Nevada Section Society for Range Management Suggested Reading: Winter 2018

Abstracts of Recent Papers on Range Management in the West

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Table of Contents

NV-SRM Suggested Reading

Winter 2018

Williams, J. R., L. R. Morris, K. L. Gunnell, J. K. Johanson, and T. A. Monaco. 2017. **Variation in Sagebrush Communities Historically Seeded with Crested Wheatgrass in the Eastern Great Basin**. Rangeland Ecology and Management. 70(6): 683-690.

View on Science Direct: https://www.sciencedirect.com/science/article/pii/S155074241730043X

Abstract:

Although crested wheatgrass (*Agropyron cristatum* [L.] Gaertn. & *A. desertorum* [Fisch. ex Link] Schult.) has been one of the most commonly seeded exotic species in the western United States, long-term successional trajectories of seeded sites are poorly characterized, especially for big sagebrush (*Artemisia tridentata* Nutt.) ecosystems in the Great Basin. Interpreting successional trajectories is particularly difficult because many seeded sites were actively managed with subsequent treatments to kill sagebrush and sustain high forage productivity of crested wheatgrass plants. In addition, inherent differences in climate, topography, soils, and disturbance regimes may lead to variable vegetation structure and species composition among seeded sites. To clarify variation in successional trajectories, we measured vegetation composition, plant species diversity, ground cover, and soil properties in 38 historical crested wheatgrass seedings distributed across 146 sampling sites that lacked subsequent sagebrush treatments. The multivariate dataset was analyzed using principal components analysis to identify "defining factors" that best explained variation among sites. Variation was primarily attributed to an inverse relationship between crested wheatgrass and sagebrush abundance (R^2 = 0.69; $P < 0.0001$) and their affinity for either silty or sandy soil textures, respectively, as well as a negative association between crested wheatgrass abundance and species diversity (R^2 = 0.67; $P < 0.0001$). These results do not support the assumption that crested wheatgrass seedings uniformly remain in vegetation states with low diversity and poor sagebrush reestablishment over the long term (i.e., 43 − 63 yr). We suggest that a broader interpretation of plant community dynamics is needed while avoiding generalizations of how historically seeded Wyoming big sagebrush sites will respond over time.

Davies, K. W. and D. D. Johnson. 2017. **Established Perennial Vegetation Provides High Resistance to Reinvasion by Exotic Annual Grasses**. Rangeland Ecology and Management. 70(6):748-754.

View on Science Direct: https://www.sciencedirect.com/science/article/pii/S155074241730057X

Abstract:

Exotic annual grasses have invaded millions of hectares of sagebrush (*Artemisia* L.) steppe in the Great Basin region and degraded wildlife habitat, reduced forage production, and promoted increasingly frequent wildfires. Revegetation after control of exotic annual grasses is needed to restore ecosystem services and break the annual grass-fire cycle. The ability of different common revegetation species and combinations of species to limit reinvasion of annual grasses is relatively unknown. We evaluated five species/combinations of perennial native and introduced bunchgrass and shrub species planted as seedlings after exotic annual grass control at two sites in southeast Oregon. To evaluate resistance to reinvasion, exotic annual grasses were seeded into all treatment plots in the fall two growing seasons after planting. Vegetation characteristics were measured in the third and fourth years after annual grass seeding. Exotic annual grass cover and density were greatly reduced in all treatments where perennial seedlings were planted compared with the control (no seedlings planted). Treatments including crested wheatgrass (*Agropyron desertorum* [Fisch. Ex Link] Schult) generally limited annual grasses more than other treatments. Most notably, forage kochia (*Bassia prostata* [L.] A. J. Scott) reduced exotic annual grasses less than crested wheatgrass and crested wheatgrass planted with forage kochia. This suggests that if forage kochia will be planted, it should be used in conjunction with perennial bunchgrasses in efforts to revegetate exotic annual grass − invaded sagebrush steppe. Established native vegetation also greatly reduced exotic annual grass reinvasion. Though some differences existed among established vegetation treatments, our study highlights that established perennial vegetation prevents redomination by invasives after exotic annual grass control.

Williams, R. E., B. A. Roundy, A. Hulet, R. F. Miller, R. J. Tausch, J. C. Chambers, J. Mathews, R. Schooley and D. Eggett. 2017. **Pretreatment Tree Dominance and Conifer Removal Treatments Affect Plant Succession in Sagebrush Communities**. Rangeland Ecology and Management. 70(6):759-773.

View on TreeSearch: https://www.fs.fed.us/rmrs/publications/pretreatment-tree-dominance-and-conifer-removal-treatments-affect-plant-succession

Abstract:

In sagebrush (*Artemisia tridentata* Nutt.) ecosystems, expansion and infilling of conifers decreases the abundance of understory perennial vegetation and lowers ecosystem resilience and resistance of the once shrub grass − dominated state. We prescribed burned or cut juniper (*Juniperus* spp. L.) and pinyon (*Pinus* spp. L.) trees at 10 sites across the western United States. We measured vegetation cover and density on untreated and treated plots 3 and 6 yr after treatment across a gradient of pretreatment tree dominance as quantified by the tree dominance index (TDI); (tree cover)/(tree + shrub + tall grass cover). We analyzed plant responses by functional group using mixed-model analysis of covariance, with TDI treated as a covariate. As tree cover increased and TDI exceeded 0.5, shrub cover declined to < 25% of the maximum on untreated plots. Although total shrub cover recovered on burned plots to untreated percentages 6 yr after treatment, sagebrush cover was still 1.1 − 0.6% on burned plots compared with 13.9 − 0.5% on untreated plots across the range of 0 − 1 TDI. Tall grass cover increased to 25.4 − 9.4% for burn plots and 24.3 − 22.4% on cut plots from 0 − 1 TDI 6 yr after treatment. Cheatgrass (*Bromus tectorum* L.) increased on prescribed fire and on cut treatments, especially at higher pretreatment TDI. However, ratios of cheatgrass to tall grass cover were much lower on cut than burn plots. To retain the shrub, especially sagebrush, components on a site and increase ecosystem resilience and resistance through increases in tall grasses, we recommend treating at low to mid TDI using mechanical methods, such as cutting or mastication. Effects of fire and mechanical treatments implemented at different phases of tree dominance create different successional trajectories that could be incorporated into state-and-transition-models to guide management decisions.

Noelle, S. M., C. A. Carr, T. K. Stringham and M. A. Weltz. 2017. **Slash Application Reduces Soil Erosion in Steep-Sloped Piñon-Juniper Woodlands**. Rangeland Ecology and Management 70(6):774-780.

View on Science Direct: https://www.sciencedirect.com/science/article/pii/S1550742417300465

Abstract:

Mitigating runoff and associated erosion is a fundamental challenge for sustainable management of rangelands. Hillslope runoff and erosion are strongly influenced by ground cover; thus, a strategic management option exists to increase cover with slash from woody plant removal activities, particularly on lands experiencing woody plant expansion. Most studies assessing slash effects on runoff and erosion have been limited to moderate slopes; however, substantial portions of rangelands exist on steeper slopes where the effectiveness of slash application is less clear. On a steep (30% ± 5%) slope that had been encroached by piñon and juniper trees, we evaluated the effectiveness of slash in reducing runoff and erosion using a portable rainfall simulator (100-yr return period events). Although total runoff did not differ across slash levels, there was marginal evidence of a difference associated with vegetation cover. Sediment yield for plots with low vegetation cover (< 13% cover) was 3.4 times greater than those with high cover, while plots with slash present (≥ 30% cover) experienced 5.4 times less sediment yield than plots without slash. These results extend findings from moderate to steep slopes, highlighting the potential efficacy of slash application for reducing erosion in steep-sloped rangelands.

Lien, A. M., C. Svancara, W. Vanasco, G. B. Ruyle and L. Lopez-Hoffman. 2017. **The Land Ethic of Ranchers: A Core Value Despite Divergent Views of Government**. Rangeland Ecology and Management 70(6):787-793.

View on Science Direct: https://www.sciencedirect.com/science/article/pii/S155074241730060X

Abstract:

In the western United States, the management and use of public lands for livestock grazing is a frequent source of conflict among environmentalists, federal agencies, and ranchers. Since at least the early 1980s, the rhetoric of the "sagebrush rebellion" has reinforced a public perception that ranchers are both antigovernment and anticonservation. Sustainable management of public lands used for livestock grazing depends on both federal agency personnel, who enforce regulations, and ranchers, who use the land and implement management plans on a day-to-day basis. As a result, the attitudes of ranchers toward conservation can have a significant impact on the overall ecological health of public rangelands. We conducted a study of ranchers in southeastern Arizona and southwestern New Mexico using Q Methodology to understand their views and motivations about ranching, conservation, and the government. Our results show three complex viewpoints, which we term *radical center ranchers* (20% of variance), *innovative conservationists* (19% of variance), and *traditional ranchers* (12% of variance). A commitment to conservation and corresponding lack of anticonservation sentiment is held across these viewpoints. Mistrust of government coexists with conservation values for two groups. This information is useful for finding common ground between ranchers and government officials, conservationists, and extension agents on range management and conservation goals.

Naeth, M. A., A. C. Cohen Fernandez, F. P. O. Mollard, L. Yao, S. R. Wilkinson and Z. Jiao. 2018. **Enriched Topographic Microsites for Improved Native Grass and Forb Establishment in Reclamation**. Rangeland Ecology and Management 71(1):12-18.

View on Science Direct: https://www.sciencedirect.com/science/article/pii/S1550742417300921

Abstract:

Low seed germination and seedling establishment are the greatest challenges for revegetation success. Topographic microsites are known to enhance seed germination and seedling establishment due to their unique soil properties and provision of shelter from elements and herbivores; soil amendments can supply organic matter and nutrients for plant establishment and growth when limited. We investigated the effect of three topographic microsites and six soil amendments and their additive effects on three disturbed grasslands in central and southern Alberta, Canada. Treatments were topographic microsites of mounds, pits, and flats, with and without amendments (erosion control blanket, hay, straw, manure, hydrogel, control) and were seeded with four native grasses and three native forb species. Seedling emergence and survival and soil temperature and water content were assessed over two seasons and plant cover over three seasons. The effect of microsites and amendments was not additive. The addition of erosion control blanket, hay, and straw to flat sites was just as productive as on topographic microsites. These amendments increased grass and forb emergence and buffered soil temperature. Mounds increased first year forb emergence and reduced over winter survival rates for grasses and forbs. Pits were not beneficial for revegetation. The effect of topographic microsites and amendments was influenced by site conditions.

Fulbright, T. E., K. W. Davies and S. R. Archer. 2018. **Wildlife Responses to Brush Management: A Contemporary Evaluation**. Rangeland Ecology and Management. 71(1):35-44.

View on Science Direct: https://www.sciencedirect.com/science/article/pii/S1550742417300702

Abstract:

Wildlife-associated recreation and biodiversity are important management considerations on public and private rangelands, making it imperative that rangeland professionals explicitly take wildlife conservation into account in vegetation management planning and implementation. Here, we synthesize the literature reporting effects of brush management on wildlife and make recommendations for applying brush management to accomplish wildlife conservation objectives. Key observations arising from our synthesis are that habitat-related terminology is often misused in brush management literature. Recommending brush management as a "wildlife habitat improvement" tool is a non sequitur because habitat is species specific and brush management has different consequences for different species of wildlife and plants. Communication between resource managers and stakeholders can be improved by making it clear that habitat is species specific and then identifying what constitutes a benefit of brush management. Changes in resources resulting from brush management may not benefit targeted wildlife species unless these changes overcome some limiting factor or factors. Wildlife responses to brush management treatments are too complex to make broad generalizations because they are mediated by environmental factors and depend on the plant community, size and configuration of the area manipulated, type of treatment applied, and time since application. Prescriptions aimed at improving habitat for wildlife generalists may have relatively modest positive effects on that group but have potentially detrimental effects on specialists. Given this potential trade-off, an idea to consider is that it may be best to err on the side of using brush management as a tool to manage habitat for specialists. Brush management plans and recommendations should take into account trade-offs such as benefiting grassland wildlife at the expense of woodland species. Taking a broader "systems" perspective that balances needs of wildlife in conjunction with other ecosystem services affected by woody plant encroachment and brush management should be a goal of natural resource managers.

Swanson, J. C., P. J. Murphy, S. R. Swanson, B. W. Schultz and J. K. McAdoo. 2018. **Plant Community Factors Correlated with Wyoming Big Sagebrush Site Responses to Fire**. Rangeland Ecology and Management. 71(1):67-76.

View on Science Direct: https://www.sciencedirect.com/science/article/pii/S1550742417300696

Abstract:

Fire kills Wyoming big sagebrush (*Artemisia tridentata* Nutt. ssp. *wyomingensis* Beetle & Young) and promotes cheatgrass (*Bromus tectorum* L.), a highly flammable and invasive annual in sagebrush communities with compromised resistance. To focus management on resistance and resilience of Wyoming big sagebrush communities with varying species composition, we studied 51 paired sites with burned and unburned areas. We quantified soil surface and foliar cover in 12 cover groups. Comparisons identified vegetation or soil surface factors that significantly ($p \leq 0.05$) correlated (Spearman's rank correlation coefficient = ρ) to burned area community composition. Cheatgrass cover in burned areas was greater where unburned areas had more cheatgrass cover ($\rho = 0.75$), litter cover ($\rho = 0.31$), and sagebrush plant canopy volume ($\rho = 0.40$), and less bare soil ($\rho = -0.39$) and cryptogam cover ($\rho = -0.32$). Cheatgrass cover in burned areas was not significantly correlated with unburned area perennial grass or forb cover. Burned area perennial grass cover appeared to be related to more perennial grass ($\rho = 0.77$) and native forb cover ($\rho = 0.30$), but less cheatgrass cover ($\rho = -0.39$) in unburned areas. Burned area native herbaceous dominance (native minus exotic herbaceous foliar cover) correlated with less cheatgrass cover ($\rho = -0.65$) and sagebrush canopy volume ($\rho = -0.34$) in unburned areas and with more perennial grass ($\rho = 0.30$) and sagebrush relative cover ($\rho = 0.39$) in adjacent unburned areas. Postfire site dominance could be of either native or exotic plants where cheatgrass cover on adjacent unburned sites was < about 15%. Native species however, never dominated or increased in dominance where cheatgrass was above 15%. Results suggest that cheatgrass cover before a fire played a strong role in determining postfire plant communities; this suggests management should focus on prefire and postfire management of cheatgrass and litter. Perhaps prescriptions and priorities should be more nuanced on the basis of driving variables of post-fire response hypothesized to be cheatgrass, perennial grass, and shrub abundance.

Hourihan, E., B. W. Schultz and B. L. Perryman. 2018. **Climatic Influences on Establishment Pulses of Four *Artemisia* Species in Nevada**. Rangeland ecology and Management. 71(1):77-86.

View on Science Direct: https://www.sciencedirect.com/science/article/pii/S1550742417300908

Abstract:

Shrub recruitment in arid and semiarid regions often occurs in pulses controlled by specific weather events. Previous research suggested that Wyoming sagebrush in Wyoming is no exception. We examined four species/subspecies of sagebrush in Nevada, in 2009 and 2010, to discover if evidence of recruitment pulses was contained in the annual growth-ring records. Sagebrush species and subspecies occur on a wide variety of ecological sites that require different management strategies. Species included black sagebrush (*Artemisia* nova A. Nelson), Wyoming big sagebrush (*Artemisia tridentata* subsp. *wyomingensis* Beetle & Young), Lahontan sagebrush (*Artemisia arbuscula* subsp. *longicaulis* Winward & McArthur), and low sagebrush (*Artemisia arbuscula* Nutt. ssp. *arbuscula*). Eighty stem sections were collected from each of 24 stands (6 stands per species or subspecies) at different geographic locations along east-west or north-south gradients where each species or subspecies naturally occurred. Annual growth-ring analysis was used to determine the year of establishment and the relationship between recruitment and weather events. Results indicated stand ages and locations were different ($P > 0.001$) among species and subspecies, and years of recruitment were strongly correlated with local and hemispheric weather patterns. Linear and multiple regressions modeled recruitment pulses for all four species. Weather-based predictor variables indicated complex interactions between recruitment and climatic controls. Pacific Decadal Oscillation (PDO) index variables were prominent predictors for all four species at their associated sites. Other important local weather variables included total annual precipitation the year before recruitment, the year of recruitment, and the year following recruitment. In Nevada and the Great Basin, it is imperative that successful sagebrush seeding technologies are discovered and implemented. Ecological restoration and postfire rehabilitation methods should be timed correctly with respect to precipitation patterns (positive phase PDO) and/or designed to mimic conditions responsible for natural sagebrush recruitment.

Cline, N.L., B. A. Roundy and W. F. Christensen. 2017. **Using Germination Prediction to Inform Seeding Potential: I. Temperature Range Validation of Germination Prediction Models for the Great Basin, USA**. Journal Arid Environments. 150:71-81.

View on Science Direct: https://www.sciencedirect.com/science/article/pii/S014019631730229X

Abstract:

Wet thermal germination regression models predict when subpopulations of seeds will germinate based on the summation of thermal time when seedbed soil water potential > −1.5 MPa. Germination rates fit models well at temperatures greater than 5 °C and less than 25 °C, but may not fit as well outside of that range. To better determine accuracy of these models, we quantified and compared seasonal wet degree days (WDD – a measure of thermal time) of sagebrush (*Artemisia* L.) -steppe seedbeds at five temperature ranges for up to 9 yr across 24 sites. Estimated thermal effects of three piñon and juniper (*Pinus* spp. and *Juniperus* spp.) tree removal treatments and three woodland infilling phases at time of tree reduction were also compared. We found that seedbeds sum a majority of WDD between 5 °C and 25 °C. Exceptions amounted to a relatively small percentage (12–20%) of total WDD in a season. Tree infilling or removal added WDD at 0 to <5 °C and 25 to <30 °C on a few sites, but germination models should still be accurate enough to predict germination for many sagebrush steppe sites and also predict the effects of vegetation manipulations on germination potential.

Cline, N. L., B. A. Roundy, S. Haregree and W. F. Christensen. 2017. **Using Germination Prediction to Inform Seeding Potential: II. Comparison of Germination Predictions for Cheatgrass and Potential Revegetation Species in the Great Basin, USA**. Journal Arid Environments. 150:82-91.

View on Science Direct: https://www.sciencedirect.com/science/article/pii/S0140196317302306

Abstract:

Germination models predict germination timing under seedbed water potential and temperature conditions. Using a wet thermal time model for germination prediction, we estimated progress toward germination (PTG) of 31 seedlots (10 species) as a function of hourly seedbed temperature (>0 °C) when soils were above a water potential of −1.5 MPa. Seasonally-summed progress toward germination with a value > 1 indicates that germination will occur for that season. We used near surface (1–3 cm) soil water potential and temperature measurements collected at 24 sites in the Great Basin to determine effects of site, season, and year on PTG. On tree encroached sites, we also determined effects of tree infilling phase at time of tree removal, removal method, and microsite on estimated PTG. Soils were wet and warm enough in early spring, late spring, and fall for PTG >1 indicating potential germination for most seedlots and species on most sites and years. Prescribed burning increased PTG as much as three times more than either tree cutting or mechanical shredding. Germination prediction could help to screen for plant materials adapted to specific sites or assess effects of seed additives or treatments that time germination to maximize seedling survival.

Smith, J. T., J. D. Tack, L. I. Berkeley, M. Szczypinski and D. E. Naugle. 2018. **Effects of Rotational Grazing Management on Nesting Greater Sage-Grouse**. Journal Wildlife Management. 82(1):103-112

View on Wiley Online Library: http://onlinelibrary.wiley.com/doi/10.1002/jwmg.21344/abstract

Abstract:

Grazing by domestic livestock is a ubiquitous land use in the sagebrush (*Artemisia* spp.) biome of western North America. Widespread, long-term population declines in greater sage-grouse (*Centrocercus urophasianus*) have elicited concern about potential negative effects of livestock management practices on sage-grouse populations. We evaluated how recently implemented rotational grazing systems affected sage-grouse nesting habitat quality as part of a large-scale, replicated, natural experiment in central Montana, USA. We used Bayesian methods to assess support for effects of rotational grazing management and rest from grazing on daily survival rates of nearly 500 sage-grouse nests monitored over 6 years, and mixed effects models to test for effects of rotational grazing and rest on vegetation structure. Though nests on rotationally grazed ranches displayed a trend toward greater daily survival rates, the evidence for an effect was weak. There was no evidence that rest from grazing (≥12 months) increased daily survival rates. Furthermore, rotational grazing systems and rest had negligible effects on herbaceous vegetation height and cover relative to other grazing strategies used in the study area. Results do not support the hypothesis that rotational grazing systems or rest from grazing increase nest success in the northern Great Plains. Estimated nest success, however, was comparable to range-wide averages, suggesting concealing cover for nests is unlikely to be limiting growth of this population regardless of grazing strategy. In light of these results and recent research questioning reported relationships between grass height and nest survival, maximization of hiding cover may be overemphasized in grazing management guidelines and policies. Rather, our findings suggest a variety of locally appropriate grazing strategies focused on fundamental range health principles may provide adequate habitat quality for nesting sage-grouse.