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Evaluating Targeted Grazing as a Fuels Treatment

Abstract

Wildfires cause concern as they have increased in severity and intensity over the last few decades. Land managers have sought management actions to mitigate wildfire risk by reducing fuel loads, thus decreasing wildfire intensity. Managers at Camp Williams, a National Guard camp near Bluffdale, Utah, created fuel breaks as part of their wildfire mitigation plan using targeted sheep and goat grazing to remove fine fuel and thin brush by grazing at 80% utilization. Questions arose about the ecological impacts of prescribed grazing rates within these fuel breaks. This study evaluated three fuel breaks and quantified the effects of targeted sheep and goat grazing at 80% utilization level. Results showed how invasive annual grasses, such as cheatgrass (*Bromus tectorum*) and bulbous bluegrass (*Poa bulbosa*), responded to heavy utilization rates.

Abbreviations: WUI, wildland-urban interface; AUM, animal unit month

Introduction

The western United States has seen an increase in wildfire size and frequency in recent years. These variations can be linked to the changes in fuel structure in rangelands throughout the West. Many years of fire suppression have led to the accumulation of fuels (Nunamaker et al., 2007) and the increase of cheatgrass (*Bromus tectorum*) (Pellant, 1996; Young et al., 1987). As cheatgrass abundance increases, it changes fuel loads and increases fuel continuity by filling interspaces between grasses and shrubs. Fuel continuity also increases the rate of wildfire spread (Pellant, 1996).

Land managers have debated in recent decades over methods to control fuels. In the last 15 years, grazing has become a popular option to reduce fuels, and the public living near the wildland-urban interface (WUI) has embraced it. Several studies have shown that grazing can reduce wildfire risk. For example, sheep were used in Carson City, Nevada, to remove cheatgrass to create fuel breaks, and goats have been used in chaparral areas in Arizona and California (Taylor, 2006). These studies often recommend utilization rates of around 80% (Diamond, 2009; Schmeltzer, 2009; Taylor, 2006;). Diamond (2009) showed that in addition to decreasing cheatgrass cover, 80% utilization effectively reduced the spread of wildfires and flame length in cheatgrass communities. However, managers should consider that Young et al. (1987) reported cheatgrass increases to fill the void due to the loss of perennial vegetation from excessive grazing.

Researchers have suggested that overgrazing occurs when grazing exceeds the capacity of plants to recover (Lovina et al., 2009; Young et al., 1987). Most rangelands can withstand 40-50% removal of native vegetation without damaging the individual plants. If plants are grazed above 50% utilization at the wrong time of year, grazing can damage plants, leading to a decline in rangeland health. Cheatgrass is a rangeland problem because it has changed the fire return interval and increased the spread of wildfires (Pellant, 1996). Cheatgrass also promotes wildfires to occur two months earlier, extending the wildfire season (Young and Blank, 1995). An earlier wildfire season can damage native vegetation and limit native vegetation from recovering, exacerbating cheatgrass dominance. Whisenant (1990) reported that within three to five years post-wildfire, the same area in Idaho is prone to burn again due to cheatgrass-induced changes in fuel type, fuel load, and fuel continuity.

Land managers and conservationists have expressed concern over the heavy grazing utilization levels typically recommended by previous research (Diamond, 2012) and the risk of converting perennial grass stands into cheatgrass-dominated communities. Therefore, the objective of this study is to evaluate fuel breaks at Camp Williams to determine if targeted grazing has increased cheatgrass or other annual grasses or aided in the decline in native bunch grasses. This research will provide a long-term evaluation of the impacts of targeted grazing as a tool to create fuel breaks.

Methods

Camp Williams is a Utah National Guard training grounds and military installation in central Utah. Wildfires threaten the camp's facilities and risk civilian lives and property surrounding Camp Williams. As of 2010, the total population of the four cities surrounding Camp Williams was 68,579 (U.S. Census, 2010).

Wildfires, roughly 400 ha in size, occur on Camp Williams approximately every four years (Frost, 2015) and threaten the surrounding communities. Rangeland managers have implemented fuel breaks along camp boundaries to protect surrounding communities. Since 2004, Camp Williams have contracted livestock producers to assist with strategic grazing.

Camp Williams consists of 9,715 ha of rangeland in central Utah. Camp Williams' average rainfall was 356 mm in 30 years (1985-2015). (U.S. Climate Data, 2016). Camp Williams' vegetation consists of sagebrush (*Artemisia tridentata*) in lower elevations (1300 m) and a mix of sagebrush and oak brush (*Quercus gambelii*) at higher elevations (2300 m). Native bunchgrasses found on the camp include Sandberg bluegrass (*Poa secunda*), needle and thread (*Hesperostipa comata*), western wheatgrass (*Pascopyrum smithii*), and bluebunch wheatgrass (*Pseudoroegneria spicata*). Invasive plants at Camp Williams include cheatgrass (*Bromus tectorum*), medusahead (*Taeniatherum caput-medusae*), jointed goatgrass (*Aegilops cylindrica*), and bulbous bluegrass (*Poa bulbosa*), along with many introduced weedy forbs such as Canada thistle (*Cirsium arvense*), musk thistle (*Carduus nutans*) and common storksbill (*Erodium cicutarium*).

Since 2004, approximately 1,200 sheep/goats have been used yearly to create fuel breaks on Camp Williams. Vegetation sampling was conducted in fuel breaks at Oak Springs, Wood Hollow, and Beef Hollow in July 2015 (Figure 1).

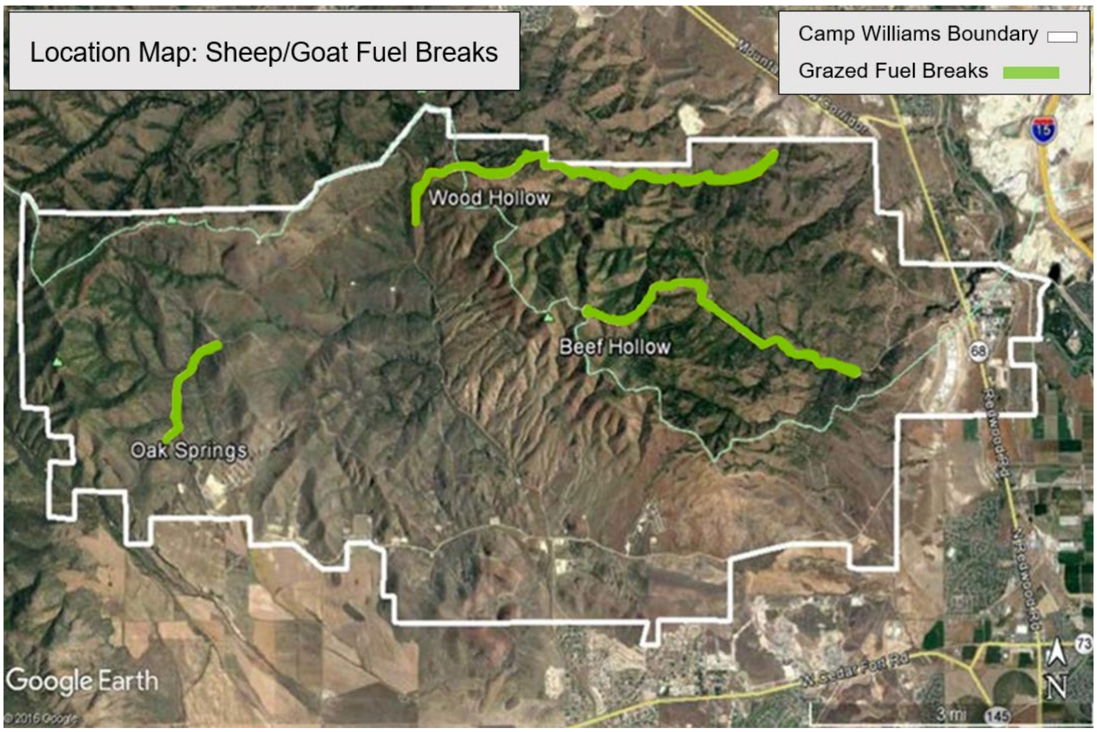

Figure 1. Camp Williams location map of sheep and goat grazed fuel break pastures: Oak Springs, Wood Hollow, and Beef Hollow.

Oak Springs is dominated by a Wyoming big sagebrush (*Artemisia tridentata var. wyomingensis*) community with some oak brush (*Quercus gambelii*). Oak Springs was grazed annually beginning at the end of May 2006. The Oak Springs site was 12.6 ha (2.6 km X 60 m wide), and the average stocking rate was 10.79 AUM/ha.

The Beef Hollow site is dominated by oak brush and covers 27.5 ha (5.5 km X 60 m). Sheep grazed Beef Hollow annually beginning at the end of June 2011. The average stocking rate at Beef Hollow was 6.11 AUM/ha.

The Wood Hollow site is 40 ha (8 km X 60 m) and is dominated by oak brush. Grazing has occurred annually in Wood Hollow since 2004, typically during mid-July for about two weeks. The average stocking rate at Wood Hollow was 4.98 AUM/ha. This study only used 5 km of the fuel break due to cattle grazing occurring in a 3 km portion of the site in 2015.

Grazing occurred at each site until the pasture reached 80% utilization. Each area was monitored using eight treatment/reference pairs (16 total). Thirty-meter transects were randomly placed inside the fuel breaks and oriented in the same direction with a 10m buffer from the edge. Reference transects were placed randomly within 100 m of the fuel breaks and ran parallel to them. Canopy cover was collected for cheatgrass, bulbous bluegrass, native bunchgrasses, native forbs, and introduced forbs. All other invasive grasses detected were placed into "other grasses" due to their low abundance. Litter and bare ground were also estimated using the line-point intercept method. Shrub canopy cover was measured using the line intercept method. Shrub density (sagebrush, oak brush, and "other brush") was determined by counting plants in 30 m x 1 m belt transects (Swanson et al., 2016). Monitoring occurred in May and June of 2015.

Data were analyzed using R Studio to perform a paired t-test on all transect sites, showing a difference at a P=0.05 level (R Core Team, 2014). During the analysis, pasture comparisons were not made; grazed/ungrazed were compared within each pasture due to vegetation community differences between pastures and the timing, duration, and grazing season.

Results

All sites exhibited little change when compared to ungrazed reference sites. In Oak Springs, sagebrush cover and density in grazed areas were lower (P=0.0001) (Figures 2 and 3); the cover and density of oakbrush and all other brush were similar. Native and introduced forbs were higher in grazed sites (P=0.019 and P=0.0001, respectively) (Figure 4). Bulbous bluegrass was the only grass at Oak Springs that increased in the fuel break (grazing); however, it was still less than 5% cover (P=0.049) (Figure 4). The bare ground cover was higher, while litter cover was lower (P=0.0001 and P=0.018, respectively) in grazed pastures. There were no differences in cheatgrass cover between the reference and grazed sites (Figure 4).

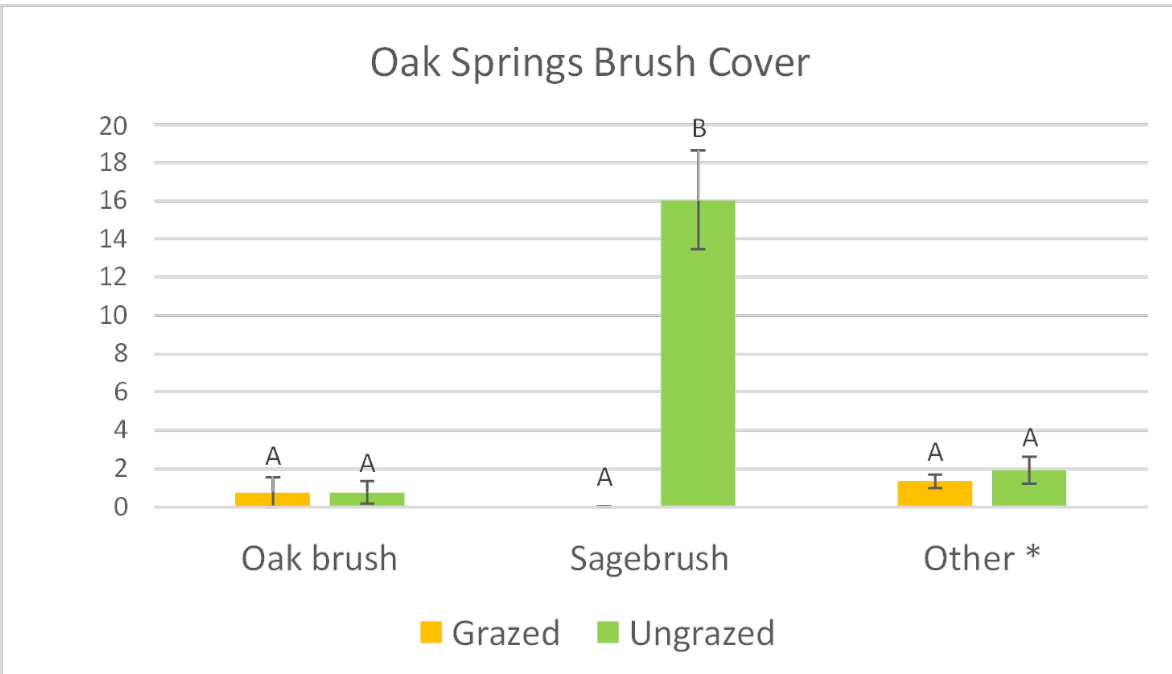

Figure 2. Percent brush cover inside (grazed) and outside (ungrazed) of fuel breaks at Oak Springs in 2015. Statistical differences (p = 0.05) are indicated with different letters. *Other vegetation consisted of *Mahonia aquifolium*, *Purshia tridentata, Petradoria pumila, Chrysothamnus viscidiflorus, Gutierrezia sarothrae, Ericameria nauseosa,* and *Symphoricarpos albus*.

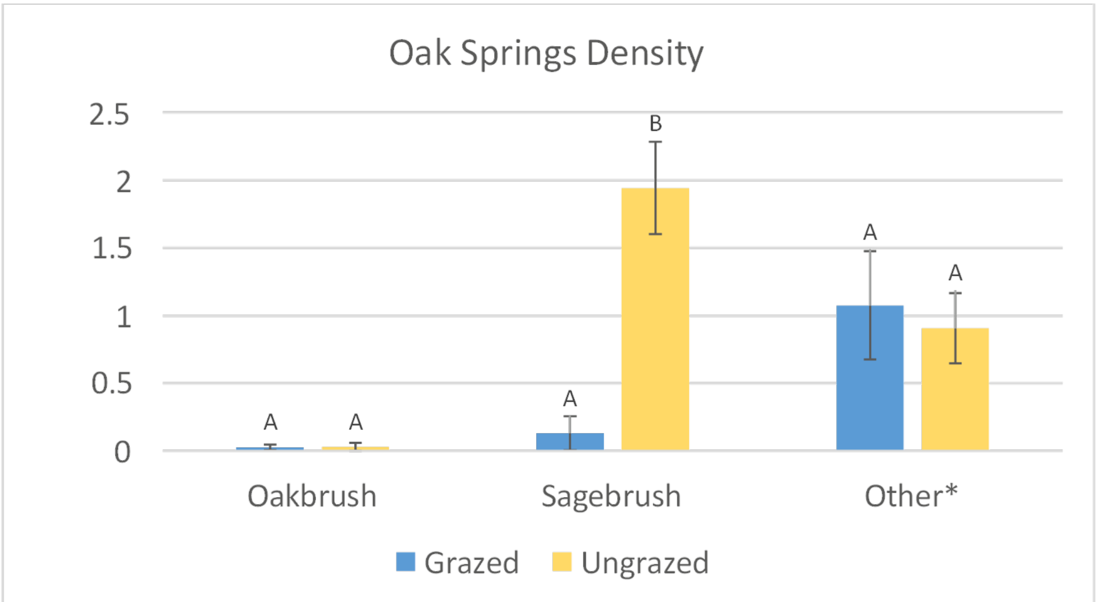

Figure 3. The brush density inside (grazed) and outside (ungrazed) fuel breaks at Oak Springs in 2015. Statistical differences (p=0.05) are indicated with different letters. *Other vegetation consisted of *Mahonia aquifolium, Purshia tridentata, Petradoria pumila, Chrysothamnus viscidiflorus, Gutierrezia sarothrae, Ericameria nauseosa,* and *Symphoricarpos albus.*

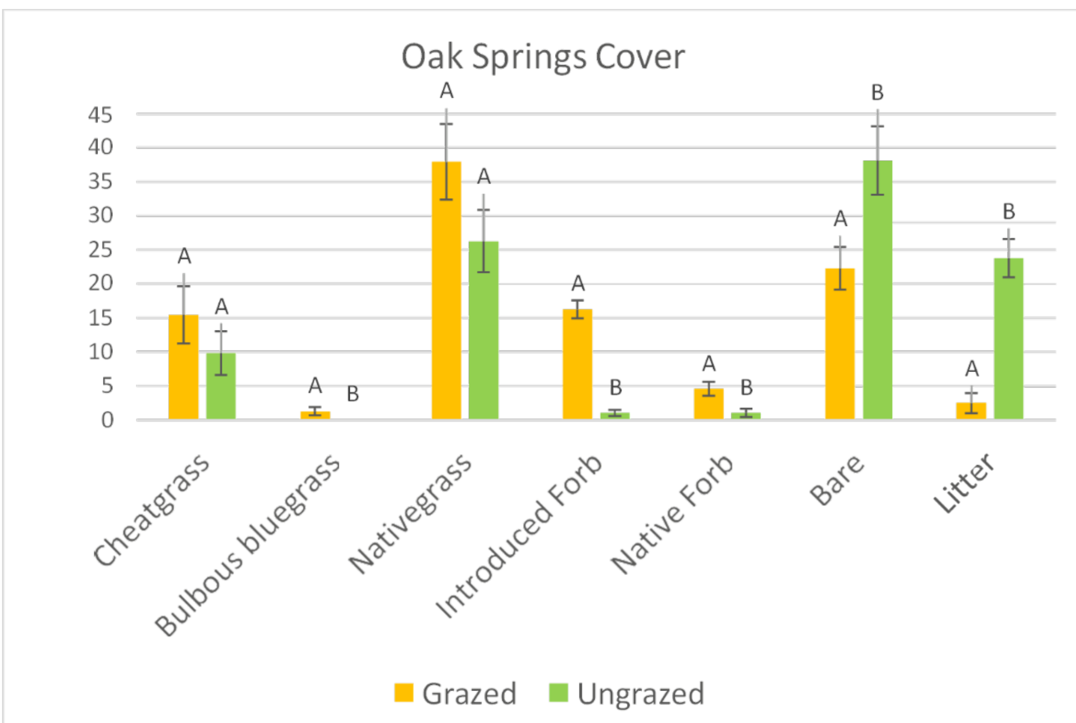

Figure 4. Percent ground cover inside (grazed) and outside (ungrazed) fuel breaks at Oak Springs in 2015. Statistical differences (p = 0.05) are indicated with different letters.

Beef Hollow showed no change in shrub cover or density (Figures 5 and 6).There was more bulbous bluegrass in Beef Hollow in grazed pastures when compared to reference pastures (P=0.0136) (Figure 7). Native bunchgrasses showed 50% less abundance in the grazed site compared to the reference (P=0.0164) (Figure 7). Litter was less in grazed sites compared to reference sites (P=0.0376). Beef Hollow was the only site to have trace amounts of medusahead (*Taeniatherum caput-medusae*) and jointed goatgrass (*Aegilops cylindrical*), but there were no differences in either species between grazed and ungrazed sites (Figure 7).

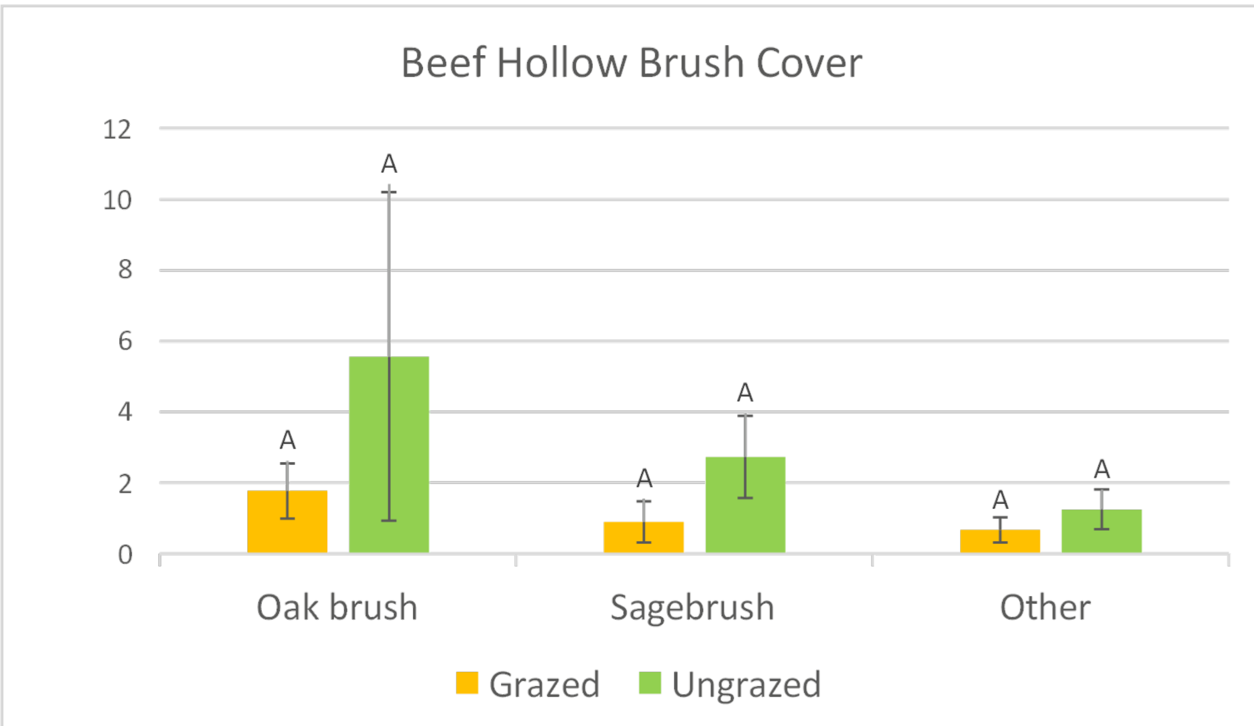

Figure 5. Percent brush cover inside (grazed) and outside (ungrazed) fuel breaks at Beef Hollow in 2015. No significant statistical differences (p = 0.05) were found. Other vegetation consisted of *Mahonia aquifolium, Purshia tridentata, Petradoria pumila, Chrysothamnus viscidiflorus, Gutierrezia sarothrae,* and *Ericameria nauseosa*.

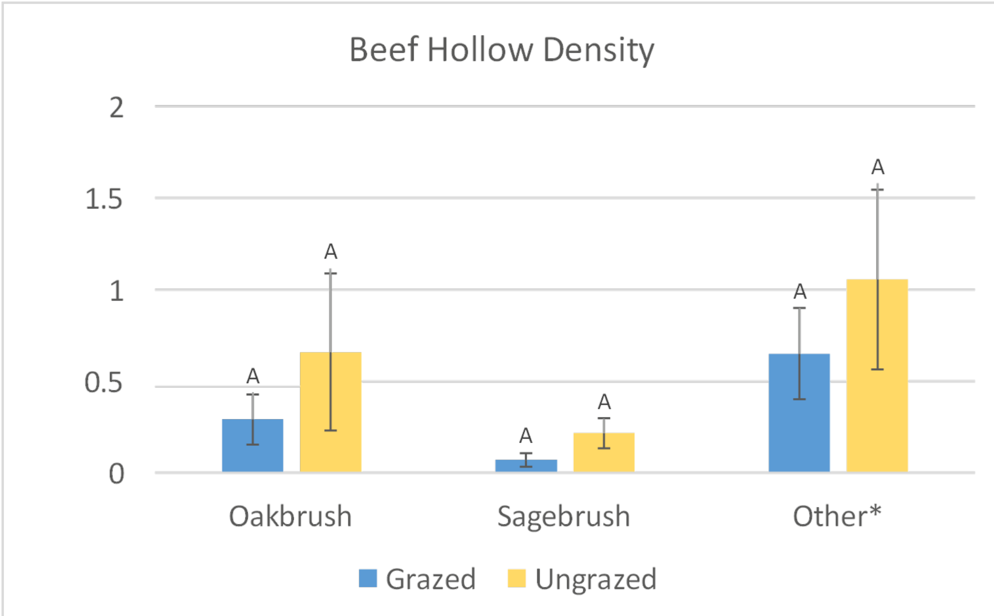

Figure 6. The brush density inside (grazed) and outside (ungrazed) fuel breaks at Beef Hollow in 2015. No significant statistical differences (p=0.05) were found.
*Other vegetation consisted of *Mahonia aquifolium, Purshia tridentate, Petradoria pumila, Chrysothamnus viscidiflorus, Gutierrezia sarothrae,* and *Ericameria nauseosa*.

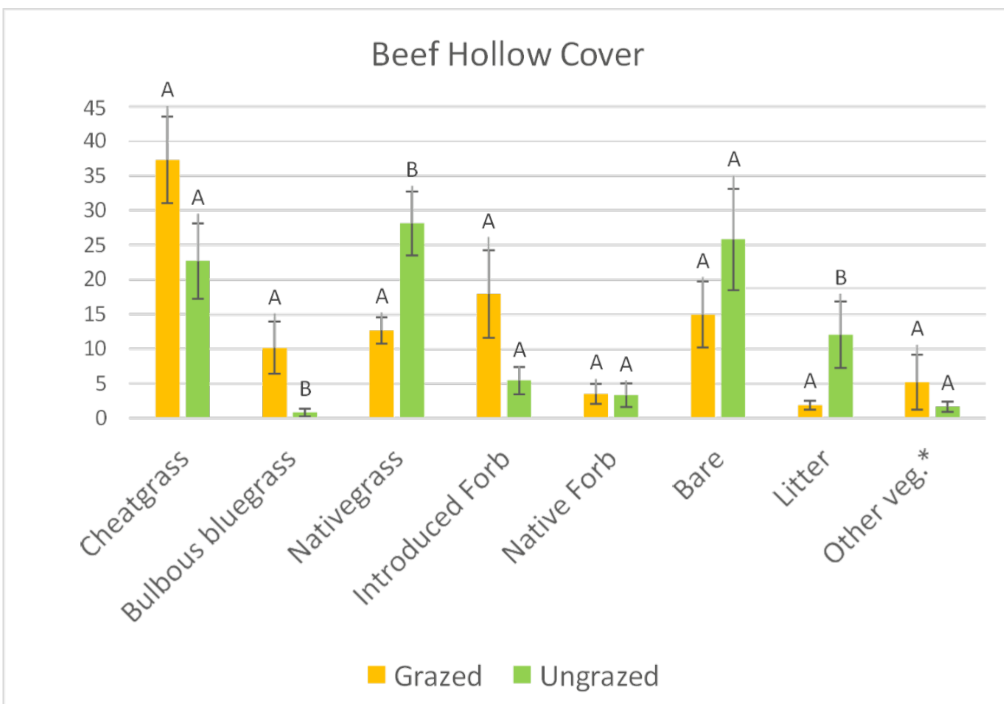

Figure 7. Percent ground cover inside (grazed) and outside (ungrazed) fuel breaks at Beef Hollow in 2015. Statistical differences (p = 0.05) are indicated with different letters.
*Other vegetation consisted of *Aegilops cylindrical, Taeniatherum caput-medusae,* and *Opuntia polyacantha*.

Wood Hollow shrub cover, shrub density, and herbaceous cover were similar when comparing grazed and reference sites (Figures 8, 9, and 10). However, Wood Hollow had abundant cheatgrass cover in both control and grazed treatments (Figure 9). Bulbous bluegrass cover was below 5%, similar in grazed and ungrazed sites.

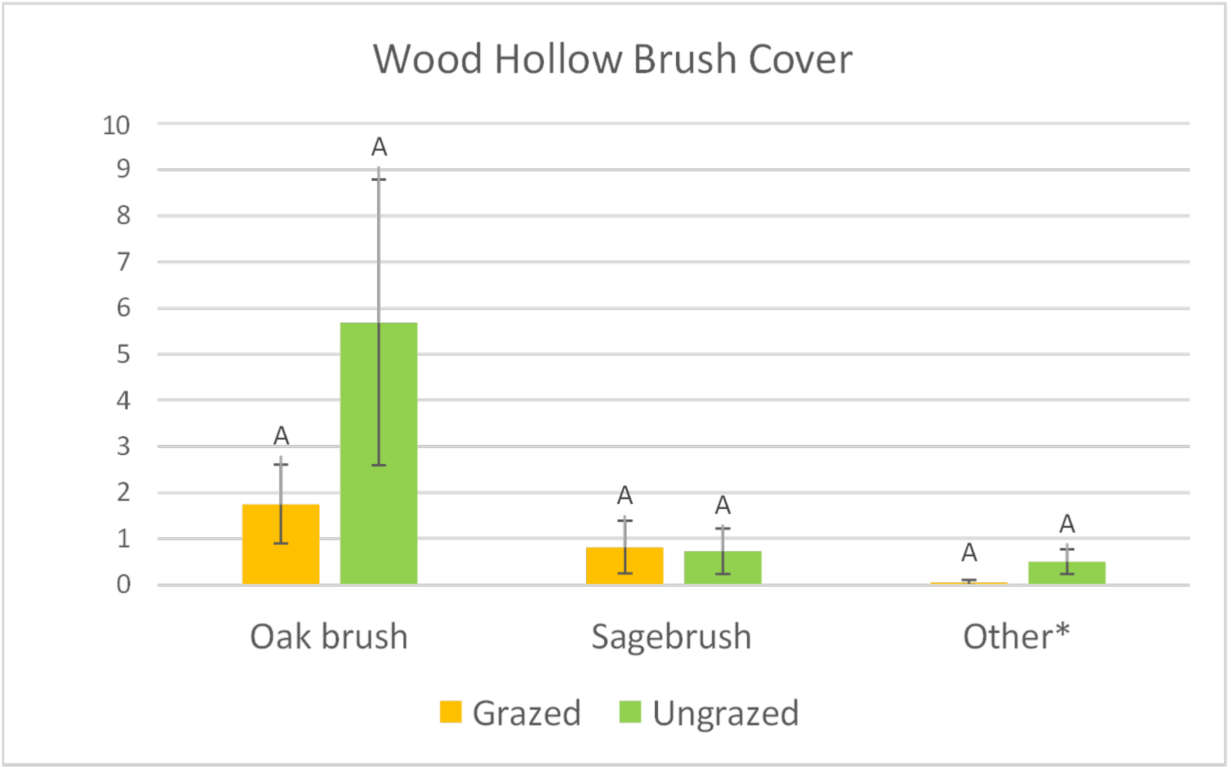

Figure 8. Percent brush cover inside (grazed) and outside (ungrazed) of fuel breaks at Wood Hollow in 2015. No significant statistical differences (p = 0.05) were found. *Other vegetation consisted of *Purshia tridentata, Chrysothamnus viscidiflorus, Gutierrezia sarothrae,* and *Ericameria nauseosa*.

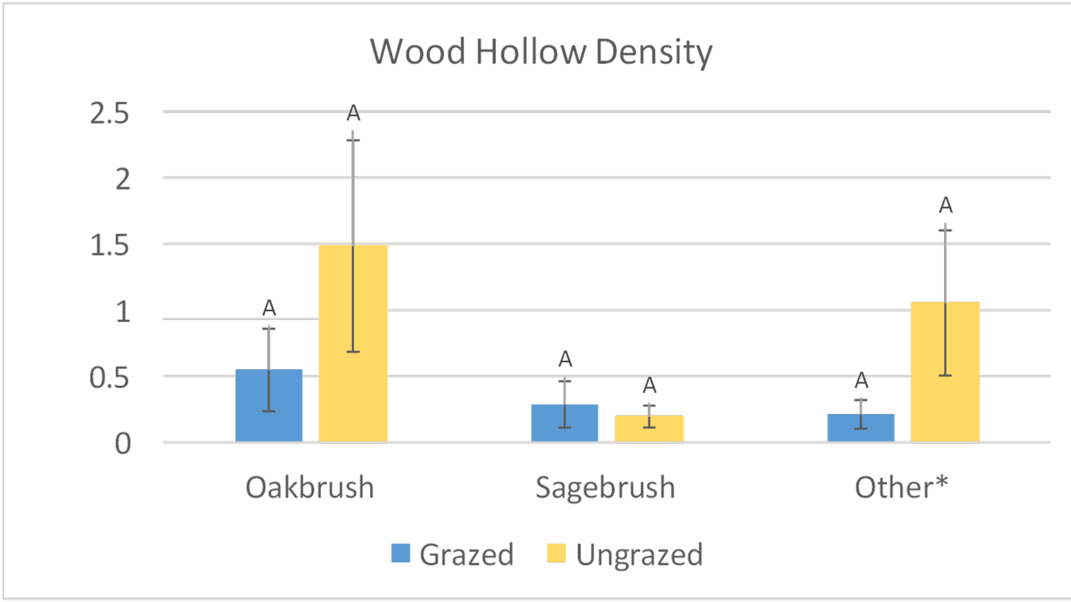

Figure 9. The brush density inside (grazed) and outside (ungrazed) fuel breaks at Wood Hollow in 2015. No significant statistical differences were found.
*Other vegetation consisted of *Purshia tridentata, Chrysothamnus viscidiflorus, Gutierrezia sarothrae,* and *Ericameria nauseosa*.

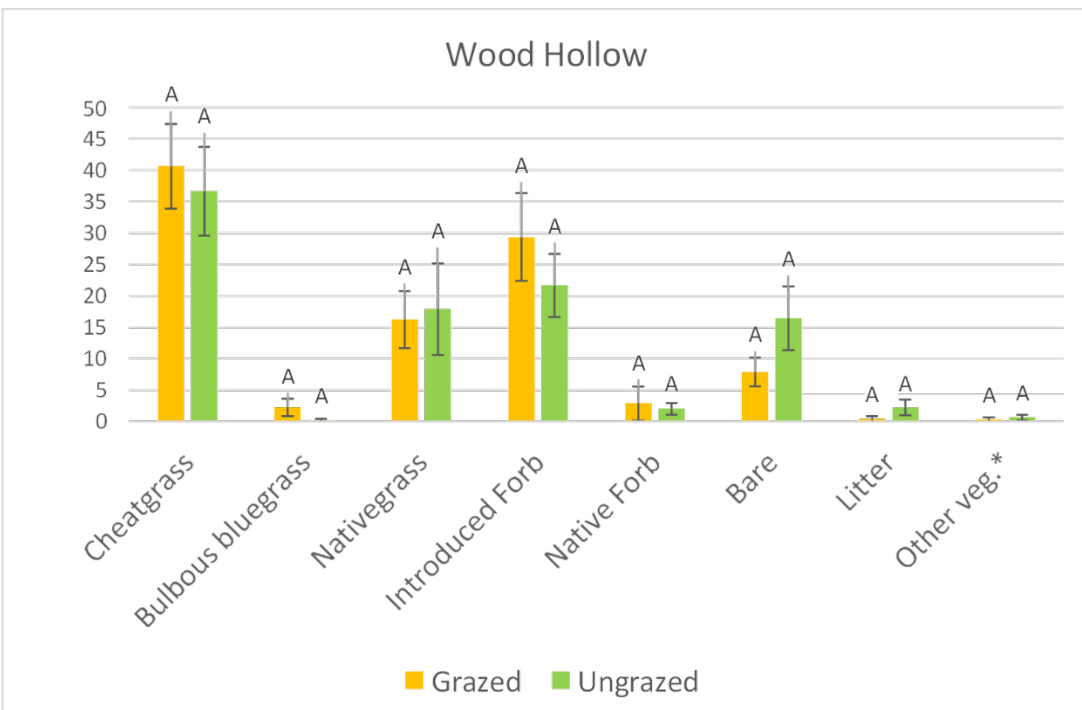

Figure 10. Percent ground cover inside (grazed) and outside (ungrazed) of fuel breaks at Wood Hollow in 2015 on Camp Williams. No significant statistical differences ($p = 0.05$) were found.
*Other vegetation consisted of *Aegilops cylindrical,* and *Opuntia polyacantha.*

Discussion

In this study, none of the sites showed a significant increase in cheatgrass cover. However, at Oak Springs, the cover and density of sagebrush were lower in grazed plots when compared to ungrazed plots (Figures 2 and 3). Petersen et al. (2014) presented research showing the effectiveness of fall/winter grazing in reducing sagebrush cover. The reduction of sagebrush also led to an increase in forbs and grasses. Similarly, other research has found that removing shrubs like sagebrush increases perennial grass and other herbaceous cover (Berlow et al., 2003; Davies et al., 2012; Swanson et al., 2016).

In Beef Hollow, native perennial grasses decreased (P=0.016) while there was an increase in bulbous bluegrass (P=0.014); in this case, grazing is likely the factor that is changing vegetation composition (Figure 7). Even though perennial grass cover was declining, it did not increase cheatgrass cover. Research has shown that improper grazing combined with wildfires can cause a plant community to transition across an ecological threshold and to a new, novel, stable state dominated by invasive annual grasses (Briggs et al., 2005; Briske et al., 2006). This transition may have already happened in Beef Hollow because the site appears stable. Therefore, the current grazing has not improved or degraded the area further. Because Beef Hollow has abundant cheatgrass, managers should evaluate cheatgrass cover regularly to ensure it does not increase further. Beef Hollow has trace amounts of medusahead and jointed goatgrass; this site should be monitored regularly to detect any increases in invasive annual grasses.

Wood Hollow and Beef Hollow have abundant cheatgrass cover (Figures 7 and 10). Therefore, removing grazing alone would not return a degraded state to a higher successional state (Briggs et al., 2005; Laycock, 1991; Yeo, 2005). Briske states that "thresholds exist at various stages of progression," which provides valuable information for defining management and policy options regarding threshold reversibility. For example, vegetative states that have crossed an ecological threshold but still retain most of their pre-threshold species richness have a greater probability of reversal than states that have lost most of their species and support ecological functions (Briske et al., 2006). This may be true with both Wood and Beef Hollow sites. The grazing may have been implemented following the change in the communities, and the sites may have already crossed ecological thresholds before grazing of fuel breaks began.

Cheatgrass abundance could also be explained by above-average moisture in the spring of 2015. Casper suggested that below-ground competition decreases when nutrients increase (Casper and Jackson, 1997). Water is a limited resource; therefore, the more abundant a resource is, the less competition occurs. Precipitation in 2015 was higher than the long-term average. In 2015, March, April, and May precipitation totals were 127 mm at Camp Williams, while the annual long-term average for the three months was only 104 mm (U.S. Climate Data, 2016). The additional precipitation reduced competition and could have increased cheatgrass abundance regardless of the treatment effect. This study was limited because the data collection only occurred in 1 year, and we do not have data from other years to encompass the annual variation in cheatgrass cover.

Conclusion

In this study, there were few negative changes in vegetation in the grazed fuel breaks even though they have experienced intense short-term grazing bouts annually. Conversely, reducing sagebrush in Oak Springs leads to increased perennial grasses, which is often desirable to create heterogeneity in sagebrush communities.

Current grazing practices have not increased cheatgrass at any sites, likely due to the grazing occurring in short, intense periods. Sheep and goats were only on each block within the pastures for two to three days, followed by a long rest period. This grazing schedule is likely the reason for stable to increasing perennial grass cover and no increase in cheatgrass. However, grazing should be closely monitored to ensure the sustainability of the plant communities. Invasive grasses such as medusahead and jointed goatgrass should be monitored closely to ensure they do not become a larger problem.

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