Colorado Parks and Wildlife

WILDLIFE RESEARCH PROJECT SUMMARY

Restoring habitat with super-absorbent polymer

Period Covered: January 1, 2018 – December 31, 2018

Principal Investigators: Magda Garbowski (Graduate Student, Colorado State University), Danielle B. Johnston (CPW), Cynthia S. Brown (Professor, Colorado State University)

Project Collaborators: Murphy Jacox (Property Technician, Dry Creek Basin State Wildlife Area), Renzo Delpiccolo (Area Wildlife Manager)

In the western United States, successful restoration of degraded habitat is often hindered by invasion of exotic species and unfavorable climatic conditions. Cheatgrass (*Bromus tectorum* L.) is an especially aggressive competitor on disturbed lands and poses threats to restoration, including outcompeting desirable species, altering soil nutrient cycles, reducing species diversity, and decreasing the quality of forage and wildlife habitat. In addition, uncertainties of future climate and precipitation changes make planning for and implementing restorations difficult. With their ability to absorb moisture when soils are wet and slowly release it over time, superabsorbent polymers (SAP) may buffer seeded species against negative impacts of precipitation fluctuations. In a prior CPW study, incorporating SAP into the soil at the time of seeding was found to reduce cheatgrass cover by up to 50% initially, and effects persisted for four years.

Because SAP acts on existing soil moisture, its effectiveness is likely to depend on precipitation factors, such as total annual precipitation, seasonal timing, and size of precipitation events. In this study, we assess the repeatability of the prior study in two additional locations that have contrasting precipitation patterns: a Colorado Eastern Slope site (Waverly Ranch, Larimer County), and a Colorado Western Slope site (Dry Creek Basin State Wildlife Area, San Miguel County). We quantify how SAP influences soil moisture through time at these locations, and how drought, cheatgrass presence, and SAP interact to influence plant community development.

Experiments were implemented in fall 2013 at the Eastern Slope site and summer 2014 at the Western Slope site (Figure 1), and responses were measured until 2017. In 2018, we have been preparing two manuscripts. The first is focused on seedling density, aboveground biomass, and belowground biomass, with an emphasis on the effects of SAP (abstract below).

Manuscript Abstract (in preparation for <u>*Restoration Ecology*</u>): In the western United States, successful aridland restoration is often constrained by drought and invasion by *Bromus tectorum*. By increasing the water-holding capacity of soil and decreasing soil resource variability, superabsorbent polymers (SAP) may ameliorate the negative impacts of drought and *B. tectorum* on native species establishment. We established a full-factorial study to investigate the interactive effects of drought (66% reduction of ambient rainfall), *B. tectorum* seeding (BRTE, 465 seeds m^{-2}) and SAP (25 g m^{-2} incorporated into soil) on initial plant establishment and three-year above- and belowground biomass and allocation in restored plant communities at two sites in

Colorado, one each on the Eastern and Western slopes. We observed an increase of over 100% in first-year seeded species establishment with SAP under ambient precipitation conditions (77.3 ± 104.1 plants m^{-2}) versus other treatments (range: 13.7 9 – 23.2 plants m^{-2}) at the Eastern Slope Site (Figure 2a). However, no SAP effects on seeded species biomass were detectable three years post-treatment (Figure 2b). Precipitation, BRTE, and SAP treatments interacted to influence all components of biomass as well as the root mass fraction, but results varied by site. Notably, at the Eastern Slope Site, negative effects of drought on belowground biomass seemed to be exacerbated by SAP resulting in lower root biomass in drought plots with SAP (61.66 ± 7.26 g m^{-2}) than in all other treatments (range: 83.67 – 91.56 g m^{-2}; Figure 3a). As SAP can interact with environmental variables to impact developing plant communities in both positive and negative ways they should be used with caution in aridland restoration.

In 2019 we will submit this manuscript for publication, and also prepare and submit manuscript containing percent vegetation cover data, with an emphasis on effects of drought and cheatgrass at contrasting sites.

Figure 1. Rainfall exclusion shelters induce artificial drought at the Western Slope site in 2014.

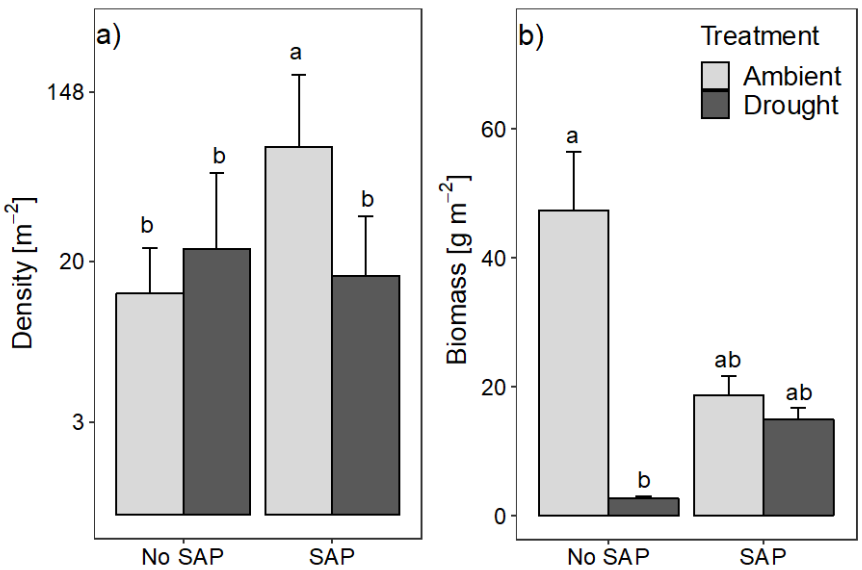

Figure 2: Eastern Slope Site a) 2014 seeded species seedling densities (log scale) and b) 2016 seeded species biomass under precipitation and super-absorbent polymer (SAP) treatments. Bars represent a) density and b) biomass means averaged over *B. tectorum* treatments. Error bars are standard error of the mean. Means with different lowercase letters above bars denote differences between treatments at the α = 0.05 level.

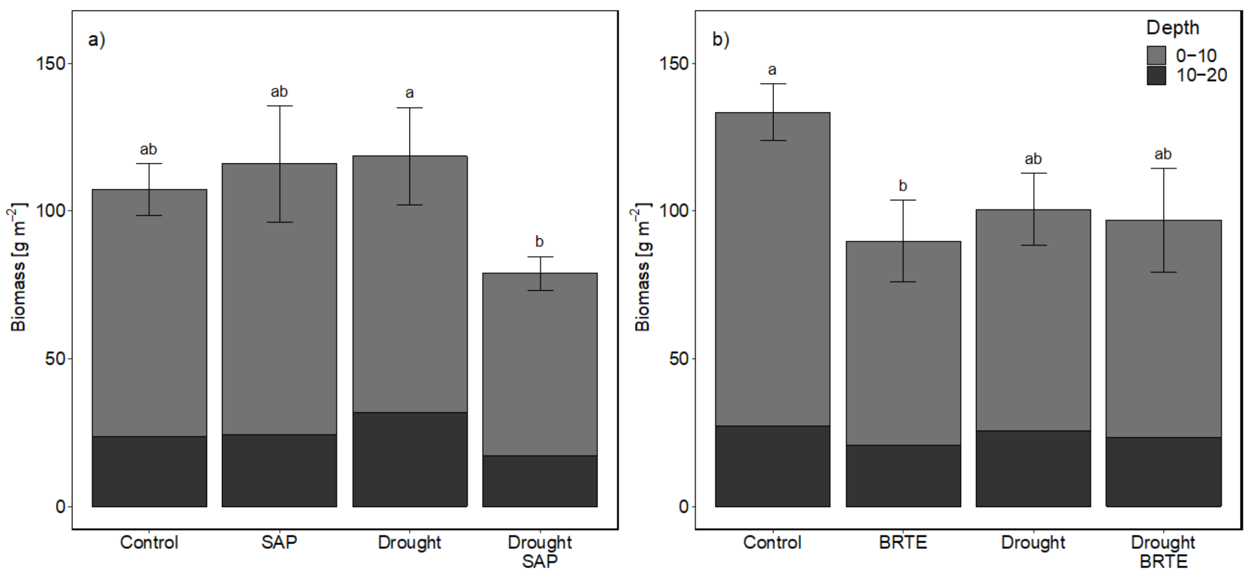

Figure 3: Eastern Slope Site 2016 belowground biomass under a) precipitation and super-absorbent polymer (SAP) treatments averaged over *B. tectorum* (BRTE) treatments and b) drought and BRTE treatments averaged over SAP treatments. Dark gray areas correspond to shallow (0-10cm) root biomass and light gray corresponds to deep (10-20cm) root biomass. Error bars are standard error of the mean for total belowground biomass. Means with different letters are statistically different at the α = 0.05 level.