Nevada Section Society for Range Management Suggested Reading: June 2016

Abstracts of Recent Papers on Range Management in the West

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Drenovsky, R. E., M. L. Thornhill, M.A. Knestick, T. J. Svejcar and J. J. James. 2016. **Seed Production and Seedling Fitness Are Uncoupled from Maternal Plant Productivity in Three Aridland Bunchgrasses.** Rangeland Ecology and Management 69(3)161-168.
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Abstract

Maintaining self-sustaining populations of desired plants is fundamental to rangeland management, and understanding the relationships among plant growth, seed production, and seedling recruitment is critical to these efforts. Our objective was to evaluate how changes in maternal plant soil resource environment influences maternal plant biomass and seed production and seedling fitness in three widespread perennial bunchgrass species (*Elymus elymoides* [Raf.] Sezey, bottlebrush squirreltail; *Festuca idahoensis* Elmer, Idaho fescue; and *Pseudoroegneria spicata* [Pursh] A. Löve, bluebunch wheatgrass). We supplied water and nutrients to adult plants growing in the field and measured their productivity and fecundity. Then, in the laboratory, growth chamber, and field we assessed effects of the maternal water and nutrient additions on offspring performance. Across the three study species, vegetative traits were more plastic than reproductive traits, with resource addition measurably increasing plant growth but not seed production. Germination was high in both the laboratory and field across treatments, although seeds from irrigated maternal plants tended to have higher field germination. Seedling relative growth rate, leaf mass ratio, and relative root elongation rate (RRER) were highly variable, although RRER tended to be higher in seedlings derived from irrigated maternal plants. In the field, seedling survivorship was low across all species, but survivorship doubled in seedlings produced by *P. spicata* plants that received additional water through the growing season. Overall, our results suggest that biomass production and fecundity responses to nutrients are decoupled in the species and environment tested but maternal effects can have significant, although variable, impacts in some grassland species. As a result, biomass responses to natural and anthropogenic changes in resource availability may not be strong predictors of how altered resource supply may ultimately influence plant community dynamics in aridland systems.

Rinella, M. J. and S. E. Bellows. 2016. **Evidence-Targeted Grazing Benefits to Invaded Rangelands Can Increase over Extended Time Frames**. Rangeland Ecology and Management 69(3):169-172.

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Abstract

Targeted grazing uses livestock to address woody plant encroachment, flammable biomass accumulations, exotic weed invasions, and other management issues. In principle, a feature distinguishing targeted grazing from production-orientated grazing is stocking regimes (i.e., rates, timings, and durations) are chosen to encourage heavy defoliation of unwanted plants at sensitive growth stages. In practice, there are limited data available to guide stocking regime choices. Those data that do exist derive mostly from short-term studies, so the long-term effects of targeted grazing most concerning to managers remain highly uncertain. In a previous study, we imposed clipping treatments to identify defoliation levels and timings effective against the invader leafy spurge (*Euphorbia esula* L.). Most treatments simulated defoliation by sheep, the animal most commonly used for leafy spurge grazing, though a baseline treatment simulated defoliation by cattle, an animal tending to avoid leafy spurge. The two most effective treatments, which gave similar responses through the end of the previous study, defoliated leafy spurge and other species either before or during leafy spurge flowering. One goal of the current study was to determine if these responses remained similar or diverged over 5 additional treatment years. The other goal was to determine if differences between simulated sheep and cattle grazing treatments increased over time. In the current study, it became increasingly clear that defoliation before flowering was most damaging to leafy spurge, even though defoliation during flowering removed greater leafy spurge biomass. Compared with simulated cattle grazing, simulated sheep grazing before flowering reduced leafy spurge biomass production 74% (52%, 86%) [mean (95% confidence interval)] and increased resident species (mostly grasses) biomass production 40% (14%, 74%) by study's end. Leafy spurge biomass differences between treatments increased gradually over the study period, suggesting long-term research is needed to accurately compare targeted grazing treatments.

Davies, K. W., A. M. Nafus, C. S. Boyd, A. Hulet and J. D. Bates. 2016. **Effects of Using Winter Grazing as a Fuel Treatment on Wyoming Big Sagebrush Plant Communities**. Rangeland Ecology and Management 69(3):179-184.

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Abstract

More frequent wildfires and incidences of mega-fires have increased the pressure for fuel treatments in sagebrush *(Artemisia)* communities. Winter grazing has been one of many fuel treatments proposed for Wyoming big sagebrush (*A. tridentata* Nutt. subsp. *wyomingensis* Beetle and A. Young) communities. Though fire risk and severity can be reduced with winter grazing,

its impact on vegetation characteristics of Wyoming big sagebrush plant communities is largely unknown. We evaluate the effect of winter grazing at utilization levels between 40% and 60% at five sites in southeastern Oregon. Winter grazing was applied for 5−6 yr before measurements. The winter-grazed and ungrazed treatments generally had similar vegetation characteristics; however, a few characteristics differed. The consumption of prior years' growth resulted in less large perennial bunchgrass, perennial forb, and total herbaceous cover and standing crop and litter biomass. Large perennial bunchgrass and perennial forb density and biomass and exotic annual grass and annual forb cover, density, and biomass did not differ between treatments, suggesting that winter grazing is not negatively impacting resilience and resistance of these communities. Shrub cover was also similar between treatments. These results imply that winter grazing can be applied to reduce fine fuels in Wyoming big sagebrush communities without adversely affecting the native plant community. Winter grazing should, however, be strategically applied because the reduction in perennial grass and perennial forb cover with the consumption of prior years' growth may negatively impact the habitat value for wildlife species that use herbaceous vegetation for concealment.

Sebastian, D. J., J.R. Sebastian, S. J. Nissen and K.G. Beck. 2016. **A Potential New Herbicide for Invasive Annual Grass Control on Rangeland**. Rangeland Ecology and Management 69(3):195-198.

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Abstract

Downy brome (*Bromus tectorum* L.), a winter annual grass, is considered one of the most invasive non-native rangeland species in the United States. Although glyphosate, imazapic, and rimsulfuron are herbicides commonly recommended to control invasive, annual grasses, their performance is inconsistent and they can injure desirable perennial grasses. Indaziflam is a recently registered cellulose biosynthesis inhibiting herbicide, providing broad-spectrum control of annual grass and broadleaf weeds. Indaziflam is labeled for winter annual grass control in citrus, grape, and tree nut crops and could represent a new mode of action for selective winter annual grass control on rangeland. Three field experiments were conducted to compare indaziflam with imazapic, rimsulfuron, and glyphosate, three herbicides commonly used for downy brome control. Multiple herbicide application timings were evaluated. At all three sites, glyphosate and rimsulfuron provided less downy brome control than indaziflam 1 year after treatment (YAT). Percent downy brome control with imazapic decreased significantly 2 YAT (45−64%) and 3 YAT (10−32%). Across all sites and application timings, indaziflam provided the greatest downy brome control 2 YAT (89−100%) and 3 YAT (83−100%). Indaziflam did not significantly reduce species richness. This study demonstrates that indaziflam can provide extended downy brome control compared with currently used herbicides.

Douglass, C. H., S. J. Nissen, P.J. Meiman and A. R. Kniss. 2016. **Impacts of Imazapyr and Triclopyr Soil Residues on the Growth of Several Restoration Species**. Rangeland Ecology and Management 69(3):199-205.

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Abstract

Herbicides are frequently used in natural systems to control invasive plants, but nontarget impacts from persistent soil residues can result in unintended ecosystem effects. Imazapyr and triclopyr are herbicides that are widely used in noncrop areas such as rangelands to manage perennial weeds, especially woody species such as tamarisk (saltcedar). Due to widespread environmental and anthropogenic changes in the American southwest, tamarisk, which is commonly thought to co-occur only with riparian plants, is increasingly being found in communities of upland rangeland species. Using an in vitro study combined with high-performance liquid chromatography (HPLC) analyses, imazapyr and triclopyr degradation rates were determined in six Colorado soils. In addition, the relative sensitivity of desirable species to the two herbicides was determined in a field dose response study. Exponential decay models estimated that triclopyr degradation (half-lives of 5 − 16 days) was 20 times more rapid than imazapyr degradation (half-lives of 82 − 268 days). All species tested were sensitive to imazapyr residues, but the degree of sensitivity was strongly dependent on soil properties. Sensitive species (alkali sacaton and western wheatgrass) were tolerant of imazapyr residues in some soils 20 − 23 months after applications. Relatively insensitive species (slender wheatgrass) were tolerant of imazapyr residues in the same soils 10 months after applications. American licorice was sensitive to triclopyr residues up to 89 days after applications, and several grasses (including sideoats grama) showed minor sensitivity. Our study indicates that there is an interaction between the spatial variability in herbicide degradation driven by edaphic properties and the sensitivity of plants to a herbicide, which could be exploited by management practitioners to aid in site rehabilitation. Specifically, managers could stagger planting of species temporally on the basis of their sensitivity to herbicide residues or could target areas of treated sites for planting that are known to have soil types facilitating relatively rapid herbicide degradation.

Bybee, J., B. A. Roundy, K. R. Young, A. Hulet, D. B. Roundy, L. Crook, Z. Aanderud, D. L. Egget and N. L. Cline. 2016. **Vegetation Response to Piñon and Juniper Tree Shredding**. Rangeland Ecology and Management 69(3):224-234.

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Abstract

Piñon (*Pinus* spp.) and juniper (*Juniperus* spp.) expansion and infilling in sagebrush (*Artemisia* L.) steppe communities can lead to high-severity fire and annual weed dominance. To determine vegetation response to fuel reduction by tree mastication (shredding) or seeding and then shredding, we measured cover for shrub and herbaceous functional groups on shredded and adjacent untreated areas on 44 sites in Utah. We used mixed model analysis of covariance to determine significant differences among ecological site type (expansion and tree climax) and treatments across a range of pretreatment tree cover as the covariate. Although expansion and

tree climax sites differed in cover values for some functional groups, decreasing understory cover with increasing tree cover and increased understory cover with tree reduction was similar for both ecological site types. Shrub cover decreased by 50% when tree cover exceeded 20%. Shredding trees at ≤ 20% cover maintained a mixed shrub (18.6% cover)−perennial herbaceous (17.6% cover) community. Perennial herbaceous cover decreased by 50% when tree cover exceeded 40% but exceeded untreated cover by 11% (20.1% cover) when trees were shredded at 15−90% tree cover. Cheatgrass (*Bromus tectorum* L.) cover also increased after tree shredding or seeding and then shredding but was much less dominant (< 10% cover) where perennial herbaceous cover exceeded 42%. Sites with high cheatgrass cover on untreated plots had high cheatgrass cover on shredded and seeded-shredded plots. Seeding and then shredding decreased cheatgrass cover compared with shredding alone when implemented at tree cover ≥ 50%. Vegetation responses to shredding on expansion sites were generally similar to those for tree cutting treatments in the SageSTEP study. Shredding or seeding and then shredding should facilitate wildfire suppression, increase resistance to weed dominance, and lead toward greater resilience to disturbance by increasing perennial herbaceous cover.

Chivers, I. H., T. A. Jones, L. M. Broadhurst, I. W. Mott and S. R. Larson. 2016. **Merits of artificial selection for the development of restoration-ready plant materials of native perennial grasses**. Restoration Ecology 24(2):174-183.

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Abstract

Although seed harvested from remnant, wildland perennial-grass populations can be used for restoration in humid and subhumid temperate regions, seed harvested in semiarid and arid environments is often of low quality and highly variable in quantity. In addition, ongoing harvest of indigenous populations can be unsustainable, especially for those that are small. In such environments, dependable and repeatable broad-scale restoration of degraded grasslands requires sufficient and consistent supplies of reliable, cost-effective seed sources that can only result from intensively managed cultivated stands. But does the harvest of intensively managed seed-production fields inadvertently compromise genetic diversity, thereby adversely affecting the restoration outcome? That is, are seed-production systems a part of the solution for restoration, or do they create new unintended management issues? This article discusses the potential impacts of cultivated seed-production systems and recurrent artificial selection for specific traits on genetic integrity and performance of native-species perennial-grass populations. Although genetic shift resulting from cultivated perennial-grass seed production may be inevitable, genetic shifts that change phenological expression may be limited in genotypes that exhibit high seed retention. Artificial selection can improve plant material performance on the often-harsh conditions of restoration sites, but sufficiently high-effective population sizes (N_e) must be maintained to conserve genetic diversity, thereby precluding the inbreeding depression that can compromise plant performance. Potentially useful traits of native perennial-grass species that respond to artificial selection include seed production, seed retention, seedling establishment, competitive ability against weeds, and herbicide tolerance. Potential trade-offs between traits should also be considered to avoid undesirable inadvertent responses to selection

Mosley, J. C., R. A. Frost, B. L. Roeder, T. K. Mosley and G. Marks. 2016. **Combined Herbivory by Targeted Sheep Grazing and Biological Control Insects to Suppress Spotted Knapweed (*Centaurea stoebe)***. Invasive Plant Science and Management 9(1):22-32.

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Abstract

The use of biological control insects is a promising option for suppressing spotted knapweed, a nonindigenous perennial forb that infests more than 3 million hectares of North American rangeland. Efficacy increases when spotted knapweed is attacked by more than one phytophagous insect; however, combined herbivory by biological control insects has not achieved widespread suppression of spotted knapweed in North America. Here we expand the concept of combined herbivory beyond two or more species of biological control insects to include a vertebrate herbivore, specifically targeted grazing by domestic sheep. Our experiment on foothill rangeland in northwestern Montana evaluated spotted knapweed response to three treatments: (1) biological control insects only, (2) biological control insects + targeted sheep grazing applied in late July (spotted knapweed in late bud–early flower stage), and (3) biological control insects + targeted sheep grazing applied in mid-August (spotted knapweed in full-flower stage). We combined targeted sheep grazing with herbivory by three species of biological control insects: knapweed flower weevil, knapweed root weevil, and sulfur knapweed root moth. Treatments were applied during four consecutive years (2009 to 2012). Spotted knapweed fitness was suppressed more where targeted sheep grazing and biological control insects were combined vs. areas treated with biological control insects alone. Combined herbivory was effective when targeted sheep grazing was applied during either late July or mid-August, but July grazing was more effective. Spotted knapweed produced 96 to 99% fewer viable seeds in sheep-grazed areas. After 4 yr of treatment, total spotted knapweed plant density (seedlings, juvenile, and adult plants) was 86% less in July-grazed areas and 61% less in August-grazed areas than in areas treated with biological control insects alone. Combined herbivory by targeted sheep grazing and biological control insects reduced adult plant density and prevented compensatory recruitment of spotted knapweed, but treatment with biological control insects alone did not.