Plant Community Response to Herbicide Application for Noxious Weeds in Rangelands

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IMPACT STATEMENT

Rangeland managers can expect good control of spotted knapweed, sulfur cinquefoil, and Dalmatian toadflax when recommended herbicides are applied in the fall. Fall application of aminopyralid (Milestone®) on rangelands controlled spotted knapweed and sulfur cinquefoil one and two years post-treatment. In response to the control of spotted knapweed and sulfur cinquefoil, perennial bunchgrasses increased. Fall application of picloram (Tordon®) controlled Dalmatian toadflax for one year post-treatment, with no detectable effect on other plant functional groups.

SUMMARY

The objective of this project was to determine how an herbicide application for target weeds affects abundance of rangeland plant functional groups one and two years post-spraying. Aminopyralid (Milestone®) was applied at two spotted knapweed infested rangeland sites and two sulfur cinquefoil infested rangeland sites, while picloram (Tordon®) was applied at two Dalmatian toadflax infested rangeland sites. Both herbicides were applied in the fall and successfully controlled all target weeds for one year post-treatment and continued to control spotted knapweed and sulfur cinquefoil for two years post-treatment. In response to weed control, perennial bunchgrasses increased at spotted knapweed and sulfur cinquefoil sites. At both spotted knapweed sites, perennial forb cover in sprayed plots decreased the first year after treatment, but recovered by the second year. In addition, annual grass cover was slightly higher in sprayed plots two years post-treatment at spotted knapweed sites.

INTRODUCTION

Spotted knapweed (*Centaurea stoebe*), sulfur cinquefoil (*Potentilla recta*), and Dalmatian toadflax (*Linaria dalmatica*) are exotic, perennial forbs listed as noxious weeds in Montana. Consequently, rangeland managers often apply herbicides to control these weeds. While this practice is generally thought to be beneficial for native plant communities, sites may again become dominated by the primary invader over time (Rice et al. 1997). Alternatively, land managers in Montana have noted that secondary invaders, often exotic annual grasses like cheatgrass (*Bromus tectorum*), can occupy the open space left when exotic forbs are targeted by herbicides.

Several studies have been conducted in western Montana, focusing on the control of spotted knapweed in rangeland. Rice et al. (1997) found that total grass cover (mix of native and exotic species) increased two years after picloram application, thus becoming a grass-dominated community. Ortega and Pearson (2010) reported an increase in native grass cover (bluebunch wheatgrass (*Pseudoroegneria spicata*)) with picloram application, but also observed an increase in the secondary invader, cheatgrass.

The objective of this project was to examine how herbicide application for target weeds affects abundance of plant functional groups in rangelands. Because several studies have looked at a similar objective in spotted knapweed-dominated rangeland, we aimed to expand this

research to rangeland dominated by sulfur cinquefoil and Dalmatian toadflax as well. Understanding the overall plant community response to weed control will hopefully allow land managers to more successfully manage for desired plant communities.

PROCEDURES

We conducted our study on six rangeland sites in western Montana from 2013 to 2015 (Figure 1). Prior to treatment, target weed cover ranged from 0-35% across spotted knapweed sites, 0-25% across sulfur cinquefoil sites, and 0-22% across Dalmatian toadflax sites. Three transects (either 50 or 100 m long) were established at each site. Pre-treatment cover of all species was sampled in paired plots along each transect in summer 2013. The herbicide treatment was applied to a randomly selected side of each transect while the other side represented a non-sprayed control. Aminopyralid (Milestone® at 5 oz/acre) was applied to sulfur cinquefoil and spotted knapweed sites in October 2013 while picloram (Tordon® at 2 pints/acre) was applied to Dalmatian toadflax sites in September 2013. Post-treatment cover of all species was sampled in summer 2014 and 2015. Cover data by species was pooled into the following plant functional groups: target weed, perennial forb, perennial bunchgrass, perennial rhizomatous grass, annual grass, annual forb, and shrub. We analyzed the percent difference in cover of plant functional groups between paired plots (non-sprayed minus sprayed), comparing one and two years post-treatment to pre-treatment cover. Only those plant functional groups that were affected by herbicide treatment are presented here ($\alpha < 0.05$). Even though we used the percent difference for analysis, we present mean cover in the results section for ease of interpretation.

RESULTS AND DISCUSSION

Herbicide application reduced the target weed at all sites (Figure 2). Spotted knapweed cover was reduced to 0% in 2014 and to 0.02% in 2015 (non-sprayed: 2.9% in 2014 and 1.7% in 2015). Sulfur cinquefoil cover was reduced to 0.3% cover in 2014 and to 0.2% in 2015 (non-sprayed: 5.6% in 2014 and 2.8% in 2015). Control for these two target weeds lasted at least two years. Dalmatian toadflax cover was reduced to 0.6% in 2014 (non-sprayed: 5.1%), but there was no statistical difference between sprayed and non-sprayed plots in 2015, suggesting that after two years, this target weed is starting to recover from the herbicide application.

At both the spotted knapweed and sulfur cinquefoil sites, native perennial bunchgrass cover increased after herbicide application (averaged across years and sites, sprayed: 10.7%; non-sprayed: 8.2%). At the spotted knapweed sites, perennial forb cover was lower in the sprayed plots one year post-treatment (sprayed: 2.26%; non-sprayed: 6.26%); however, there was no difference two years post-spraying. This result is similar to Rice et al. (1997) in which forb canopy cover was reduced in several herbicide treatments 1-2 years following spraying, but forb cover recovered by the third year.

At the spotted knapweed sites, exotic annual grass cover was slightly higher in sprayed plots two years post-spraying (sprayed: 2.66%; non-sprayed: 1.06%). This trend was especially apparent at one spotted knapweed site that had higher pre-treatment exotic annual grass cover compared to other sites and had a greater variety of exotic annual grass species present, including cheatgrass, Japanese brome (*Bromus japonicus*), ventenata (*Ventenata dubia*), brome fescue (*Vulpia bromoides*), and windgrass (*Apera interrupta*). This small increase in exotic annual grass abundance warrants further research to determine if this trend will continue with repeated herbicide applications typical of rangeland noxious weed management.

Overall, our results showed that plant communities can be fairly resilient to a single herbicide application. We sampled in plant communities with fairly abundant native plant cover. If a site is more severely degraded, integrated weed management strategies may be necessary. For example, combining herbicide application with seeding a mix of plants that utilize different portions of the soil profile may help avoid the secondary invasion of exotic annual grass.

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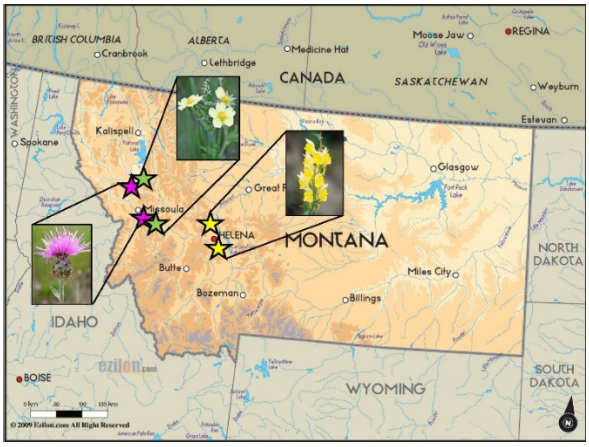

Figure 1. Map of Montana showing field sites selected in spring 2013. Pink stars represent spotted knapweed sites, green stars represent sulfur cinquefoil sites, and yellow stars represent Dalmatian toadflax sites.

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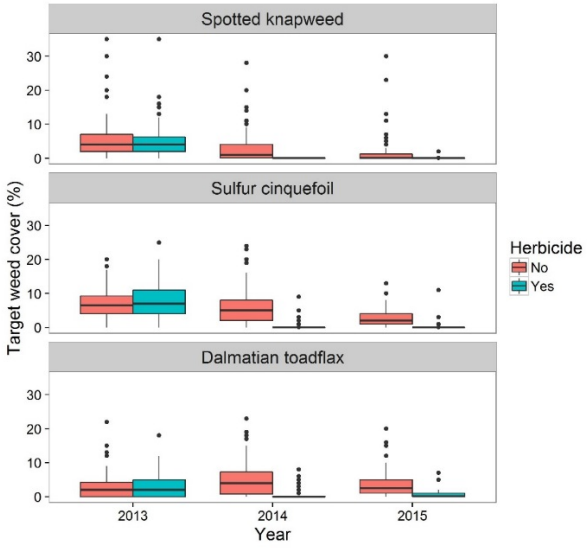

Figure 2. Boxplots of target weed cover at spotted knapweed, sulfur cinquefoil, and Dalmatian toadflax sites in 2013 (pre-treatment), 2014 (one year post-treatment), and 2015 (two years post-treatment). Boxes shown in pink represent non-sprayed plots while boxes in blue represent sprayed plots.