Nevada Section Society for Range Management Suggested Reading: Summer 2020
Abstracts of Recent Papers on Range Management in the West

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Nafus, A.M, T.J. Svejcar, and K.W. Davies. 2020. [Native vegetation composition in crested wheatgrass in northwestern Great Basin](#). Rangeland Ecology and Management. 73(1):9-18.

Abstract:

Crested wheatgrass, an introduced perennial bunchgrass, has been seeded extensively on the rangelands of western North America. There is a perception that this species is very competitive and that it forms monoculture or low diversity stands where successfully seeded. However, there is limited information on species composition in sites previously seeded to crested wheatgrass. We measured native vegetation and environmental characteristics in areas seeded with crested wheatgrass across the northwestern Great Basin. Plant community composition within these crested wheatgrass stands was variable, from seedings that were near monocultures of crested wheatgrass to those that contained more diverse assemblages of native vegetation, especially shrubs. Environmental factors explained a range of functional group variability from 0% of annual grass density to 56% of large native bunchgrass density. Soil texture appeared to be an important environmental characteristic in explaining vegetation cover and density. Native vegetation was, for all functional groups, positively correlated with soils lower in sand content. Our results suggest environmental differences explain some of the variability of native vegetation in crested wheatgrass stands, and this information will be useful in assessing the potential for native vegetation to co-occupy sites seeded with crested wheatgrass. This research also suggests that crested wheatgrass seedings do not always remain in near monoculture vegetation states as seedings substantially varied in native vegetation composition and abundance with some seeded areas having a more diverse assemblage of native vegetation. In half the sites, there were five or more perennial herbaceous species and 63% of sites contained Wyoming big sagebrush. Although not exclusively true, species most commonly encountered in crested wheatgrass seedings are those that are able to minimize competition with crested wheatgrass via temporal (i.e., Sandberg bluegrass, annual forbs, annual grasses) or spatial (i.e., shrubs) differentiation in resource use.

Serpe, M.D., A. Thompson, and E. Petzinger. 2020. [Effects of a companion plant on the formation of mycorrhizal proagules in *Artemisia tridenata* seedlings](#). Rangeland Ecology and Management. 73(1):138-146.

Abstract:

Inoculation of seedlings with arbuscular mycorrhizal fungi (AMF) can increase their establishment after outplanting. The success of this practice depends partly on the extent of root colonization and abundance of AMF propagules in the outplanted seedlings. We conducted a greenhouse experiment to investigate the effects of a companion plant, the native grass *Poa secunda* J Presl (Sandberg bluegrass), on the formation of spores and vesicles, AMF colonization, and AMF taxa present in the roots of the shrub *Artemisia tridentata* Nutt (big sagebrush). These effects were tested at two phosphorus (P) fertilization levels, 5 µM and 250 µM. Neither coplanting nor differences in P had an effect on spore density in the potting mix. In contrast, coplanting increased vesicular colonization of *A. tridentata* from 5% to 18%, but only at low P. Differences in P also affected vesicular colonization of *P. secunda,* which was 10% and 30% at high and low P, respectively. Arbuscular colonization of *A. tridentata* was not affected by the treatments and ranged between 12% and 20%. In *P. secunda,* arbuscular colonization was lower but

increased from high to low P. Coplanted seedlings exposed to low P also had the highest levels of total AMF colonization, 70% for *A. tridentata* and 63% for *P. secunda.* On the basis of partial sequences of the 28S ribosomal RNA gene, coplanting did not affect the AMF taxa, which were within the Glomeraceae. In some taxa within this family, root fragments containing vesicles are the main propagules. Particularly in this situation, increases in vesicle density caused by coplanting and low P are likely to facilitate mycorrhization of *A. tridentata* after outplanting, resulting in higher levels of colonization than those naturally occurring in the soil. Such outcomes are critical for assessing the extent to which *A. tridentata* establishment is limited by insufficient AMF colonization.

Hak, J.C. and P.J. Comer. 2020. **Modeling invasive annual grass abundance in cold desert ecoregions of the interior western United States**. Rangeland Ecology and Management. 73(1):171-180.

Abstract:

Invasive annual grasses, primarily *Bromus tectorum,* are a severe risk to native vegetation of the intermountain West. Once established, annual grasses alter natural fire regimes and outcompete natives until, in some places, they become the overwhelming dominant. We developed a regional spatial model encompassing eight ecoregions to indicate the relative abundance of invasive annual grass at five levels of canopy cover. We used field sample data representing invasive annual grass abundance to build and calibrate the model. Explanatory variables, represented as map inputs, included image indices, climate, landform, soil, and human-induced surface disturbance. As a novel modeling approach, we built multiple models based on classes of invasive annual grass cover abundance were developed individually and then combined into a final 90-m pixel resolution model that indicates locations relative to invasive annual grass abundance into classes of < 5%, 5−15%, 16−25%, 26−45%, and > 45% cover. Each component model was validated using held-out sample data, and relative accuracy was 86%, 74%, 62%, 62%, and 60%, respectively, with an overall kappa of 0.773. The Columbia Plateau, Northern Basin and Range, and Snake River Plain ecoregions appear to have the greatest overall proportions (48−62%) mapped within at least one of the invasive cover categories. Overlay of the resulting model with major vegetation types indicated > 50 major vegetation types that are affected by current distribution of annual grasses and are at risk of expansion. Among these, Intermountain Basins, Big Sagebrush Steppe, and Columbia Plateau Steppe and Grassland each consistently scored high for invasive risk where they occur. Spatial models of this type should assist with rangeland restoration and for decisions involving placement of infrastructure, vegetation treatments where further surface disturbance could trigger additional cheatgrass expansion. Options exist for extending this model, using climate projections over upcoming decades, to indicate areas of increasing risk for invasion.

Rinella, M.J., A.D. Knudsen, J.S. Jacobs, and J.M. Mangold. 2020. **Seeding causes long-term increases in grass forage production in invaded rangelands**. Rangeland Ecology and Management. 73(2):329-333.

Abstract:

Seeding is sometimes used in attempts to increase grass forage production in invaded rangelands, but insufficient long-term data prevent determining if seeded grasses are likely to become and remain productive enough to justify this expensive practice. We quantified long-term seeding outcomes in a widespread Rocky Mountain foothill habitat invaded by leafy spurge (*Euphorbia esula* L.) and several exotic grasses. Fourteen yr after seeding, the most productive grass (bluebunch wheatgrass [*Pseudoroegneria spicata* (Pursh) Á. Löve]) produced 900 (100, 12 000) kg ha^{-1} [mean (95% CI)], which was about 70% of total plant community biomass. This result was not greatly altered by grazing according to an unreplicated, grazed experiment adjacent to our replicated ungrazed experiment. Regardless of treatment, *E. esula* gradually became less productive and seeded and unseeded plots produced similar *E. esula* biomass 14 yr after seeding. *P. spicata* reduced exotic grasses about 85%. Our results resemble those of another foothills study of another invasive forb (*Centaurea stoebe* L. ssp. *micranthos* [Gugler] Hayek) and a Great Plains study of *E. esula,* so foothills seeding outcomes seem somewhat insensitive to invader composition, and seeding can increase forage across much of *E. esula's* range. While there is always some risk seeded grasses will fail to establish, our study combined with past studies identifies invaded habitats where seeded grasses have a good possibility of forming persistent, productive stands.

Perryman, B.L., B.W. Schultz, M. Burrows, T. Shenkoru, and J. Wilker. 2020. **Fall-grazing and grazing exclusion effects on cheatgrass (*Bromus tectorum*) seed bank assays in Nevada, United States**. Rangeland Ecology and Management. 73(3):343-347.

Abstract:

Cheatgrass (*Bromus tectorum* L.) seedlings suffer mortality if they do not occupy safe sites that provide establishment requirements. Previous research demonstrated that fall cattle grazing has strong potential for reducing invasive annual grass species dominance in winter-dominated precipitation areas of the Intermountain West. Fall cattle grazing reduces the volume of safe sites through the removal of standing dead biomass in the fall and early winter, when cheatgrass can actively germinate. This study continued an assessment of cheatgrass seed bank characteristics under fall-grazing and grazing exclusion treatments initiated by a previous study. A seed bank assay was organized into a randomized complete block, repeated measure design to assess cheatgrass seed bank characteristics from 2014 to 2017 in central Nevada. Across years, fall-grazed areas had about half the assayed seed bank levels (3 432 ± 2 513 seeds · m^{-2}) of ungrazed areas (7 187 ± 1 569), (P <0.0001). There was also a difference among years with 2015 producing higher assayed numbers in both grazing treatments. Combined plotted data from this and the previous study indicated that after several years of fall-grazing treatments, removal of fall cattle grazing for only 1 yr can result in significant increases in cheatgrass seed bank size. Conversely, reapplication of fall cattle grazing can quickly decrease cheatgrass seed bank potential.

Waldron, B.L., J.K. Sagers, M.D. Peel, C.W. Rigby, B. Bugbee, and J. E. Creech. 2020. **Salinity reduces the forage quality of forage kochia: A halophytic *Chenopodiaceae* shrub**. Rangeland Ecology and Management. 73(3):384-393.

Abstract:

Forage kochia (*Bassia prostrata* [L.] A.J. Scott) is a perennial, halophytic *Chenopodiaceae* shrub adapted to semiarid rangelands and steppes. It is noted for its ability to produce edible forage in saline environments, but the effect of salinity on its nutritive value has not been determined. Therefore, this study evaluated the dose-response of increasing salinity on the forage quality of forage kochia and Gardner's saltbush (*Atriplex gardneri* [Moq.] D. Dietr., a chenopod forage shrub indigenous to the United States). Individual plants were evaluated in hydroponics for 28 days at 0, 150, 300, and 600 mM NaCl. Salt from accumulated ions, minerals, and forage nutritive value were determined using ground shoot samples. Analysis of forage nutritive value is problematic in plants with high salt concentrations, so neutral detergent fiber (NDF) and in vitro true digestibility (IVTD) were also predicted on an ash-corrected dry matter (DM) basis (NDF$_{corrected}$ and IVTD$_{corrected}$). Forage kochia exhibited a dose-response for salt concentration, IVTD$_{corrected}$, and crude protein (CP) as salinity increased. Salt concentrations increased to 19% of DM at 600 mM NaCl, which may reduce voluntary intake by ruminants grazing forage kochia. Results indicated that uncorrected IVTD estimates were inflated as forage kochia IVTD$_{corrected}$ decreased from 65% to 56% with the major change between 300 and 600 mM NaCl. Crude protein did not differ between two forage kochia cultivars but decreased from 26% to 15% between 0 and 600 mM NaCl, whereas Gardner's saltbush CP decreased by only five percentage points as salinity increased. Nonetheless, despite the greater CP sensitivity to salinity level, forage kochia salt concentration was less and digestibility and metabolizable energy (ME) were greater than Gardner's saltbush. Overall, salinity reduced the forage quality of forage kochia, though not as dramatically as for Gardner's saltbush, thus supporting use of forage kochia to improve the forage base of saline rangelands.

Clements, C.D., B.L. Waldron, K.B. Jensen, D.N. Harmon, and M. Jeffress. 2020. **'Snowstorm' forage kochia: A new species for rangeland rehabilitation**. Rangelands. 42(1):17-21.

Abstract:

Forage kochia, (Bassia prostrata) formerly (Kochia prostrata), native to the semi-arid regions of Eurasia has been referred to as "Russian alfalfa" as well as "alfalfa of the desert". Forage kochia was first introduced to the United States in the early 1960s by researchers looking for plant materials that could biologically suppress exotic and noxious weeds, such Halogeton (Halogeton glomeratus) and cheatgrass (Bromus tectorum). Crested wheatgrass (Agropyron cristatum) was widely planted on big sagebrush sites throughout the Great Basin and successfully suppressed Halogeton and cheatgrass, however crested wheatgrass lacks the ability to persist on saline soils, therefore scientists proposed the use of forage kochia as a candidate species on these soils. Forage kochia is a perennial semi-shrub that has the inherent potential to germinate and establish on a variety of soils including, clay, sandy, and loamy as well as in climates that range from 5-27" of annual precipitation. Forage kochia persists under heavy grazing, as it evolved in heavily grazed arid environments, as well as the ability to resprout following wildfires. For

centuries, forage kochia has been an important fall and winter forage for cattle, sheep, horses, camels and wildlife in Kazakhstan, Uzbekistan, and surrounding regions. Early on researchers recognized its' nutritional quality, including 8-14% crude protein in the fall and early winter, therefore suggesting this species be used to improve winter forage for wildlife, especially mule deer (Odocoileus hemionus). In 1984, the cultivar 'Immigrant' forage kochia (Bassia prostrata ssp. virescens) was released to aide in rangeland rehabilitation efforts. 'Immigrant' forage kochia can reach plant heights ranging 1-3', competes with the exotic and invasive annual grass cheatgrass (Bromus tectorum), stays green throughout the fire season and provides a nutritional forage on arid rangelands. 'Snowstorm' forage kochia was released in 2012 by USDA-Agricultural Research Service and the Utah Agricultural Experiment Station as a rehabilitation species to improve forage production for livestock and wildlife in semi-arid saline environments. 'Snowstorm' forage kochia is similar to 'Immigrant' in its' adaptation to the semi-arid environments, but 'Snowstorm' is more pubescent and grayish in color than 'Immigrant', which is green and turns reddish during seed maturity. 'Snowstorm' is more than 60% taller in stature, produces nearly 70% more forage, and has higher crude protein and digestibility than 'Immigrant. As wildfire frequencies have increased, the ability to restore native perennial species back into these habitats has been extremely challenging and largely unsuccessful, in which many resource managers have given up on these degraded rangelands. However, the use of forage kochia in greenstrips and rehabilitation seedings to break up fuel continuity, especially on cheatgrass dominated rangelands, is well documented as a rangeland rehabilitation tool that not only reduces the rate and spread of wildfires, but also protects against further loss of browse communities. 'Snowstorm' forage kochia provides resource managers with an added tool to increase grazing resources and wildlife habitat by improving the nutritional quality of degraded rangelands year-around.

Bateman, T.M., J.J. Villalba, R.D. Ramsey, and E.D. Sant. 2020. **A multi-scale approach to predict the fractional cover of medusahead (*Taeniatherum caput-Medusae*)**. Rangeland Ecology and Management. 73(4):538-546.

Abstract:

Medusahead is an aggressive, winter annual that is of dire concern for the health and sustainability of western rangelands in the United States. Medusahead reduces plant diversity, alters ecosystem function, and reduces carrying capacities for both livestock and wildlife. The species has competitive advantages over cheatgrass and native grasses that causes an increased amount of fine fuels deposited on western rangelands. The Channeled Scablands of eastern Washington in the United States represent a typical example of a region being challenged by the expansion of this weed. The costs of the invasion are high and financial constraints can limit successful management. Managers need the ability to identify medusahead across entire landscapes, so they can work towards effective and efficient management approaches. Remote sensing offers the ability to measure vegetation cover at large spatial scales, which can lead to a better understanding of the invasive characteristics of problematic species like medusahead. For instance, research has been successful in creating large-scale distribution maps of cheatgrass over western rangelands. Many applications rely on the phenological characteristics of a target plant which can present problems in separating two species with similar phenologies (i.e. cheatgrass & medusahead). A medusahead-specific map gives managers the flexibility to prioritize and direct management needs when attempting to control the spread of medusahead into non-invaded areas. This study integrated GPS acquired field locations from three study sites (Sites S, C, & N) and imagery from two remote sensing

platforms (1-m aerial imagery & 30-m Landsat), to model and predict fractional cover of medusahead over 37,000+ ha of rangelands in the Channeled Scabland region of eastern Washington. Using a multi-scaled approach, this research showed that regression tree algorithms can model the complex spectral response of senesced medusahead using late summer Landsat scenes. The predictive performances resulted in a R^2 of 0.80 near the model's training site (Site S) and an average R^2 of 0.68 away from the training site (Sites C & N). This research provides a non-phenological approach to produce accurate large-scale, distribution maps of medusahead which can aid land managers who are challenged by its invasion.

Jimenez, A., J. Schmalz, M.N. Wright, and M.M. Skopec. 2020. **Sagebrush characteristics influencing foraging patterns of pigmy rabbits**. Journal Wildlife Management. 84(6):1-9.

Abstract:

The pygmy rabbit (*Brachylagus idahoensis*) is endemic to the sagebrush steppe landscapes in the western United States. Pygmy rabbits have adapted to this region by depending on big sagebrush (*Artemisia tridentata*) as a source of nutrition and concealment from predators. Being a central place forager, and a dietary specialist makes pygmy rabbits an ideal subject to study foraging tradeoffs. Our objectives were to determine if pygmy rabbit foraging patterns are influenced by the nutrient content of individual sagebrush, or the size and location of individual sagebrush. We first developed a near infrared spectroscopy assay that can be conducted in the field, with whole plant foliage, to determine individual sagebrush crude protein (CP) and acid detergent fiber (ADF) contents. We then measured the size, location, protein, and fiber contents of >1,500 foraged and non-foraged sagebrush plants surrounding pygmy rabbit burrows in 2 field sites in northern Utah, USA. We found significant site differences in sagebrush CP levels and significant season differences in sagebrush ADF levels; sagebrush closer to central burrows were higher in protein and lower in fiber. Pygmy rabbits preferred to forage on taller sagebrush plants that were closer to the central burrow but only marginally higher in CP (0.2%) and lower in ADF (1%). Sagebrush plants with a >50% chance of being foraged, were <5.6 m from the burrow, >0.67 m tall, >10.4% CP, and <34.95% ADF. The selection of closer, larger, and more nutrient-dense sagebrush may be influenced by pygmy rabbits' need for concealment from predators or a way to minimize foraging effort.

Eckrick, C.A., P.K. Coe, D.A. Clark, R.M. Nielson, J. Lombardi, S.C. Gregory, M.J. Hedrick, B.K. Johnson, and D.H. Jackson. 2020. **Summer habitat use of female mule deer in Oregon**. Journal Wildlife Management. 84(3):576-587.

Abstract:

Mule deer (*Odocoileus hemionus hemionus*) populations have been declining throughout their range and loss or deterioration of habitat has been associated with observed trends. An understanding of the relative importance of landscape characteristics in affecting mule deer distribution will allow wildlife managers that alter habitat to make predictions regarding future use by mule deer, which is likely to influence mule deer population size and recruitment. We radio-marked 376 adult female mule deer with global positioning system-collars from 2006–2012 in south-central Oregon, USA, to evaluate summer habitat

use. We used multiple linear regression to develop a resource utilization function (RUF) model for mule deer to relate landscape characteristics to the height of a utilization distribution estimated with a Brownian bridge movement model. We validated the predictive capacity of the RUF model with locations from an independent dataset of 95 deer that summered within our study area. Our best model describing mule deer habitat use included 5 covariates: overstory canopy cover, slope, distance to forest edge, distance to intermittent or perennial streams, and distance to dirt roads. Predicted intensity of use peaked at roughly 40% canopy cover and decreased with increasing slope and distance from forest edge. Predicted use was greater closer to streams and decreased, albeit slightly, with increasing distance from dirt roads. Model validation revealed our model predicted summer habitat use by mule deer very well. Our results provide a basis for predicting effects of future land management actions on mule deer habitat use on summer range. Forest management prescriptions that maintain canopy cover around 40% and create forest edge may benefit mule deer in south-central Oregon and other forested ecosystems, particularly if these prescriptions are implemented on areas with gentle slopes and access to streams.