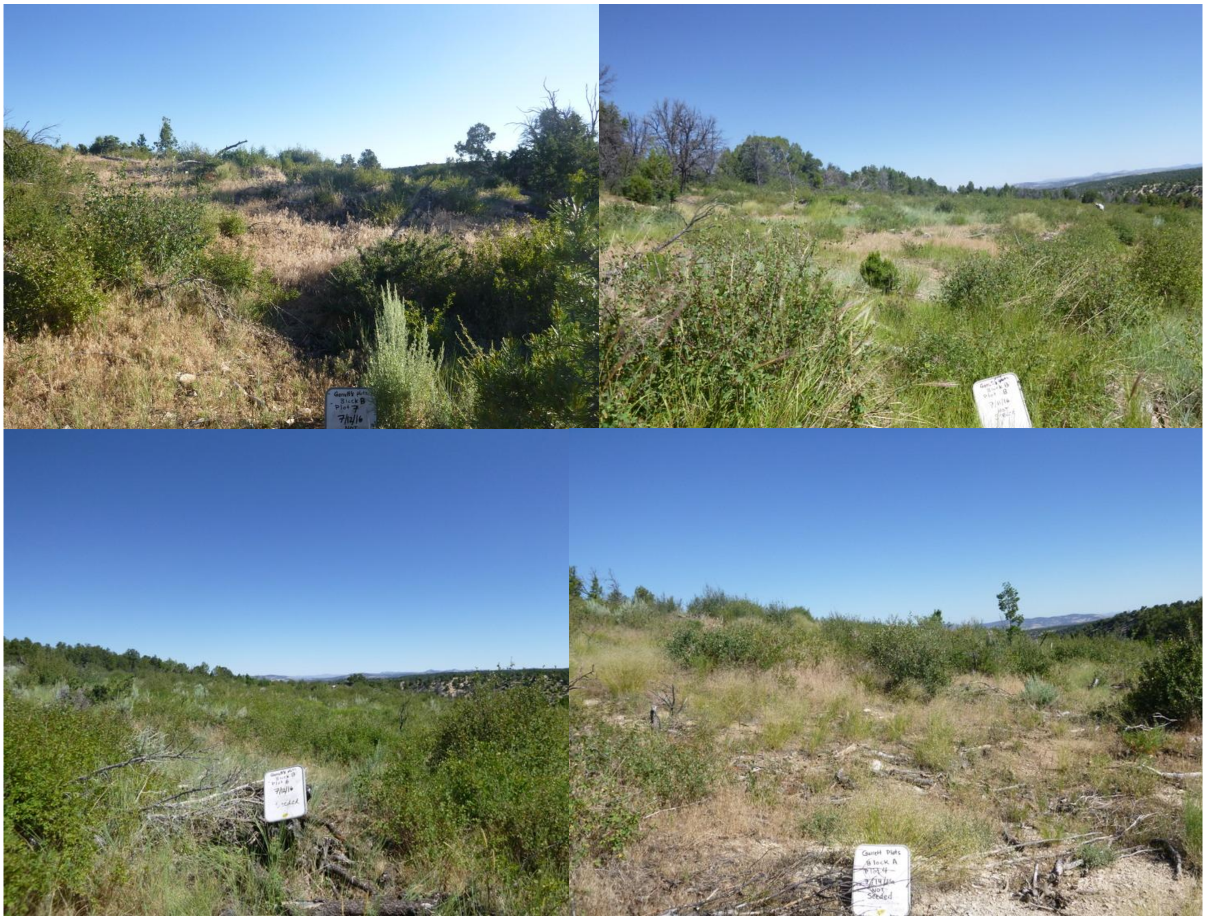

Figure 5. A photo collage of sites where PJ was removed at the North Magnolia site shows good perennial grass and shrub cover, but also reveals some undesirable cheatgrass patches.

Literature Cited

Johnston, D. B. 2014. Examining the effectiveness of mechanical treatments as a restoration technique for mule deer habitat: Colorado Division of Parks and Wildlife Avian Research Program annual progress report, Colorado Parks and Wildlife, Fort Collins, CO.

Johnston, D. B. 2016. Restoring Energy Fields for Wildlife: Colorado Division of Parks and Wildlife Avian Research Program annual progress report. Colorado Parks and Wildlife, Fort Collins, CO.

Merrill, K. R., S. E. Meyer, and C. E. Coleman. 2012. Population genetic analysis of *Bromus tectorum* (Poaceae) indicates recent range expansion may be facilitated by specialist genotypes. American Journal of Botany **99**:529-537.

Miller, R. F., J. D. Bates, T. J. Svejcar, F. B. Pierson, and L. E. Eddleman. 2005. Biology, ecology, and management of western juniper (Juniperus occidentalis). Oregon State University Agricultural Experiment Station.

Stephens, G. J., D. B. Johnston, J. L. Jonas, and M. W. Paschke. 2016. Understory responses to mechanical treatment of pinyon-juniper in northwestern Colorado. Rangeland Ecology & Management **69**:351-359.