

ABSTRACTS

1. ASSESSING WILDFIRE, INVASIVE ANNUAL GRASS, AND CONIFER EXPANSION THREATS IN GREAT BASIN SAGE-GROUSE HABITATS. Mike L. Pellant*¹, Tom Rinkes²; ¹BLM, Boise, ID, ²BLM (retired), Boise, ID

ABSTRACT

Wildfire, conversion of sagebrush habitat to invasive annual grasses, primarily cheatgrass (*Bromus tectorum*), and conifer expansion are primary threats to the sustainability of Greater Sage-Grouse (*Centrocercus urophasianus*, hereafter sage-grouse) in the western portion of the species range. The determination on whether sage-grouse will be listed as a threatened or endangered species will be based in part upon information contained in Bureau of Land Management (BLM) and Forest Service land use plans. A Fire and Invasive assessment protocol has been developed as part of this planning effort to assist in prioritization of funding and management strategies to conserve or restore important habitat. Management strategies are types of actions or treatments and are divided into proactive approaches (e.g., fuels management and habitat recovery/restoration) and reactive approaches (e.g., fire operations and post-fire rehabilitation). This assessment is based in part on National Resources Conservation Service soil surveys that include geospatial information on soil temperature and moisture regimes which are associated with resistance to invasive annual grasses and resilience after disturbances. Percent of landscape cover of sagebrush and areas of high sage-grouse breeding bird densities are also important components in the assessment. The assessment process includes two steps: 1) Important Priority Areas for Conservation (PACs) and focal habitats are identified and potential management strategies (described above) are discussed. 2) Local land management units work together to address threats in or near focal habitat areas. Local information and geospatial data are collected and evaluated to improve on Step 1 geospatial data. Activity/implementation plans are then developed that include prioritized management tactics and treatments to implement effective, fuels management, habitat recovery/restoration, fire operations, and post-fire rehabilitation strategies. The assessment encourages a collaborative approach working across management boundaries to address common threats to sage-grouse habitat.

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2. OVERCOMING BARRIERS TO COMMUNICATING SCIENCE TO NONSCIENTISTS: A SUCCESS STORY FROM THE SAGE GROUSE INITIATIVE . Deborah Richie*; Sage Grouse Initiative, Missoula, MT

ABSTRACT

Why is it that nonscientists have a way of glazing over when an exuberant scientist proudly shows charts, graphics with clusters of dots and explains them with terms like ecosystem resilience, resistance, biophysics, moisture regimes, and dataset aggregations? Scientists are simply speaking a different language, easily slipping into jargon and their comfort zones surrounding data. They forget that most charts are forgettable, but a photo is worth a thousand charts. The Sage Grouse Initiative, achieving wildlife conservation through sustainable ranching, is both science-driven and a partnership of the people. In this session, we'll share our success stories of how we've overcome those barriers through a "Science to Solution" series of articles, rancher series, on our website (www.sagegrouseinitiative.com), and through linking science to the wildlife, ranches, and narratives of westerners on the land making a difference.

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3. TELL ME A STORY: USING NARRATIVE TO SELL YOUR FACTS. Lori Hidinger*; Arizona State University, Tempe, AZ

ABSTRACT

Stories have engaged humans throughout history—just think of the rich treasury of legends, folklore, and myths from cultures around the world designed to teach moral and societal lessons. The human brain has an affinity for narrative—it actually remembers more from narrative than other styles of writing. Narrative, or creative, nonfiction is a growing method for experts to share their knowledge in a way that readers can embrace. It balances substance with style and uses stories to engage readers and convey facts. In this portion of the workshop, we will explore narrative nonfiction, its use of scenes, and the balance of the creative and the factual. And most importantly how participants can integrate narrative into their nonfiction writing.

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4. FROM COMMUNICATION TO ENGAGEMENT: STRATEGIC RELATIONSHIP-BUILDING WITH SOCIAL MEDIA. Faith R. Kearns*; University of California, Berkeley, CA

ABSTRACT

When it comes to science communication, social media use can be an overwhelming topic. It's clear that as we move away from primarily one-way communication models, social media can be a helpful tool for engaging directly with various communities. But, once you've signed up for the accounts, what comes next? How much time should you invest in what can be a never-ending stream of content and conversation? One guiding principle that can be helpful is strategically investing in social media with an eye toward relationship-building. In this session, we will talk about some

conceptual ideas of community engagement using social media, but we will also get into the nuts and bolts of building online networks, from content development to using social media as a listening tool to how to effectively manage your accounts (and energy) through lists and other management strategies. It's helpful to know that social media presents an opportunity to experiment with science communication and outreach; finding what works for yourself and your goals is an ongoing process.

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5. IMPACTS OF BRINE ON SOIL AND VEGETATION IN THE BAKKEN REGION OF WESTERN NORTH DAKOTA. Hannah A. Tomlinson*, Aaron W. Klaustermeier, Ryan F. Limb, Aaron L. Daigh, Kevin K. Sedivec; North Dakota State University, Fargo, ND

ABSTRACT

Brine contamination is an anthropogenic disturbance that stalls natural successional processes. Climate, hydrology, and mineralogy influence salt movement within the soil profile. Semi-arid to arid climates of western North Dakota are characterized by their lack of water availability, which prohibit salts from leaching beyond depths that allow seed germination and propagation of plant roots. Positively charged NaCl ions bind tightly to negatively charged clays that affect the soil water's osmotic energy potential, inhibiting the plants ability to uptake water and nutrients. Inevitably less salt tolerant species become stressed from the lack of available water and nutrients, unable to carry-out their natural physiological functions to survive. In the absence of remediation techniques, salts from spills related to energy development in the Bakken region can remain in the soil profile for decades, significantly reducing soil and plant productivity. Spill sites will remain barren until the chemical stressor is reduced or removed. The purpose of this study is to collect quantitative insight on plant and soil parameters to help create best management practices to remediate land affected by brine spills and to reinforce the problems that occur when land is not reclaimed. We sampled seven unreclaimed brine spill sites in western North Dakota in August, 2014. Brine spill sites ranged from recent (less than five years) to 40+ years. Soil bulk density, core samples, and electrical conductivity along with vegetation composition and biomass data was collected along a brine gradient, starting at the center of the spill and extending beyond the spill boundary. Analysis of soil samples will be used to determine the characteristics of brine contamination. Data from the analysis will be used to determine brine tolerances of native and introduced species.

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6. LINKING SEED BANK COMPOSITION TO OIL AND GAS PIPELINE DISTURBANCE IN SOUTHERN ALBERTA'S MIXEDGRASS PRAIRIE. Lysandra A. Pyle*, Edward W. Bork, Linda Hall; University of Alberta, Edmonton, AB

ABSTRACT

Disturbances such as pipelines, roads and well sites can function as entry points for invasive species and through

subsequent seed dispersal provide an opportunity for spread into adjacent native grasslands over time. In theory, seed bank presence and subsequent establishment of invasive plants will be a function of distance from disturbance, propagule dispersal ability and time since establishment. Where distance from disturbance increases over time for both plant establishment and seed bank. Invasive species of concern include: *Agropyron cristatum*, *Poa pratensis*, *Sonchus arvensis* and *Melilotus* spp., among others. Invasive cool season grasses along with *Melilotus* spp. growing in a linear feature are often visual indicators of pipeline disturbance. Here we report on the seed bank composition associated with field surveys of energy developments on the University of Alberta Mattheis Research Ranch, a property with more than 150 well sites connected by pipelines. A total of 18 pipelines were visually identified and sampled. Sampling of each location used a series of sixteen 55 m long transects oriented perpendicular to the pipeline. A higher sampling resolution was used adjacent to the pipeline, which then declined with distance. Cores 6 cm deep were collected and bulked by distance. Soil was placed in a greenhouse and monitored for seedling germination for 12 months. In addition, vegetation composition was sampled along every third transect. Seed bank and vegetation will be compared to identify the extent of seed bank invasion relative to the current plant community. These results will provide information on the risk of invasion by non-native species associated with existing pipelines.

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7. THE FUTURE: COMBINING ENERGY PRODUCTION WITH RANGELAND CONSERVATION. Katie R. Tierney*¹, LynneDee Althouse¹, Daniel E. Meade¹, Royce Larsen², Jacqueline E. Tilligkeit¹, Jason Dart¹; ¹Althouse and Meade, Inc., Paso Robles, CA, ²UC Cooperative Extension, Templeton, CA

ABSTRACT

Alternative land use demands on rangelands are increasing as suburban expansion and energy development continue to rise. Land managers, owners, ranchers, and future energy developers need to work together to preserve rangeland production and the native species that rely on this habitat. Topaz Solar Farms, located on the Carrizo Plain in California exemplifies a successful partnership between agriculture, habitat conservation, and energy production. This 4,700-acre, 550-megawatt passive photo-voltaic solar farm is currently one of the largest solar projects in the world. Construction practices minimize environmental impacts while preserving natural resources, endangered species habitat, and existing agricultural land uses. Monitoring studies found that native plant species occur more frequently in array fields than on reference sites. Average vegetation height is significantly greater in arrays compared with control sites. In 2014, grazing within 3,348 acres of fenced arrays supported over 1,000 head of sheep for 105 days (average stocking rate of 37 sheep per acre) while aiding in habitat management for endangered species, invasive weed control, and fire fuel reduction. Monitoring tracks the federally listed San Joaquin kit

fox and state protected American badger within completed solar array fields. Site design preserves pronghorn antelope and other animal movement corridors. Topaz Solar Farms is an example for future energy projects of how collaboration between agencies, ranchers, conservationists, and developers can combine sustainable energy production, rangeland conservation, and rare species protection.

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8. THINKING SMALL: ARGUMENTS FOR LOCAL MANAGEMENT OF DIVERSE DAIRY CATTLE SYSTEMS. Belinda Richardson, Owen G. Cortner*, John Short; University of California Davis, Davis, CA

ABSTRACT

While the United States has built its current dairy industry by aggregating farms, often pasture-based, into larger operations on concentrated feedlots, countries around the world have very different approaches to owning and managing herds. Whether through the persistence of traditional practices, cultural evolution through social change or outside influence, or the infusion of new scientific knowledge, dairy production systems are as varied as the languages and cultures of the individuals who engage in them. In Morocco, large numbers of three-cow farms produce 90% of the country's domestic milk supply and employ 70% of its population. Farmers are considering rain-fed sorghum and legume silage mixes instead of thirsty corn. In the northern highlands of Nicaragua, dairies struggle with delayed rainfall and poor market connections but have opportunities for improved silvopastoral management. Each place and system may hold an important lesson that can be adapted and used in another part of the world. Climate change, a growing global middle class that demands more meat and dairy products, and pressures on available grazing land necessitate not only diverse approaches, but sharing and adapting those approaches to improve efficiency, protect natural resources, and sustain livelihoods. Consumer demand for grass-fed dairy and beef products is changing the way that land is managed in the United States. The challenges and successes of smaller scale producers around the world could help inform these changing management practices. A contrasting case study of small dairy producers in Nicaragua and Morocco highlights ways this process can happen.

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9. "BULL WHISPERING" IN SWITZERLAND: LOW STRESS HALTER BREAKING FOR BEEF CATTLE. Regina Dahl*¹, Edward W. Bork², Carl Brandenburger³; ¹University of Alberta, St. Albert, AB, ²University of Alberta, Edmonton, AB, ³Plantahof, Landquart, Switzerland

ABSTRACT

The safe, efficient and humane handling of bulls is an important component of managing both commercial cow/calf operations and purebred animals intended for show and sale. In this presentation, we provide an overview of a novel method used for 'taming' breeding bulls. This method, used

*Presenter

by Carl Brandenburger, manager of the 'Plantahof' agricultural school in Switzerland, uses an innovative approach to halter break cattle. The approach is modelled after that used by Monty Roberts on horses but is adapted to the behavior of beef cattle. The process achieves low stress halter braking in only 10 steps, and can easily be performed by most experienced livestock handlers. The result consistently allows most young breeding bulls to be halter broke within less than 30 minutes. Further repetition of halter leading exercises will make most animals ready for handling or auction without exposing them to high stress situations. This poster provides beef cattle producers with guidance on how to get their animals trained for handling and presentation with a low stress approach.

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10. CATTLE PRODUCTION IN ARID AND SEMIARID RANGELANDS IN SONORA, MEXICO: 2000-2012. Francisco G. Denogean B.*¹, Felix Ayala², Salomon Moreno-Medina³, Fernando A. Ibarra-Flores⁴, Martha H. Martin-Rivera³; ¹Universidad de Sonora, Santa Ana, Sonora, Mexico, ²Universidad de Sonora, Santa Ana, Mexico, ³University of Sonora, Santa Ana, Mexico, ⁴University of Sonora, Hermosillo, Mexico

ABSTRACT

The state of Sonora has the second largest area in Mexico with nearly 18.5 million ha; of these, approximately 51.5% is arid and 35.9% is semiarid region. The main use of these almost 16 million ha is extensive cattle production. Sonora's cattle production has traditionally maintained in the top five nationwide; however, in recent years, it has fallen to eighth place. Statistical information from the state of Sonora was analyzed from various sources for the total production in live weight (LW), number of cattle produced in Sonora, and annual average precipitation during the years of 2000 to 2012. Our results indicate that the average number of head produced annually was 441,446; 196,098 in semiarid and 148,871 in arid rangelands. Total LW was 130,326 tons; 51,266 tons in semiarid and 56,056 tons in arid rangelands. The annual average precipitation for the state was 423.4 mm; 315.9 mm in semiarid and 261.4 mm arid rangelands. The amount of LW per hectare produced was 9.224, 7.187, and 5.964 kg/LW/ha for the state, semiarid and arid rangelands, respectively. It is advisable to continue this type of work considering the Stocking Rate Coefficients, annual precipitation, production levels, overgrazing and its impact on the vegetation of these regions.

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11. EFFECTS OF ROLLER CHOPPING ON NATIVE HERBACEOUS VEGETATION IN THE SONORAN DESERT. Felix Ayala*¹, Francisco G. Denogean B.², Ana Bertha Martinez-Duran¹, Salomon Moreno-Medina³, Luis Ernesto Gerlach-Barrera¹; ¹Universidad de Sonora, Santa Ana, Mexico, ²Universidad de Sonora, Santa Ana, Sonora, Mexico, ³University of Sonora, Santa Ana, Mexico

ABSTRACT

Brush management techniques are widely applied on rangelands for multiple objectives; two common objectives are to increase forage production for livestock and to maintain healthy wildlife habitat. Our objectives were to determine the effects of implementing a roller chopper on habitat productivity for native wildlife; and to determine the effects of roller chopping on the native herbaceous vegetation on previously disturbed and undisturbed desert scrubland communities. The study was conducted in the southern end of the Sonoran Desert in the state of Sonora, Mexico. The experimental design was a randomized complete block with three replications. Treatments evaluated were: roller chopping, roller chopping on previous cleared areas, previous cleared areas, and control. Response variables included canopy cover of woody plants, canopy cover of herbaceous plants and native species richness. There was a multivariate main effect among treatments for the dependent variables total canopy cover of herbaceous plants, litter, and bare ground. Variables that contributed to the significant overall effect included litter and total herbaceous cover. The indicators of roller chopping as a management practice in the desert scrubland are reflected by providing sites of increased herbaceous vegetation for wildlife. This contributes to the continuity of the biological processes in the ecosystem and the specimens that cohabit in it.

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12. ECOLOGY AND MANAGEMENT OF THE PALM BRAHEA ACULEATA IN DRY FOREST RANGELANDS OF SONORA, MEXICO. Leonel Lopez-Toledo¹, Franceli Macedo-Santana², Carlos Espinoza-Hidalgo², Christa M. Horn³, Bryan A. Endress*⁴; ¹Universidad Michoacana de San Nicolás de Hidalgo, Morelia, Mexico, ²Universidad Michoacana de San Nicolás de Hidalgo, Michoacan, Mexico, ³Institute for Conservation Research, Escondido, CA, ⁴Oregon State University, La Grande, OR

ABSTRACT

The use of non-timber forest products (NTFPs) has great potential for the conservation of natural resources and rural development. Palms are important NTFPs, providing numerous products, including leaves. The harvest of palm leaves rarely results in the immediate death of individuals and can be considered one example of the sustainable use of forest resources. However, in most cases basic ecological information, such as the distribution and abundance of the species is unknown, as is information on the ecological implications of human impacts, such as leaf harvest and livestock grazing. In the tropical dry forests of north-

west Mexico, leaves from the threatened palm *Brahea aculeata* are harvested for roofing material and represent an important NTFP. In this study, we assessed the distribution and abundance patterns of this species across 52 plots in the tropical dry forest of Sierra de Álamos-Rio Cuchujaqui Reserve in Sonora, Mexico. We also evaluated patterns of leaf harvest and cattle browse intensity on palm populations. We found that *B. aculeata* density is highly variable across the landscape with a mean of 121.7 ha⁻¹. Results indicate that *B. aculeata* is primarily distributed near arroyos and rivers. The highest densities were found in sites with low incidence radiation and narrow stream width in arroyos/rivers (<9.5 m). Overall, fewer than 6% of the stems were seedlings. Leaf harvesting and browsing appear to affect the demographic vital rates of the species; specifically we found a significant negative effect of harvesting and browsing on smaller palms, and positive effects on growth and leaf production for larger individuals. Additionally, we found the highest germination and establishment rates were adjacent to the streams in areas which had the lowest light intensity and temperatures, and highest humidity. Results indicate the distribution, abundance of populations are influenced by several factors including seed predation/removal, micro-environmental variables, livestock grazing and leaf harvest.

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13. THE SKINNY COW PROBLEM: STRATEGIES FOR IMPROVING RESOURCE USE FOR DAIRY PRODUCTION IN DEVELOPING COUNTRIES. Belinda Richardson*, Owen G. Cortner, John Short; University of California Davis, Davis, CA

ABSTRACT

It is well known that feeding a lactating dairy cow only enough to meet her maintenance requirements is like driving an empty delivery truck. The added marginal benefit of every kilogram of feed after maintenance requirements are met is where one gets a return on their - and the planet's - investment. This can result in a natural resource drain, especially in developing countries, where agricultural extension services and pocketbooks are limited, that stems from an unavailability of adequate cattle forages and feeds. These inadequacies have diverse causes: climate change limiting the amount of water available to grow feed crops and water cattle; poverty traps which prevent farmers from purchasing proper amounts of nutrition for calves, heifers and lactating dairy cows at critical stages; government programs that do not fully address the ecological and production impacts of placing dairy cows in regions not well-suited to large herbivores; and overstocking and overgrazing of limited rangeland, with increasing suburban and urban populations demanding more milk and milk products. A nutritional balance of available feeds and forages to dairy cattle requirements in a northern Nicaraguan community illustrates the need for systems thinking and adaptability in rural anti-poverty programs, which, in this case, depend heavily on grazing. An economic analysis of milk value chains in Morocco shows overstocking driven by high beef prices and the cash needs

of small dairy farmers. Financial constraints prevent farmers from fattening calves optimally and selling for the highest profit. This comparative case study demonstrates problem-solving options for meeting dairy cow nutrition needs in resource-limited contexts.

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14. BIODIVERSITY AND SPECIES RICHNESS ASSESSMENT OF DUAL PURPOSE FARMS IN A SUBTROPICAL REGION OF MEXICO. Benito Albarran-Portillo*¹, Carlos M. Arriaga-Jordan², Anastacio Garcia-Martinez², Rolando Rojo-Rubio², Francisca Aviles-Nova²; ¹UAEM, Toluca, Mexico, ²Universidad Autonoma del Estado de Mexico, Toluca, Mexico

ABSTRACT

Dual purpose production systems (DP) in Mexico in general is characterized by beef and milk production under extensive management conditions. However they are quite diverse in terms of location, farmer socioeconomic characteristics, management, scale, production orientation, performance, and how they use natural resources. The aim of this study was to assess the effects of DP farms according to their productive orientation (PO) on vegetal diversity indices (Margalef and Menhinick) and, species richness (Shanon-Weinner and Simpson), of rangelands in Zacazonapan Municipality, southwest of the State of Mexico, Mexico. From previous studies using multivariate analysis, four groups of DP farms were identified according to their PO: i) milk production oriented (DPM); ii) beef production (DPB); iii) calf production (DPC) and, i) traditional DP (DPT). During 2010, three farms from each group were visited in order to conduct ten transects (50 x 2 m), with the objective of determining diversity and richness indices. In general, a farm's rangelands are comprised of grazing areas with native and introduced grasses, crop areas, other herbaceous areas, brush and dispersed tropical trees. DPMs had the highest score (3.95) in Margalef index, whereas DPT had the lowest score (3.63). Regarding the Menhinick index, DPC had 1.68 (highest) while DPT scored the lowest with 1.11. DPM registered the lowest score (3.00) in Shanon-Weinner index; and DPC scored the highest (3.53). Finally, the Simpson index ranged between 0.72 (DPB) to 0.87 DPC. In general DP farms with different productive orientations showed high values in the two diversity indices, as well as the two richness indices evaluated, indicating the environmental sustainability of DP farms in the study region.

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15. PERFORMANCE OF GOATS AND SHEEP GRAZING IN BRAZILIAN SEMI-ARID RANGELANDS WHEN SUPPLEMENTED WITH PROTEIN BLOCKS. Aldo Sales*¹, Maria Gracas Gomes², Carlos Villalobos¹, Maria Lourdes Herminio Oliveira²; ¹Texas Tech University, Lubbock, TX, ²Agricultural Research Corporation of the State of Paraiba, Soledade, Brazil

ABSTRACT

A question of Brazilian ranchers is to identify the genotype of sheep and goats that will be most productive when finished on native rangeland in the semi-arid region (Caatinga) of northeast Brazil. Therefore, the performance of lambs and kids supplemented with protein blocks was evaluated under grazing/browsing on Brazilian Caatinga scrubland conditions. Forty non-castrated males with an initial average body weight of 19.3± 1.9 kg were used: 20 goats (10 Savana breed and 10 Boer breed) and 20 sheep (10 Santa-Inês breed and 10 Dorper breed). The experimental design was a complete randomized block with four treatments and ten replications. The animals were allowed to graze in the Caatinga until they achieved 30 kg of body weight. The available forage in the pastures was 1015 kg DM-1 ha⁻¹ and forage quality was DM=46.37%; CP=11.37% and NDF=47.53%. The animals were supplemented ad-libitum with the protein block (DM=89%, CP=24% and ME=2.4Mcal). Blocks composition was: 31% molasses, 5% urea, 18% corn, 4% soybean, 5% salt, 2% mineral-mix, 9% hydrated lime and 26% malt. The stocking rate of each pasture was determined using the forage available at the beginning of the study and 60% of utilization. Animal performance was evaluated using Average Daily Gain (ADG) data. The Dorper breed had a greater ADG (P>0.05) than the Santa-Inês breed, (151 and 114 g day⁻¹, respectively). Supplemental block intake was 151.6 g day⁻¹ and 240 g day⁻¹. for Dorper and Santa-Inês respectively. The Boer goats were superior to the Savana breed in ADG (130 and 92.8 g day⁻¹, respectively). Boer goats consumed 281 g day⁻¹, whereas, the Savana goats consumed 188 g day⁻¹ from the supplemental block. The variables evaluated in this research, showed that performance of the Dorper sheep and Boer goats was greater (P>0.05) than that of the Santa-Inês sheep and Savana goats. Therefore, Dorper (sheep) and Boer (goats) are the genotypes recommended for finishing when supplemented with Feed-block under grazing/browsing in the Caatinga ecosystem in northeast Brazil.

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16. ECONOMIC AND SOCIAL ATTRIBUTES OF PUBLIC LANDS RANCHERS. Brianne N. Lind*¹, John A. Tanaka¹, Kristie Maczko²; ¹University of Wyoming, Laramie, WY, ²Sustainable Rangelands Roundtable - University of Wyoming, Laramie, WY

ABSTRACT

Public lands ranchers make essential social and economic contributions to many rural communities across the United States. Numerous challenges face ranchers utilizing public

lands potentially causing associated challenges in community settings. To meet these challenges, reliable social and economic data describing public lands ranchers is needed to help inform decision-making on public lands. Therefore, the focus of this survey is to determine how public lands ranchers contribute to the structure and function of their local communities. Survey data also will provide baseline social and economic information that can be used by decision makers. This study will use a mail survey, administered in January 2015, to obtain social and economic data needed for analyses. Approximately 2,000 public lands ranchers will be surveyed in order to obtain statistically valid data. Prior to receiving and analyzing survey results, it is challenging to predict what the survey outcomes will be. However, it is anticipated that public lands ranchers are important contributors; and potentially an essential part of the socio-economic structure of rural communities nationwide. The results of this survey will be published in peer-reviewed literature accessible to federal agencies like the Bureau of Land Management and the U.S. Forest Service for use in socio-economic sections of their decision documents. Other decision makers and public lands advocates will also be able to use the information to influence public land policies and management. All who value public lands are affected by decisions made regarding management. Therefore it is essential that we gather information on all public land resource aspects-social, economic, and ecological- if we are to make well-informed decisions on public land use. This survey is a start toward having statistically valid data to aid in the public lands management decision-making process.

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17. THE ECONOMICS OF RARAMURI CRIOLLO VERSUS BRITISH CROSSBRED CATTLE PRODUCTION IN THE CHIHUAHUAN DESERT. Jose M. Diaz^{*1}, L. Allen Torell², Rick E. Estell³, Alfredo Gonzalez³, Andres F. Cibils², Dean M. Anderson³; ¹NMSU, Las Cruces, NM, ²New Mexico State University, Las Cruces, NM, ³USDA-ARS, Las Cruces, NM

ABSTRACT

Preliminary research indicates Raramuri Criollo cattle may range significantly further and forage in areas where traditional breeds rarely venture. These small-frame animals are well adapted to harsh environments and maintain productivity with minimal inputs and supplementation. The objective of this research was to compare the economics of range-fed beef production with Raramuri Criollo cattle versus production of Hereford X Angus (H x A) cattle typically found on Chihuahuan Desert ranches. Enterprise budgets were developed for a 150 AU ranch using production and cost data for herds maintained at the USDA Jornada Experimental Range near Las Cruces, NM. Based on limited studies about differences in forage requirements, animal foraging behavior, grazing distribution and forage use, we assumed the Criollo herd could be maintained at 180 AU, a 20% increase. With 2009-2013 average real beef prices, net returns from Raramuri Criollo cattle production was found to be 30% higher than H x A production (\$22,085 versus

\$16,978). The assumed 20% increase in stocking rate was a major factor in the net return increase. Total cash costs were estimated to be 64% less for Criollo production (\$265/AU versus \$411/AU). Notable cost differences included supplemental feed costs (\$42/AU versus \$128/AU) and veterinary, medicine and vaccine expenses (\$6/AU versus \$28/AU). The major factor favoring Criollo production was a strong demand for breeding animals with all Criollo heifers sold as bred heifers in the budget comparison. A limitation for Raramuri Criollo production was the extended period required to produce marketable range-fed animals. The typical cow/calf ranch sells calves after 8 months, requiring about 1.35 AU/mature cow. By comparison, Criollo steers graze for 30 months and heifers for 24 months before sale. The smaller Criollo animals have a reduced forage requirement but the extended grazing period increases the total forage requirement to about 2 AU/mature cow.

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18. ADVANTAGES OF EARLY WEANING IN RANGELANDS OF NORTHWESTERN MEXICO: A RANCHER EXPERIENCE. Salomon Moreno-Medina^{*1}, Martha H. Martin-Rivera¹, Jesus Fimbres-Preciado², Fernando A. Ibarra-Flores³, Francisco G. Denogean B.⁴; ¹University of Sonora, Santa Ana, Mexico, ²Rancher, Hermosillo, Mexico, ³University of Sonora, Hermosillo, Mexico, ⁴Universidad de Sonora, Santa Ana, Sonora, Mexico

ABSTRACT

Severe and continuous droughts in the Sonoran desert have induced ranchers in the last several years to be more efficient in applying proper range management and beef production tools. This study was conducted from 2010 to 2012 in Rancho Grande at Carbo in Central Sonora, Mexico to evaluate the benefits of using early weaning to reduce drought risk and increase beef production and profitability. We compare cattle performance of two herds stocked in two different contiguous pastures planted with buffelgrass. Each herd was 100 head of mature Charolaise and Charbray crossbred cows, with similar age and body condition. Animals in both herds had sufficient forage, water and free minerals. In one herd all newborns were allowed to continue with the cows during six months until weaning (control), while in the other herd calves were removed from the cows at three months of age and fed in corrals for the following three months. All cows remained in the pastures with the bulls. We evaluated calf daily gains, cow conception rates, postpartum intervals, and cow body condition, as well as profitability. Results show that calves on early weaning treatment gained 1.1 kg/head/day while control calves gained 0.43 kg/head/day. Average cow conception rate on the early weaning treatment was 94% and 73% in the control. Cows on the early weaning treatment had an average of a 90 day postpartum interval, while the control cows had an average of 194 days. Body condition score for cows in the early weaning treatment averaged 4.5, while the control cows had an average body condition score of 3.2. In average cows in the early weaning treatment were 45 to 72 kg heavier as compared to the control herd. Profitability in

the control was 1,250 to 1,890 pesos per cow, while in the early weaning pasture ranged from 3,520 to 4,590 pesos per cow. We conclude that early weaning is an effective alternative to increase range productivity and profitability.

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19. LONG-TERM FIRE EFFECTS ON PLANT SUCCESSION AND EXOTIC WEEDS IN PROTECTED AREA SAGEBRUSH STEPPE. Claire Reed-Dustin*¹, Ricardo Mata-Gonzalez²; ¹Oregon State University, Corvallis, OR, ²Oregon State University, Eugene, OR

ABSTRACT

Historically, fire acted as a dominant ecological process in sagebrush steppe ecosystems. A recent synthesis on the effects of fire in the Great Basin emphasizes the need for long term (>10 years) research on fire effects. We examined the effect of fire in shaping community composition in a basin big sagebrush (*Artemisia tridentata* Nutt. spp. *tridentata*) communities through cover and density measurements. We used data collected over repeated intervals post-burn, in plots that range in age from 9 to 15 years, at the John Day Fossil Beds National Monument, Oregon. In addition, emphasis was placed on determining the effect of fire on the invasive, annual grasses, cheatgrass (*Bromus tectorum* L.) and medusahead (*Taeniatherum caput-medusae* [L.] Nevski) and on the native tree, western juniper (*Juniperus occidentalis* Hook). Initial analysis shows an increase in cheatgrass cover to 58.4% at 10 years post-burn from 45.14% cover pre-burn. Cheatgrass cover remained low in plots that were dominated by native grasses, particularly Idaho fescue (*Festuca idahoensis* Elmer) pre-burn. Medusahead cover increased to 3.73% cover at 10 years post-burn over 2.05% pre-burn. The average density of basin big sagebrush declined from 11.62 individuals per 150 mp² pre-burn to 1.29 individuals per 150 m² at 10 years post-burn, with immature sagebrush making up less than 0.01% of the counted individuals.

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20. EFFECTS OF MICRO-SCALE FIRE TREATMENTS ON POPULATION DYNAMICS OF MEDUSAHEAD. Sasha A. Berleman*¹, Katharine Suding¹, Scott Stephens²; ¹UC Berkeley, Berkeley, CA,²PI of the California Fire Science Consortium, UC Berkeley, Berkeley, CA

ABSTRACT

Medusahead (*Taeniatherum caput-medusae* (L.) Nevski) is one of the most damaging invasive plants in North America. It is prolific and spreads quickly, is unpalatable to livestock, and significantly reduces species diversity. Research shows that prescribed fire can effectively manage medusahead, but some results have been mixed. We focus on micro-scale processes (one-square-meter), examining seedbank and seed rain dynamics, and fire's effect on abundance and fecundity for three focal species representing different functional guilds: native perennials (purple needlegrass),

non-native forageable grasses (wild oat), and non-native invasives (medusahead). Our key objectives are to:

1. Understand effect of species cover and dominance on treatment success, and whether these may improve or hinder restoration objectives
2. See effect of fire on oat, needlegrass, & medusahead fecundities
3. Consider role of scale in treatment success through seed-limitation, and investigation of seed rain and seed bank

We anticipate that this knowledge can help guide management decisions regarding the appropriate spatial scale of treatments (in this case, prescribed burns). The insight gained through this project could be particularly valuable to rangeland managers trying to enact Early Detection Rapid Response (EDRR) techniques to respond to plant invasion quickly. Given the current challenges in planning for large scale treatments, there may be opportunities for adjusting treatments according to the mechanism in which invasion occurs, and using combined treatment approaches to accomplish eradication/control goals.

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21. RELATING GRAZING UTILIZATION TO FUELS PROPERTIES IN SAGEBRUSH BUNCHGRASS COMMUNITY. Travis W. Decker*, Eric T. Thacker; Utah State University, Logan, UT

ABSTRACT

Wildfires in the Western United States have increased in size and frequency in recent years. Land managers have sought tools to reduce fuels and thus reduce wildfire risk. Fuel reductions increase the ability of wildland fire fighters to suppress wildfires and protect wildland-urban interfaces. Grazing has been identified as a tool to reduce fine fuel and thus decrease flame lengths and rate of spread. Often fine fuel treatments rely on high levels of grazing utilization (> 80%). However high levels of utilization can lead to ecological degradation by reducing or eliminating native bunchgrasses. The objectives of our study are to determine how different levels of grazing utilization (30%, 50% and 80%) relate to fuel characteristics and subsequent fire behavior. This was conducted by clipping 0.5 m frames at 30%, 50% or 80% utilization by weight. Immediately afterward, fuel measurements were collected (fuel bed depth and fuel loading). This data was then used to model flame lengths and rate of fire spread for each utilization level. We suggest that moderating grazing utilization levels may allow for more sustainable fuel reduction treatments while still reducing wildfire risks. These results will ensure that fuels objectives are met while maintaining ecological integrity.

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*Presenter

22. FIRE IGNITIONS, FIRE-INDUCED DEBRIS FLOWS AND THEIR ROLES IN LAND MANAGEMENT DECISION MAKING. Katherine T. Gibble*, Jennifer L. Pierce, Eric Lindquist; Boise State University, Boise, ID

ABSTRACT

Fire plays an inherent role in shaping the lands of the West and, as a result, is integral to western landscape management. While natural fire ignitions assist in maintaining a landscape's fire regime, unplanned ignitions often must be managed to meet resource and protection objectives (USFS). Unplanned ignitions are prominently human-caused and commonly occur in close proximity to homes and roads (NIFC). The cost and risk associated with extinguishing unplanned ignitions and managing the resulting landscape raises the need to recognize patterns of ignition distribution, the unintended consequences they have on the landscape, and where this understanding fits into land management decision making. The Boise Front provides an excellent setting for this analysis to unfold. The foothills of the Boise Front have been altered by human activity; transforming from sagebrush-steppe-dominated to invasive grass-dominated terrain and, as a result, has changed the role of ignitions and landscape response to fire. We propose the examination of the spatial distribution of ignitions in the Boise Front, highlighting areas most prone to or threatened by ignitions. In addition, we will assay the overlap of ignition distribution with areas that are most prone to debris flows, erosive phenomena apt to occur on the vulnerable foothills of the Boise Front. Areas that have both high debris flow potential and high frequency of ignitions will be highlighted, as fire exacerbates the likelihood of debris flow occurrence, creating a significant threat to life and property to those within the flow's path. Informing this work will be a collaboration with land managers who play a role in fire-related land management in order to better understand the utility of these factors in decision making. Here we present our preliminary findings, ongoing work and results of collaborative efforts with land managers.

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23. RESPONSE OF IDAHO FESCUE AND BLUEBUNCH WHEATGRASS ASSOCIATIONS ONE YEAR POST-FIRE IN THE CANYON GRASSLANDS. Samantha J. Pack*¹, Lesley Morris²; ¹Oregon State University, La Grande, OR, ²SRM, Bismark, SD

ABSTRACT

The effects of natural wildfires on the plant communities of canyon grasslands have been understudied. Studies within the Hells Canyon National Recreation Area (HCNRA) have shown inconsistent short-term results for the response of native bunchgrass species to wildfires. Although the short-term results are inconsistent, the long-term results of the impacts of these wildfires are generally consistent within canyon grasslands. The purpose of this study is to assess the short-term (one year post-fire) impacts on two different sites within two different plant community types, bluebunch wheatgrass

and Idaho fescue. Both sites are located on the same ridge and burned in the fall of 2000 during the Jim Creek Fire. Using cover data, both pre-fire (1982) and post-fire (2001), we were able to determine if either plant community type recovered differently from the same fire. Results from Nonmetric Multidimensional Scaling (NMDS) and Multi-response Permutation Procedures (MRPP) show that the plant community composition changes significantly for both sites following the wildfire. Wilcoxon Rank Sum results show that the bluebunch wheatgrass increased significantly following the wildfire ($p=0.006$), while Idaho fescue did not change significantly following the wildfire ($p=0.1464$). The results for the Idaho fescue community are consistent with the short-term results of a similar study located on Craig Mountain, Idaho. In contrast, the results from the bluebunch wheatgrass association are more similar to short-term results found by other studies within the HCNRA. Other studies have concluded that the grasslands of the HCNRA are stable communities and show only temporary short-term changes in species cover following moderate- to low-severity fire. The short-term response of native bunchgrass cover is becoming more important to these grasslands as exotic species further establish and influence fire regimes.

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24. FIRE AND FIRE LINE EFFECTS ON VEGETATION ON MONTANA RANGELANDS. Samdanjigmed Tulganyam, Craig Carr*; Montana State University, Bozeman, MT

ABSTRACT

Fire line construction using a bladed implement such as a bull dozer breaks fuel continuity and stops the spread of fire by removing vegetation. Because bladed fire lines can alter subsequent vegetation, these changes may be more significant than the impact of the fire itself, however relatively little research has been performed to evaluate this potential. In this study we compared vegetation attributes among burned, unburned, and bladed fire line conditions on two fires that burned in late summer 2012, one in north-central Montana and one in southwest Montana. Vegetation cover and standing biomass were quantified in 2013 and comparisons between treatments made using analysis of variance with significance evaluated at $\alpha = 0.05$. Fire line construction generated a significant decrease in perennial grass cover and biomass and an increase in annual grass and annual forb cover and biomass. Burning did not cause a change in vegetation relative to the unburned treatment with the exception of a reduction in litter biomass. Our data show a significant reduction in vegetation abundance and suggest the potential for conversion to an annual grass dominated system in association with fire line construction. This is concerning because the dominant annual grass was *Bromus tectorum* which has the ability to permanently degrade ecosystem function. Although longer term data are required to more fully understand how these fire lines recover, our data suggests a need to consider the impacts of unplanned bladed fire line construction particularly in situations where other high value entities are not in jeopardy.

25. USING FIELD DATA AND REMOTE SENSING TO BUILD COUNTY-LEVEL MAPS OF HERBACEOUS FUEL CONDITIONS. Edward Rhodes*¹, Jay Angerer², James R. Conner², Wayne T. Hamilton², Jason S. Jones³; ¹Center for Natural Resource Information Technology, Temple, TX, ²Texas A&M University, College Station, TX, ³Jones-Heroy and Associates, Inc., Lampasas, TX

ABSTRACT

Having near-real time access to herbaceous standing fuel conditions can be a vital tool for decision making and planning for wildfire prevention, control, and mitigation. By combining field validated data with plant growth models and remote sensing technology, daily maps of fuel conditions may be generated for wildfire management. Field data were collected from a three-county area in north-central Texas through a combination of basal cover, frequency and biomass measurements. Data were then entered into the Phytomass Growth Simulator (PHYGROW), which is a daily time-step growth model often used in drought and wildfire early warning systems. Model outputs were interpolated across the study area based upon NRCS Ecological Site Descriptions to give an estimate of fuel load deviation from a 50-year average. Model estimates were cross-checked with additional field sampling. Map outputs and data are stored online and are accessible to managers through an interactive web interface that is overlain on Google maps. Land managers can use this data to plan the acquisition and movement of resources such as personnel and equipment to areas that are more at-risk, or to help coordinate fuel reduction treatments.



26. RECOVERY OF SUBALPINE MONTANE GRASSLANDS FOLLOWING THE 2011 WALLOW FIRE . Amber Dalke*¹, George B. Ruyle¹, Judith Dyess²; ¹University of Arizona, Tucson, AZ, ²USDA Forest Service, Albuquerque, NM

ABSTRACT

The 2011 Wallow fire burned 538,000 acres of the White Mountains primarily in east central Arizona. The White Mountains contain fragmented, open park-like, high elevation (>7700 ft) ecosystems called subalpine montane grasslands. These systems are one of the least studied ecosystems in Arizona. The Wallow fire provides an excellent opportunity to study the post-fire recovery of vegetation in subalpine montane grasslands. Nine macroplots (300 ft X 100 ft) were measured between 2011 and 2013. Measurements included production, total canopy cover, dry weight rank, frequency, and line point intercept. Individual macroplots were compared over three years to determine trend. Preliminary results show that production and total canopy cover did not vary between years, suggesting the low fire severity in subalpine montane grasslands did not result in catastrophic damage to the ecosystem. At the community level, graminoid species by weight were greater in 2012 compared to 2011 and 2013, suggesting nutrients released during the fire and/or the reduction of litter was initially favorable to graminoid

*Presenter

species, but this effect is only short-term. At the species level, fire affected different species in different ways. For example, *Blepharoneuron tricholepis* (pine dropseed) abundance was stable or increasing on most macroplots between 2011 and 2013 while *Muhlenbergia montana* (mountain muhly) abundance showed a gradual to drastic decline since the fire on most macroplots. Studying the vegetation recovery at the community and plant level in areas burned by the Wallow fire allows for a greater understanding of complex subalpine montane grasslands ecosystems.



27. STUDIES OF GRASSLAND FUEL DYNAMICS IN A VARIABLE ENVIRONMENT. David M. Engle*¹, J.D. Carlson¹, Erik S. Krueger¹, Dirac Twidwell², Tyson Ochsner¹, Samuel Fuhlendorf¹, Christine H. Bielski³, Sonisa Sharma¹, Andres Patrignani¹; ¹Oklahoma State University, Stillwater, OK, ²University of Nebraska - Lincoln, Lincoln, NE, ³University of Nebraska-Lincoln, Lincoln, NE

ABSTRACT

Herbaceous fuels drive fire behavior in grasslands and in mixed fuel complexes where grasses are a component of the surface fuels. In their “dead fuel” phase, herbaceous fuels constitute 1-hour fuels and contribute greatly to fire danger and fire spread. In their “live” phase, herbaceous fuels can serve as a heat source or sink depending on their fuel moisture. Therefore, grassland fuels are a fitting subject for study, especially considering the enormous land area over which they occur worldwide. Some of the biggest unknowns in fire danger/behavior modeling pertain to live and dead fuel loads, as well as live fuel moisture (not only what the values are but also how they change throughout the year). For those fire danger/behavior systems that are dynamic, fuel loads between the live herbaceous and 1-hour dead classes are shifted as a function of either manual observations (e.g., percent curing, percent greenness) or satellite observations. Live fuel moisture is often modeled by similar methods. Such systems largely have ignored the effect of surface weather conditions on fuels as well as the effect of soil conditions (e.g., directly measured soil moisture). During intensive bi-weekly field sampling of local plots from 2012 and 2013, we collected fuel bed data from tallgrass prairie with successional vegetation produced by fuel treatments consisting of spatially and temporally variable fire and grazing. Relationships will be investigated between the measured/calculated fuel bed variables and soil moisture measurements, weather data, and remotely sensed spectral reflectance data from a hand-held radiometer as well as from satellites. This paper will describe insights gained from these data and from associated studies relating soil moisture and weather data from the Oklahoma Mesonet to wildfire occurrence and size in Oklahoma from 2000 to 2012.



28. EFFECTS OF PHOS-CHEK® ON SOIL NUTRIENT AVAILABILITY. Tye A. Morgan*¹, Robert Blank²; ¹USDA, Reno, NV, ²USDA-ARS, Reno, NV

ABSTRACT

Effects of Phos-Chek® on Soil Nutrient Availability Tye A. Morgan, and Dr. Robert R. Blank and Matt O'Neill Wildfire frequencies and intensities have been steadily increasing on western US landscapes. Phos-chek® is an aerially-applied fire retardant used to contain and control wildfires. Composed of ammonium and phosphate salts, Phos-chek® has the potential to increase soil nutrient availability of N and P. We measured soil nutrient availability, 0-10 cm, 9 months after Phos-chek® application and in control areas north of Reno, NV. Soil beneath Phos-check® had dramatic increases in ortho-p (414%), bicarbonate-extractable P (112%), NH₄⁺ (574%), NO₃⁻ (60%), and DTPA-extractable Zn (39%), Cu (39%), and Mn (58%), relative to the control areas. That the bicarbonate-extractable P and mineral N pools increased so markedly suggests long-lasting effects to vegetation and soil organisms. Such increases in soil nutrient availability likely explain greater growth of vegetation witnessed on Phos-chek® applied areas.

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29. THE FIRE SCIENCE EXCHANGE NETWORK: A JOINT FIRE SCIENCE PROGRAM CONNECTING YOU TO FIRE SCIENCE PROGRAM. Stacey S. Frederick*¹, Scott Stephens², Susan Kocher³; ¹California Fire Science Consortium, UC Berkeley, Berkeley, CA, ²PI of the California Fire Science Consortium, UC Berkeley, Berkeley, CA, ³UCANR, South Lake Tahoe, CA

ABSTRACT

An often-heard phrase is "use the best available science". But managers often don't know what information is already available nor the quality and applicability of that research to their management plans and projects. Another problem is the research may not be integrated in a context meaningful to management. And while the research may be of the highest quality and peer-reviewed, demonstration of science findings in the field is often lacking. The Joint Fire Science Program (JFSP) goal is to accelerate the awareness, understanding, and adoption of wildland fire science information by federal, tribal, state, local, and private stakeholders within ecologically similar regions. Our vision is a national collaborative science delivery network that has been embodied by the Fire Science Exchange Network. This network now covers all of the US, as well as some international partnerships to provide resources and the communication networks to meet this vision. This poster will provide information on the Fire Science Exchange Network and ways for meeting participants to connect with their local exchange. The Joint Fire Science Program is developing a national network of knowledge exchange consortia comprised of interested management and science stakeholders working together to tailor and actively demonstrate existing fire science information to benefit management. This poster describes the background,

vision, and goal behind the network, provides an overview of existing regional consortia, and illustrates examples of the types of activities and services the consortia provide. National Contact list: http://www.firescience.gov/JFSP_exchanges_contact_list.cfm

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30. SAGEBRUSH WILDFIRE EFFECTS ON SOIL CHEMISTRY: A TEMPORAL AND SPATIAL STUDY. Robert Blank*¹, Charlie D. Clements², Tye A. Morgan², Dan Harmon³; ¹USDA-ARS, Reno, NV, ²USDA, Reno, NV, ³USDA ARS, Reno, NV

ABSTRACT

In sagebrush ecosystems, surface soil nutrient availability, particularly of N, often increases immediately following wildfire. However, little is known on how soil N availability and other nutrients, change over time post-wildfire. In Oct., 2013 a wildfire approximately 30 km north of Reno, NV occurred in a Wyoming big sagebrush (*Artemisia tridentata*) community. An experiment was designed to quantify post-fire surface soil chemistry (0-10 cm) by microsite (burned and unburned canopy, burned and unburned interspace) and temporally (monthly from Nov., 2013 through June, 2015). We report on data collected through Aug., 2014. Changes in nutrient availability due to wildfire largely occurred in sagebrush canopy microsites. For all months, burned sagebrush canopies averaged nearly nine times greater in mineral N, mostly due to elevated ammonium, relative to unburned sagebrush canopies. After a 30-day laboratory incubation period, total mineral nitrogen was greater on burned shrub canopies than unburned. Burned sagebrush canopies also had greater DTPA-Mn (6 times), solution-phase sulfate (12 times), and solution-phase ortho-P (2 times) availabilities than unburned sagebrush canopies. Except for solution-phase ortho-P, the magnitude of differences in nutrients between burned and unburned canopies did not decline over the months measured. In a complimentary post-fire rehabilitation study, burned canopy microsites fostered greater seedling density and plant growth than burned interspaces, possibly due to greater availability of N and P.

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31. EFFECTS OF SEASONAL CLIPPING AND FIRE ON PURPLE THREEAWN (*ARISTIDA PURPUREA*) BASAL CROWN TOTAL NONSTRUCTURAL CARBOHYDRATES (TNC) RESERVES. Leobardo Richarte-Delgado*¹, Carlos Villalobos²; ¹Texas tech University, Lubbock, TX, ²Texas Tech University, Lubbock, TX

ABSTRACT

Purple threeawn (*Aristida purpurea*) is a native perennial grass classified as undesirable to cattle production because it is a low-quality forage. Fire is one of the management tools that has been used to improve grasslands invaded with purple threeawn. The objective of this study was to characterize the total nonstructural carbohydrates (TNC) dynamics of purple threeawn throughout the growing season and their

response to clipping and fire treatments during three phenological stages. This research was conducted at the Texas Tech University Native Rangeland in Lubbock, TX. During the 2010 growing season, 90 purple threeawn plants were randomly selected regarding plant size and treated with clipping and burning. Treatments were applied to 30 plants during each phenological stage. Phenological stages were vegetative, reproductive and post-reproductive. In each stage ten plants were clipped, ten were burned and ten more were used as control plants. Clipping treatments simulated 90% utilization while the burning treatment consisted on prescribed fire to plants individually. Samples were collected from basal crowns 30 and 45 days after treatments. TNC concentration measurements were performed on basal crowns using the acid hydrolysis process, then TNC concentrations were measured spectrophotometrically at 612 nm. TNC concentrations of control plants showed a constant increase from the first sampled collection in mid-July to the last collection at the end of November. Sampling time, phenological stage and defoliations type interacted ($P > 0.05$) in their effects on TNC concentrations. TNC concentrations in the basal crowns were higher ($P > 0.05$) in plants treated during the post-reproductive stage among phenological stages, on control plants between defoliation treatments and in plants sampled 45 days after treatment applications. Our results showed that threeawn TNC concentration storage period extends as far as late November. Purple threeawn TNC concentration is dynamic across the growing season and it is easily affected by common defoliation events such as burning and clipping. The results of this study can be used to identify the best season to apply prescribed burning in order to control this species.

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32. PATCH-BURN GRAZING PROMOTES POLLINATOR DIVERSITY THROUGH SPATIALLY EXPLICIT HABITAT HETEROGENEITY. Shelly Wiggam*, Gregory Zolnerowich, Brian McCornack; Kansas State University, Manhattan, KS

ABSTRACT

Rangelands in North America are managed primarily for livestock production, yet they have enormous potential to conserve native biodiversity while maintaining livestock productivity. Although pollinators are critical to the maintenance of healthy rangelands, livestock production, ecosystem services, economies, and human health, they are a group of wildlife of greatest conservation concern that would benefit directly from changes in current rangeland management practices. Patch-burn grazing is a rangeland management practice that has been shown to maintain cattle production metrics and profitability while increasing diversity in wildlife habitat such as vegetative structure and plant species composition. Certain invertebrate taxonomic groups have been shown to have higher diversity in patch-burn grazing pastures, but pollinator community responses have not been studied in detail. This study examines the response of native pollinator species richness and abundance in cattle pastures throughout the Flint Hills ecoregion to the traditional range-

land management practice of annually burning and grazing as compared to patch-burn grazing. Initial results indicate a twofold increase in relative pollinator abundance in patch-burn grazing pastures as compared to annually burned and grazed pastures, which is driven by increases in both native bee and butterfly abundance ($ps < 0.05$). Additionally, there is a threefold increase in native bee species richness in patch-burn grazing pastures, as well as a twofold increase in butterfly species richness ($ps < 0.05$). Three grass skippers of greatest conservation concern are only found in patch-burn grazing pastures, and regal fritillary abundance is substantially higher in patch-burn grazing pastures. Lastly, patch-burn grazing has more spatially explicit patches of habitat heterogeneity as measured by vegetative structure and plant species composition ($ps < 0.05$). These findings indicate that patch-burn grazing has significant potential to conserve and restore one of North America's most endangered taxonomic groups of wildlife, native grassland pollinators, with one of its most dominant land-use enterprises, cattle grazing.

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33. GROUNDWATER MOVEMENT IN RESTORED MEADOWS OF THE SIERRA NEVADA RANGE. Karly B. Wagner*¹, Sherman R. Swanson², Adam McMahon³, Barry Hill⁴; ¹UNR, Reno, NV, ²University of Nevada, Reno, NV, ³University of Nevada Reno, Reno, NV, ⁴US Forest Service, Vallejo, CA

ABSTRACT

In the Sierra Nevada Range a recently adopted and successful restoration technique, the Pond and Plug Method, attempts to raise an incised channel to the meadow surface. This technique takes material available on site to dam the incised channel in several places, which creates a pond behind each plug as the groundwater table rises back to closer to the meadow surface. An old, or occasionally new, stream channel is hydrated or created, on the meadow surface and it is closely connected to the active floodplain. Water flowing through the meadow is now slowed by floodplain spreading, meanders, and roughness from increased vegetation. One proposed benefit of this type of restoration is higher base flow in the late summer months downstream of the projects. This benefit has been observed in some cases, but in other projects the opposite has been observed where prolonged or increased base flow does not extend into the fall, due to the current drought and increased evapotranspiration or deep percolation. Conceptually meadows may act as sponge, storing abundant water from snowmelt or precipitation and releasing water in dry periods; valve, recharging the meadow through springs and regulating water outflow; and drain, water drains from the meadow to a regional aquifer. To test these ideas, we studied eight restored meadows over three summers for patterns in meadow hydrology. Once the meadows or parts of meadows have been defined as one of the three model types this study hopes to link these models with the local geology, soils, meadow gradient, and or meadow geography.

34. POST-FIRE STREAM RECOVERY ON NEVADA'S RANGELAND. Camie M. Dencker*¹, Sherman R. Swanson¹, Kent McAdoo²; ¹University of Nevada, Reno, Reno, NV, ²University of Nevada Cooperative Extension, Elko, NV

ABSTRACT

After wildfire, land managers have difficulty balancing the needs of ranchers with needs for recovery of riparian zones, as well as upland areas. The Emergency Stability and Rehabilitation Handbook suggest a two year rest from grazing following wildfire for the recovery of vegetation and key processes. Bureau of Land Management (BLM) policy says the length of this hiatus should be until objectives are met, as longer closures can detrimentally impact local economies. Burned areas vary in recovery time depending on their prior condition, their potential, and resource objectives. However, little research identifies the time required for recovery of riparian attributes or the drivers that influence that period. This is important, since wildlife, humans, and livestock production all depend on these areas for food, habitat, recreation, and water. This study uses the protocol Multiple Indicator Monitoring (MIM) of Stream Channels and Streamside Vegetation (Burton et al. 2011) to determine rate of riparian recovery of 40 streams burned in 2012 wildfires. We focus on reaches of management concern (e.g. functional at-risk reaches, threatened species habitat, or aspen stands). Long term MIM indicators include greenline plant composition, woody species height class, streambank stability and cover, woody species age class, and greenline-to-greenline width. Once grazing returns, short term indicators, stubble height (height of key graminoid species), woody species use, and streambank alteration (e.g. hoof prints) are measured to determine the impact of livestock. Other measures, such as bank incisement ratio, will help us determine the importance of certain stream characteristics in stream recovery. We hypothesize that riparian areas in better condition at the time of fire will recover faster and meet riparian objectives and allow post-fire grazing sooner.

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35. REHABILITATION OF AN AGRICULTURAL WETLAND: UTILIZING SEED BANK DATA TO INFORM RESTORATION AND MANAGEMENT. Annie Overlin*¹, Tamzen K. Stringham²; ¹University of Nevada, Reno, Reno, NV, ²University of Nevada Reno, Reno, NV

ABSTRACT

Data indicates that in the US, 53% of wetlands have been lost primarily due to agricultural practices (USACE 2008). The success of converting back to functioning wetlands is rife with accounts of exotic wastelands. These observations have been difficult to explain because agricultural practices may change nearly every aspect of an ecosystem (Kulmatiski et al. 2006). Initiating a starting point of simply establishing an appropriate species assemblage only begins a trajectory in restoring wetland functionality. Knowledge of the viable seed bank in conjunction with species specific responses to common agricultural practices such as grazing and ground

water fluctuations due to changes in meadow hydrology can provide valuable information in predicting potential species composition. Seed viability can range from days to decades. The existing species composition in agricultural wetlands is often different from the associated seed bank because many species reproduce vegetatively, often in response to haying or grazing. Consequences of an altered community structure may include weed invasion or the suppression of species that may have historically been present and/or important components of the ecosystem. We hypothesize that resistance to weed invasion is a function of the maintenance of community structure, meadow hydrology, and biomass management. The purpose of this study is to compare the seed bank composition with depth to ground water data, biomass accumulation, and existing species composition within three dominant wetland communities to help determine the resiliency of the current state to weed invasion or the risk of transitioning to another state or phase. Knowledge of the seed bank can give insight about potential risks associated with management options such as irrigation manipulation, biomass removal, fire or other restoration techniques.

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36. REPAIRING HEADCUTS IN UPLANDS AND INCISED STREAM CHANNELS IN CALIFORNIA'S INNER COAST RANGE. Craig D. Thomsen*, Vic P. Claassen; University of California, Davis, Davis, CA

ABSTRACT

Accelerated soil erosion, gully formation, and stream channel entrenchment undermine hydrologic function, rangeland productivity, and wildlife habitat. On Bureau of Land Management's 13,000-acre Cache Creek Natural Area in western Colusa County, CA, anthropogenic disturbances have created unstable watershed conditions, warranting rehabilitation efforts. Within our 200-acre project area, we documented 39 active headcuts, extensive gullying, sedimentation, and degraded riparian zones. Our goal was to stabilize eroding sites by using a variety of innovative rock structures that provide grade control, protect landforms, capture sediment, retain soil moisture and facilitate revegetation. We designed and installed 51 structures including One Rock Dams, Zuni Bowls, Rock Mulch Rundowns, Rock Mattresses, Media Lunas, and Check Dams. We based our designs on channel morphology, stream flow intensity, and educational opportunities for stakeholders. Following first-year storm runoff events, we evaluated the integrity of our structures and made repairs as needed. In an upland site, we backfilled gullies to restore natural topography; in creeks, we are relying on natural sedimentation to fill incised channels. To improve site conditions further, we revegetated with native plants. Overall, the structures we installed are providing the watershed rehabilitation function we are seeking. We reduced upland soil erosion from two drainages that were depositing loads of sediment into a wildlife pond. Within an ephemeral creek and associated tributary, scour pools and stream reaches are capturing sediment, enabling channels to regain access to their historic floodplain. At other sites, we

are awaiting sufficient flows to evaluate structure effectiveness. Despite two years of intense grasshopper defoliation and three years of drought, our revegetation efforts are providing cover, nesting sites, and food for area wildlife. Our results are encouraging and have wider application for upper watershed rehabilitation and wildlife enhancement projects elsewhere where adequate rock is available.

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37. AN ASSESSMENT OF FENS IN THE BIGHORN NATIONAL FOREST, WYOMING. George Jones, Joy Handley*, Louise Jacques; University of Wyoming, Laramie, WY

ABSTRACT

In 2014, the first year of Level I Groundwater Dependent Ecosystem surveys were conducted on the Bighorn National Forest to provide the Forest Service with information documenting the locations of fens (peat accumulating wetlands), the variety in their biotic and abiotic features, and the degree of impact on them from human activities. The Palustrine Emergent Class with a saturated water regime (PEMB) and the Palustrine Scrub-shrub Class with a saturated water regime (PSSB) of the National Wetland Inventory (NWI) of the U.S. Fish and Wildlife Service, are thought to have the highest likelihood among all the wetland types of containing fens. PSSB and PEMB polygons were selected for sampling with a stratified sampling method that included elevation zones and geologic types throughout the Forest. Products from these surveys will include: a profile of fen-types on the forest, a protocol to be used by forest service biologists and resource specialists in additional fen surveys on the forest, a digital layer and a database of fen sites and other wetland sampling sites on the forest, and estimates of the success rate of the NWI layer in predicting the occurrence of fens. With this, Forest biologists and managers will be better able to plan future resource inventories and mitigation projects, and to understand the effects of management plans on wetlands.

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38. ECOHYDROLOGIC CONNECTIVITY IN SEMIARID WATERSHEDS OF CENTRAL OREGON: A PAIRED WATERSHED STUDY. Grace L. Ray*¹, Carlos G. Ochoa¹, Tim Deboodt², Michael Fisher³, John Buckhouse¹, Michael Borman¹; ¹Oregon State University, Corvallis, OR, ²Oregon State University Extension Service, Prineville, OR, ³Central Oregon Community College, Bend, OR

ABSTRACT

There is an increasing concern by range managers for understanding the effects that western juniper (*Juniperus occidentalis*) has on the ecologic and hydrologic state of western rangelands. This paired watershed study considers hydrologic function while investigating the long-term effects of juniper removal on vegetation composition and soil water availability at the watershed scale. Juniper under 140 years of age were removed from one watershed in 2005 after 12 years of reconnaissance monitoring. Analysis of historical

*Presenter

data revealed precipitation as a trigger for increasing soil water content at the deepest soil profile measured (80 cm). This soil response and subsequent shallow groundwater level rise observed in selected piezometers seemed to indicate a direct connectivity between precipitation, soil, vegetation and groundwater. These results were more evident in the treated when compared to the untreated watershed and led us to further our investigation of the understanding of the hydrologic connectivity between precipitation, vegetation, and soil water response. Objectives of this ongoing study are to 1) characterize the understory vegetation composition of a previously treated and untreated watershed, and 2) determine soil-water-vegetation relationships within a pair of previously treated and untreated watersheds. 289 monitoring transects were established to determine vegetation-soil texture-soil water content relationships in both watersheds. Multiple points were measured at each transect to determine vegetation composition and cover, to characterize soil textural properties, and to assess soil water content distribution. Preliminary results suggest similarities in soil volumetric water content and vegetation composition when compared with aspect in both watersheds. In the treated watershed, average soil volumetric water content was 8% and vegetation cover was 80%. Preliminary results of soil texture analysis reveal a high composition of sandy loam and other lighter textured soils. These findings may have implications for the better understanding of plant-water-soil interactions in western juniper woodlands, and a further investigation into results will hope to strengthen the linkage between these interactive systems.

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39. USING ECOLOGICAL SITES TO MODEL GRAZING EFFECTS IN RIPARIAN PASTURES AT TEJON RANCH, CALIFORNIA. Felix Ratcliff*¹, James W. Bartolome¹, Michele R. Hammond², Sheri Spiegel³, Michael D. White⁴; ¹University of California Berkeley, Berkeley, CA, ²UC Berkeley, Berkeley, CA, ³University of California Berkeley, Berkeley, CA, ⁴Tejon Ranch Conservancy, Lebec, CA

ABSTRACT

Ecological site and state-and-transition models provide a framework to interpret and guide management activities on spatially and temporally variable rangelands. Development of these models is currently being extended to riparian systems. At the Tejon Ranch in southern California, we are using ecological site theory to investigate the variable effects of cattle and feral pigs on riparian vegetation resources. Using camera traps, we have recorded time of use, behaviors, and a seasonal activity index for the two ungulates on our 15 study plots. State-and-transition models link inter-annual changes in riparian plant species composition, functional groups, and cover to varying intensities and timing of cattle and feral pig use, and catalog the potential vegetation states occurring on the spatially variable rangelands of Tejon Ranch. Results from the second year of this project highlight the spatial variation of riparian woodland vegetation communities as well as the temporally and spatially variable activity of cattle and feral pigs.

40. THE EDIBLE CORM, NAHAVITA (*DICHELOSTEMMA CAPITATUM* SSP. *CAPITATUM*): SOURCE POPULATION ADAPTATION AND VEGETATIVE RESPONSE. Ken Lair*¹, Robert A. Pearce²; ¹Lair Restoration Consulting, Hesperia, CA, ²Natural Resources Conservation Service, Bishop, CA

ABSTRACT

Underground plant organs harvested historically by the Big Pine Paiute Tribe for food include corms of Nahavita (*Dichelostemma capitatum* ssp. *capitatum*), providing an important starch and protein component of the tribe's diet. An experimental study was conducted in 2011 on the Big Pine Paiute Tribe (BPPT) reservation to examine impact of transplantation (from three native locales - Buttermilk, Symmes Creek, and Pinon Creek) on Nahavita corm establishment, survival, and productivity on reservation soils on which future, larger-scale production of corms as a tribal food source would occur. Project sponsors included the Big Pine Paiute Tribe of the Owens Valley, Big Pine, CA; Inyo-Mono Resource Conservation District and the Natural Resources Conservation Service, Bishop, CA; and the NRCS-USDA California Plant Materials Center, Lockeford, CA. While the Symmes Creek accession exhibited higher emergence and survival during 2012, the Pinon Creek accession approached or equated with the Symmes Creek accession by the end of 2013 (15% survival). The Buttermilk accession displayed reduced survival at the headquarters study site (9%). The Buttermilk accession, however, consistently exhibited more flowering stems at multiple monitoring dates, demonstrating potential for new seedling recruitment, and tending to compensate for the reduced corm survival over time. The Buttermilk accession also supported vegetative cormlet reproduction better than the other accessions (2:1 ratio compared to approximately 1:2 and 1:1 ratios for the Symmes Creek and Pinon Creek accessions, respectively). Moisture conservation and/or shading effect were considered the predominant factors promoting the natural occurrence and transplant survival of Nahavita corms. The vast majority of corms originated directly under the canopy of mature native shrubs – primarily antelope bitterbrush (*Purshia tridentata*) and Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*). Cormlet production is achievable for all three accessions, suggesting that established, transplanted corm populations could be sustained via vegetative reproduction under optimal soils and management.

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41. PURPLE PRAIRIE CLOVER (*DALEA PURPUREA* VENT.) NORTHERN GREAT PLAINS POPULATION DIFFERENCES. Michael P. Schellenberg*; Agriculture and Agri-Food Canada, Swift Current, SK

ABSTRACT

Purple prairie clover, a native legume with anti-microbial characteristics, is one of many native plant species of interest to the reclamation and livestock industries. In 2013, nurseries were established to examine a number of characteristics including plant height, canopy diameter, seed

yield, biomass, ADF, NDF, crude protein, total phosphorous, and calcium content of 6 different populations (AC Lamour, NCP368, NCP585, NCP 591, NCP 599, RF). For the nutritional characteristics ADF, NDF, crude protein, and Total P, the cultivar AC Lamour was the one population that was significantly greater. For the morphological characteristics, such as biomass, seed yield and plant height, AC Lamour had the highest output although not always statistically significant. All characteristics showed a great deal of variation within and without populations indicating potential for selection for specific characteristics.

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42. EFFECTS OF BIOSOLIDS EXTRACTS ON THE GERMINATION OF SEVEN SONORAN DESERT SHRUBS. Martha H. Martin-Rivera*¹, Maria B. Arechiga-Carrillo², Fernando A. Ibarra-Flores³, Salomon Moreno-Medina¹, Rafael Retes-Lopez³; ¹University of Sonora, Santa Ana, Mexico, ²University of Sonora, Navojoa, Mexico, ³University of Sonora, Hermosillo, Mexico

ABSTRACT

Biosolids play an important role in rehabilitation of deteriorated rangeland soils but data regarding their effects on seed germination of Sonoran desert shrubs does not exist. The study was conducted at the National Service of Seed Inspection and Certification (SNICS-SAGARPA) at Ciudad Obregon, Sonora, Mexico. The objective was to test the effect of domestic biosolids extracts upon seed germination. Seeds of fairy duster (*Calliandra eriophylla*), mesquite (*Prosopis juliflora*), tree morning glory (*Ipomoea arborescens*), Ironwood (*Olneya tesota*), palo verde (*Cercidium microphyllum*), piojito (*Caesalpinia pumila*), and Rosary Babybonnets (*Coursetia glandulosa*) were germinated with biosolid extracts and distilled water. One hundred seeds were set on triplicated petri dishes in a germinator chamber at two temperatures 15 and 28 °C. Evaluated variables were seed germination and viability. The tetrazolium test was used for viability. A randomized complete block design and analyses of variance were used for plot distribution and data analyses. The greatest ($P \leq 0.05$) germination for all species was obtained with 28 °C. Biosolid extracts did not ($P \geq 0.05$) significantly increase seed germination in most species, except palo verde and mesquite. Germination of palo verde and mesquite averaged 52 and 74% in the controls and 85 and 88% in the biosolids extraction treatment. Biosolid extracts negatively affected seed germination in fairy duster, tree morning glory, piojito and Rosary Babybonnets. Average germination declined from 17 to 26% among these species, and germination was consistently greater ($P \leq 0.05$) in the controls. Seed germination of Ironwood was not affected by biosolids extracts. Seed viability was 80.0, 91.6, 98.7, 98.0, 77.0, 99.0 and 98.0 for fairy duster, mesquite, tree morning glory, ironwood, Palo verde, piojito and Rosary Babybonnets, respectively. We conclude that since biosolids-treated soils may reduce seed germination of browse species, range managers need to take that under consideration to adjust seeding rates for proper plant establishment.

SOIL SEED BANKS FROM SOUTH DAKOTA BADLANDS. Kelsey R. Ducheneaux*, Lora Perkins; South Dakota State University, Brookings, SD

ABSTRACT

Fragmentation of wildlands is one of the most important components of global change with profound but critically underexamined impacts. A need exists to understand how fragmentation impacts vegetation dynamics in order to mitigate and adapt management as land-use change and climate change progress. This research will develop a mechanistic understanding of how seed bank dynamics are altered by fragmentation. South Dakota Badlands contain characteristic geological features of vegetated relict pediments (colloquially, 'Sod Tables'), formed by erosion of the surrounding land to create a distinct island/matrix landscape. Each Sod Table is a remnant fragment, or island, of the prairie surrounding the Badlands. A matrix of sparsely vegetated, nutrient-poor clay soils surrounds Sod Tables. Thus, Sod Tables are a unique system to examine the effects of fragmentation on soil seed banks. To examine the effects of fragmentation on soil seed banks, we collected samples from the top of Sod Tables and from the surrounding matrix. We germinated the samples for 5 months with alternating cycles of wet and dry. All germinates were identified to species. Species richness and diversity were calculated and similarity of the germinable seed bank was compared between sod tables and the surrounding matrix. Overall, 29 species were germinated from the seed banks including species not previously recorded in South Dakota (*Malcolmia africana*). Assemblages of species that emerged from the sod table samples and from the matrix samples were dissimilar. Between each sod table-matrix pair Jacquards Index of Similarity values range 0-0.25 and Bray-Curtis Dissimilarity Index values range 0.5-1. When pooled all sod tables and matrix samples again were dissimilar (Jacquards= 0.18, Bray-Curtis= 0.81). These results suggest that the vegetation communities on sod tables are distinct from communities in the surrounding matrix and that fragmentation may have substantial effects on soil seed banks.

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44. TILLER DIAMETER AND FORAGE YIELD DEPEND ON TILLER DENSITY IN NATIVE GRASSES USED FOR RE-VEGETATION. Carlos R. Morales-Nieto¹, Ricardo Valdez-Cepeda², Federico Villarreal-Guerrero³, Martin Martinez-Salvador⁴, Alicia Melgoza-Castillo³; ¹Universidad Autónoma de Chihuahua, Chihuahua, Mexico, ²Universidad Autónoma Chapingo, Estado de México, Mexico, ³Universidad Autónoma de Chihuahua, Chihuahua, Mexico, ⁴INIFAP, Chihuahua, Mexico

ABSTRACT

Biodiversity loss is a problem in the Mexican rangelands. It is common that this loss involves native forage species. Thus, there is need for using high forage yield native species in re-vegetation programs. It is important to find out how to identify such species through morphological, cyto-

logical and biochemical attributes that are linked to at least one trait of interest (e.g. forage yield). The aim of this study was to look at the dependence of tiller diameter and forage yield on tiller density in five native forage species used in re-vegetation programs within the Mexican state of Chihuahua. For that, measurements of tiller density, NS (number of stems) diameter, and TD (cm), as well as forage yield (FY) were performed in 91 plants of Arizona cotton top grass, 101 plants of Green sprangletop grass, 111 plants in Plains bristlegrass, 135 plants of Sideoats grama and 136 plants of Blue grama grass. These plants were collected in the field and then established at 'La Campana' Experimental Station of the National Institute for Forestry, Agriculture and Livestock (INIFAP). All the bivariate relationships were notably well-adjusted to potential models $TD=3.128NS^{0.356}$ and $R^2=0.657$, and $FY=0.175NS^{1.237}$ and $R^2=0.872$ for Arizona cotton top grass; $TD=4.636NS^{0.309}$ and $R^2=0.425$, and $FY=1.181NS^{1.079}$ and $R^2=0.627$ for Green sprangletop grass; $TD=2.478NS^{0.351}$ and $R^2=0.463$, and $FY=1.777NS^{0.715}$ and $R^2=0.382$ for Plains bristlegrass; $TD=2.115NS^{0.371}$ and $R^2=0.663$, and $FY=0.096NS^{1.33}$ and $R^2=0.749$ for Sideoats grama; and $TD=3.195NS^{0.31}$ and $R^2=0.443$, and $FY=0.194NS^{1.143}$ and $R^2=0.733$ for Blue grama.

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45. EFFECTS OF SEASONAL CLIPPING AND FIRE ON PURPLE THREEAWN (*ARISTIDA PURPUREA*) BASAL CROWN TNC RESERVES. Leobardo Richarte-Delgado^{*1}, Carlos Villalobos²; ¹Texas Tech University, Lubbock, TX, ²Texas Tech University, Lubbock, TX

ABSTRACT

Purple threeawn (*Aristida purpurea*) is a native perennial grass which causes grazing problems in the Western United States. This species is catalogued as undesirable to cattle production because it is low quality coupled with low palatability forage. Fire is one of the management tools that have been used to control it on infested grasslands. The objective of this study was to determine the response of total nonstructural carbohydrates (TNC) reserves of the purple threeawn plants to defoliation types during three phenological stages. This research was conducted in the Texas Tech University, Native Rangeland, Lubbock, TX. During the 2010 growing season 90 purple threeawn plants were randomly selected based on plant size in vegetative, reproductive and post-reproductive stages. In each phenological stage ten plants were clipped, ten more burned and ten were used as control. Clipping treatments consisted in simulating 90% utilization while burning consisted of applying fire individually. TNC samples were collected from basal crowns 30 and 45 days after treatment application. TNC concentration determinations were performed in the laboratory. Samples were prepared using the acid hydrolysis process then TNC concentration was measured spectrophotometrically at 612 nm. TNC concentrations of control plants were significantly ($P<0.05$) different from the reproductive stage to early dormancy; this pattern was characterized by a steady

increase across phenological stages. Defoliation treatments affected significantly ($P < 0.05$) the TNC reserves of purple threeawn plants during each phenological stage. TNC reserves of plants treated in vegetative and reproductive stages behaved similarly, with higher concentration at the first collection, decreasing by the second one. On the other hand plants treated in post-reproductive stages showed an increase in TNC concentration from the first to the second collection date. Our results showed that threeawn presents a lower TNC concentration in relation to other grasses, and also seems to still be storing carbohydrates even during early dormant stage in late November.

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46. CHARACTERISTICS THAT DETERMINE A SUCCESSFUL SQUIRRELTAIL (*ELYMUS ELYMOIDES*). Dan Harmon^{*1}, Charlie D. Clements²; ¹USDAARS, Reno, NV, ²USDA, Reno, NV

ABSTRACT

Seeding of native grasses in the Great Basin is perilous and developing improved germplasm has been a research priority for decades. Limitations are the criteria by which "improved" has been defined. All improvements (ex: forage production) hinge on an assumption of establishment. This research examines how improvements relate to establishment. Bottlebrush squirreltail is a native perennial grass that has been studied extensively for rangeland rehabilitation potential. Squirreltail is a good candidate for plant material development because of phenotypic variation and known hybridization. We have had little rehabilitation success with germplasm releases. In 2009, we began searching for squirreltail populations in degraded Wyoming big sagebrush rangelands of the northwestern Great Basin. By 2011, we identified 3 unique phenotypes. Type 1: exhibits rapid seedling growth and pubescent leaves. The pubescence gives a silvery appearance. Type 2: exhibits colder temperature germination, a characteristic attributed to the success of cheatgrass. Type 3: exhibits a small leaf surface almost needle-like, similar to drought tolerant needle grasses. We hypothesized seeding success ranking as Type 1 (vigor), Type 2 (cold germination) and Type 3 (leaf morphology). To test this hypothesis we seeded the 3 phenotypes along with a popular release germplasm (Toejam) at five sites (8" pricip) and designed a common garden soil box test to reduce external field variables. Field studies indicated that Type 1 and 3 were equally successful. Soil boxes determined Type 1 the most successful, partially supporting our hypothesis. All three phenotypes established well above the cultivated 'Toejam' and within the range of providing cheatgrass suppression (Type 1- 9.64 plants/m², Type 2- 9.43/m², Type 3- 7.71/m² and Toejam - 0.36/m²). Establishment, though promising, was based on first year July seedling counts and continued die-off is expected. The true test of success is the sustainability of plant densities, cheatgrass suppression and future seedling recruitment.

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47. COMPARING TERRESTRIAL LASER SCANNING, ALLOMETRIC MEASUREMENTS AS NON-DESTRUCTIVE ESTIMATES OF WOODY UNDERSTORY BIOMASS AND STRUCTURE. Sarah L. Anderson^{*1}, Devan A. McGranahan², Anthony Hewitt³, Stephanie S. Day²; ¹North Dakota State University, Minneapolis, MN, ²North Dakota State University, Fargo, ND, ³US Fish and Wildlife Service, Zimmerman, MN

ABSTRACT

American Hazel (*Corylus americana*), a native North American shrub, offers valuable wildlife food and habitat, but without fire and grazing this aggressive rhizomatous plant dominates the understory, reduces herbaceous vegetation, and alters savanna fuelbeds. Sherburne National Wildlife Refuge in Zimmerman, MN features a globally endangered habitat type, Prairie-Oak Savanna, that is characterized by old-growth Bur Oak (*Quercus macrocarpa*) stands and expansive lowland and upland tallgrass prairie habitat. But previous land-use and management have allowed hazel to dominate the understory in many areas of the Refuge, making hazel control a primary objective of fire and grazing management. Conventional woody biomass harvesting is destructive, laborious and time-consuming, while allometric measurements require species-specific calibration, high replication, and can also be time-consuming. Terrestrial laser scanning (TLS) has the potential to non-destructively sample greater areas more efficiently and with finer resolution than traditional sampling techniques. TLS has been used in other ecosystems to estimate woody plant biomass and model vegetation structure, but has not yet been applied in Prairie-Oak Savanna. We compare TLS and allometric measurements (diameter at ground level, length to first stem, diameter at first stem, total stem length and overall standing height) in modelling both hazel biomass and vertical understory structure. Each method is calibrated against harvested biomass data across a gradient of hazel abundance in both burned and grazed areas. We discuss the relative effectiveness and merits of TLS and allometric measurements as non-destructive estimators of woody biomass and understory structure.

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48. IMPROVING RANGELAND SEEDLING EFFECTIVENESS BY DELAYING SEED GERMINATION WITH ABSICISIC ACID (ABA). Turmandakh Badrakh^{*1}, Matthew D. Madsen², Bruce A. Roundy¹; ¹Brigham Young University, Provo, UT, ²USDA-ARS, Burns, OR

ABSTRACT

Western US rangelands are declining due to catastrophic wildfires associated with weed dominance. Restoration efforts commonly require that native perennial species be reseeded in fall. Seeds are drilled or broadcast from an airplane and fail to establish due to unfavorable moisture and temperature conditions. Failure results in weed dominance and recurrent wildfires. Recent research indicates that seeds planted in fall may germinate; causing seedlings to be subject to mortality from frost over winter. We propose

that abscisic acid (ABA), a plant hormone that delays germination, can be applied through seed coating technology to delay seed germination until spring and subsequently prevent winter seedling mortality. We are coating bluebunch wheatgrass (*Pseudoroegneria spicata* (Pursh) A.Love), bottlebrush squirreltail (*Elymus elymoides* (Raf.), and blue flax (*Linum lewisii* (Pursh.) with five different ABA concentrations and testing under five different temperatures. We have found that higher ABA concentrations result in greater germination delay. We will use our extensive set of soil moisture and temperature data to determine if the delay is sufficient to avoid freezing temperatures. This research will guide subsequent field experiments which have the potential to increase seeding success and restore weed-dominated rangelands.

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49. WORKING WITH FARMERS FOR HEDGE ROW IMPLEMENTATION. Garrett W. Vogel*; UC Berkeley Student, Gilroy, CA

ABSTRACT

I report on my time interning with the United State’s Department of Agriculture’s Natural Resources Conservation Service negotiating hedge row implementation on farms to recruit beneficial insects and wildlife. While hedge row usefulness in attracting pollinating and pest-fighting insects, aiding in biodiversity, and providing a variety of other benefits for agricultural areas is a fact, there still remains the challenge of convincing farmers to utilize this them on their farms. Through group and individual meetings with farmers from San Benito and Santa Clara counties, I shadowed the NRCS staff as they broke down cultural, lingual, and generational barriers to spread their knowledge about hedge row benefits and successfully advocated for their implementation. Conclusions: The negotiation techniques were largely successful. Field visits helped to paint a picture of what hedgerows could do to better their fields through improved pollination, supplying habitat for other beneficial wildlife, and a variety of other ecological services as well as helped visualize what their fields would look like when they were planted. A field visit with representatives of Willoughby Farms in Gilroy, CA for example tremendously helped the clients to visualize where and how hedgerows can be utilized on their farm. Providing well-detailed packets and notes about the benefits of hedgerows also greatly helped farmers to ask questions and understand the benefits of hedge rows, and greatly helped the clients of a different oak tree recruitment workshop to get more involved.

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50. SCALE-DEPENDENT DISTRIBUTION OF ARTHROPODS IN RESTORED GRASSLAND FRAGMENTS. Luke Petersen*, Emilio Laca; UC Davis, Davis, CA

ABSTRACT

Pest suppression by natural enemies, a valuable ecosystem service, generally increases with semi-natural habitat in a

landscape, but this effect is highly variable. Ecological interactions and processes operate across a wide range of spatiotemporal scales. The success and efficiency of perennial rangeland restoration in California to promote ecosystem services may be increased by targeting efforts at the scale most relevant to the desired service(s). This manipulative experiment examines how the spatial distribution of restored habitat interacts with arthropod foraging and dispersal traits to influence community composition and biocontrol potential throughout a heterogeneous landscape. Epigeal arthropods were sampled with pitfall traps in perennial grass strips that varied independently in proportion seeded and grain of heterogeneity. Individuals were identified to family and morphospecies, assigned a trophic level and functional guild, and body length was measured. Initially, generalized linear mixed effect models were fit to arthropod abundance and morphospecies and family richness as a function of date and 0% or 100% restored treatment. To examine variation in community composition, Bray-Curtis distances were visualized with MDS ordination and grouped by relevant factors. Preliminary results showed arthropod community metrics did not differ significantly between restored and unrestored plots, suggesting: (1) This grassland arthropod community does not perceive these habitats as different, or (2) the processes determining community composition occur at spatial scales not captured with this analysis. Community metrics did vary throughout the growing season: arthropods were smaller and less abundant and diverse as season progressed. These significant trends may be due to decreased resource availability as vegetation senesces in the late season. Further research will examine community differences at larger and smaller scales, relate results to vegetation and resource characteristics, and focus on specific taxonomic and functional groups, especially those with potential to provide arthropod mediated ecosystem services to the surrounding agricultural mosaic.

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51. VEGETATION RESPONSE TO WATER AND SOIL CONSERVATION PRACTICES IN ARID RANGELAND IN CHIHUAHUA, MEXICO. Tomas Cabanillas*, Carlos Ortega; University of Chihuahua, Chihuahua, Mexico

ABSTRACT

Rainfall and soil nutrients are the principal driving factors for vegetation growth. In arid lands such as Chihuahuan Desert drought periods are common; however, recently these drought cycles are more recurrent and extended. This climatic condition affects negatively rangelands productivity and the cow calf system. A soil and water conservation project to mitigate the lack of rangeland productivity is taking in a 160 ha in the desert part of the state of Chihuahua. The objective is the measure changes in vegetation composition and cover along the micro watershed in which different types of work is done to retain soil and store water in the underground. Four plots were set approximately 30 ha each, two of them have soil and water conservation works (treatment) and the remaining two as a control in an area without work. Within

*Presenter

each plot 9 subplots were established at random. Each subplot has 36 m² in which data collection were made for two consecutive years (2013-14). We measure at the beginning and end of the growing season floristic composition, plant height, basal and canopy coverage using a 1 m² quadrant. Preliminary results (first year 2013) showed the presence of about 32 species of grasses and herbs dominating annual grasses such as nineawn pappusgrass. (*Enneapogon desvauxii*) and matted grama (*Bouteloua simplex*). In addition, we are collecting rainfall, soil and air temperature and soil moisture at three depth levels to understand the micro watershed hydrological dynamic.

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52. GROWTH ANALYSIS OF SIDEOATS GRAMA [*BOUTELOUA CURTIPENDULA* (MICH.) TORR.] GENOTYPES UNDER GREENHOUSE CONDITIONS. Alvarez-Holguin Alan*¹, Carlos R. Morales-Nieto², Alicia Melgoza-Castillo¹, Sierra-Tristan J. Santos³, Juan Angel Ortega-Gutierrez¹, Raul Corrales-Lerma²; ¹Universidad Autonoma de Chihuahua, Chihuahua, Mexico, ²Universidad Autonoma de Chihuahua, Chihuahua, Mexico, ³INIFAP, Chihuahua, Mexico

ABSTRACT

Nowadays most of the grasslands in Mexico have some degree of impairment. To recover the productivity and functionality of these ecosystems different strategies have been implemented, most with a low probability of success. Therefore, it is important to study the production and growth of the species and varieties used in this kind of program. Sideoats grama (*zacatebanderitas*) is one of the native species more utilized in grassland (*patizales*) rehabilitation programs. Due to its high nutrient concentration and to its preference by livestock, it's considered second in agronomical significance. The objective of this research was to study the growth patterns of sideoats grama [*Bouteloua curtipendula* (Mich.) Torr.] genotypes: Vaughn, Niner and El Reno varieties, and E-689 and E-592 ecotypes. Variables under study were aerial biomass (AB), leaf area (LA), chlorophyll content (CC), and relative growth (RGR), absolute growth (AGR) and net assimilation rates (NAR). They were weekly measured during 9 weeks. Comparisons among genetic materials were performed through PROC MIXED of the SAS using 5 applications. All measured variables were adjusted to nonlinear models against time. In general, the results indicate that E-689 was the best genetic material under the basis of AB, LA and CC. AB, NAR and AGR were adjusted to potential models, whereas LA, CC and RGR were adjusted to quadratic functions of second degree. Their coefficients determination (R²) changed from 0.98 to 0.99 for AB, from 0.95 to 0.98 for NAR, from 0.82 to 0.94 for AGR, from 0.92 to 0.99 for AF, from 0.77 to 0.98 for CC and from 0.54 to 0.95 for RGR.

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*Presenter

53. CHARACTERIZATION OF SEEDLING ROOT MORPHOLOGICAL AND PHYSIOLOGICAL TRAITS OF ELEVEN ALFALFA POPULATIONS FOR DROUGHT TOLERANCE. Austin J. Hanson*¹, Lan Xu¹, Arvid Boe¹, Patricia S. Johnson², Roger Gates²; ¹South Dakota State University, Brookings, SD, ²South Dakota State University, Rapid City, SD

ABSTRACT

Alfalfa is the main forage legume in crop livestock systems worldwide. It does not only provide forage for animals, but also improves soil nitrogen, provides sources for pollinator and potential for biofuel. Alfalfa has been introduced to the semiarid Northern Great Plains region; however, its stand establishment and persistence are negatively influenced by drought condition in this region. Therefore, the development of drought-tolerant alfalfa cultivars is of great need. Seedling root development plays a critical role in seedling survival and stand establishment, particular its morphological and physiological traits associated with drought tolerance. Yellow-flowered alfalfa (*Medicago sativa* subsp. *falcata*) is characterized by fibrous root with abundant branches compared to conventional alfalfa (*M. sativa*) taproots. Information on the variations of root morphological traits would be useful for identifying potential alfalfa for breeding drought tolerance, persistence and productivity cultivars for the northern Great Plains. The objective of this study was to evaluate the variability of root morphological and physiological traits of eleven alfalfa populations under different drought stress treatments. Eleven entries were evaluated: one *M. sativa* population as control, seven *M. sativa* subsp. *falcata* populations, and three naturalized variegated populations. Fourteen uniform growth stage seedlings from each population were selected and transplanted into individual cone-container filled with potting soil in a greenhouse. The study consisted of three drought treatment regime (100, 50 and 25% field capacity) combined with two drought durations (15 d vs. 30 d). At each drought duration sampling date, root total length, surface area, average diameter, and volume were measured using WinRhizo; stomata conductance was measured by a porometer. Meanwhile, root and shoot biomass were harvested at each sampling date. Variations of these measured parameters among eleven populations under different drought stress treatment are being analyzed and to be presented at the SRM meeting.

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54. BROMUS TECTORUM AND NATIVE GRASS ESTABLISHMENT UNDER DROUGHT AND WARMING IN SAGEBRUSH STEPPE AFTER FIRE. Alex A. Suazo¹, Matthew J. Germino², Beth A. Newingham*³; ¹University of Idaho, Moscow, ID, ²US Geological Survey, Boise, ID, ³USDA-Agricultural Research Service, Reno, NV

ABSTRACT

Fire and climate change are two important drivers of desert plant communities. Changes in precipitation and temperature due to climate change will create novel environmental con-

ditions that will likely affect post-fire plant establishment, invasions, and eventually alter plant community assemblages. In a field experiment, we reduced precipitation using rainout shelters and increased temperature using open-sided warming frames in sagebrush steppe communities in the Great Basin. At five burned sites, we established control, drought, warming, and drought + warming plots. Seeds of two native perennial grasses (*Elymus elymoides* and *Pseudoroegneria spicata*) used in post-fire rehabilitation and an invasive annual grass (*Bromus tectorum*) were sown in experimental plots. We measured seedling emergence, density, survival, biomass, height, and specific leaf area to evaluate native and non-native species responses to drought and warming. Native grass emergence was low in drought and warmed plots. However, warming increased native grass height and specific leaf area. *Bromus* emerged in all treatments, but drought and warming negatively affected *Bromus* biomass, plant height, and high specific leaf area. Our results suggest that native and non-native species may respond differently to future climate. Individual species responses to climate change are likely to result in altered species interactions and thus plant communities.

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55. EVALUATION OF SEEDBEDS FOR RANGELAND REHABILITATION. Raul Corrales-Lerma^{*1}, Carlos R. Morales-Nieto¹, Alicia Melgoza-Castillo²; ¹Universidad Autónoma de Chihuahua, Chihuahua, Mexico, ²Universidad Autónoma de Chihuahua, Chihuahua, Mexico

ABSTRACT

Given the conditions of grasslands in Chihuahua, Mexico, there is need to implement technological packages for their improvement. In order to evaluate four seedbeds (SB) and their impact on plant establishment, forage production and reduction of invasive species in a deteriorated grassland, a two-year study was conducted in the Experimental Station La Campana-INIFAP, Chihuahua. An area of approximately 400 ha in poor conditions was selected. As a control, an area without tillage was used (SB-1) and four seedbeds were prepared with the following implements: partial harrow (SB-2), total harrow (SB-3), rangeland rehabilitator (SB-4) and aerator roller (SB-5). On the prepared seedbeds, a single grass mixture was sown including: *Bouteloua gracilis* (Bogr), *Bouteloua curtipendula* (Bocu), *Leptochloa dubia* (Ledu), *Eragrostis curvula* (Ercu) and *Sorghum alatum* as a mothership. The evaluated variables were: plant density per species (PDE), dry matter production from each species (DME), total plant density (TPD) and total dry matter production (TDM). A sample size of 115 quadrants (1.0 m²) and 23 repetitions per seedbed were used. Statistical analysis was performed in SAS 9.1.3 (2006) with the GLM procedure and the Tukey test. Additionally, diversity and similarity indexes of Simson and Sorensen, respectively, were used to compare SB vegetation. The SB-1 presented 90.5, 1.3, 1.1 and 0.4% of *Eragrostis lehmanniana* (Erle), *Brickellia spinulosa*, *Mimosa biuncifera*, and *Astragalus mollissimus*, respectively, having the highest ($P < 0.001$) percentage of

invasive and toxic species. The lower ($P < 0.001$) DM yield was also for SB-1 (1107 ± 138 kg DM ha⁻¹). In the SB prepared, Ercu had the highest ($P < 0.001$) establishment and DM production. SB-2 and SB-3 had the highest ($P < 0.001$) production of TDM (2397 ± 157 and 2305 ± 191 kg DM ha⁻¹, respectively). The highest plant diversity was found in the control bed, where Erle dominated. Erle grass plants decreased in the different SB after overseeding. SB-3 was the least affected by the presence of Erle. The SB-4 showed the lowest presence of Erle. Seedbeds preparation neither favored nor affected the establishment and production of Bogr, Bocu and Ledu. According to site conditions, a good seedbed preparation with either partial harrow, full harrow, aerator roller or rangeland rehabilitator is recommended. Any of these methods increase forage production and combat invasive, toxic and undesirable species.

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56. REVEGETATION AFTER RUSSIAN-OLIVE (*ELAEOAGNUS ANGUSTIFOLIA* L.) REMOVAL ALONG THE YELLOWSTONE RIVER IN EASTERN MONTANA. Jennifer M. Muscha^{*1}, Mark K. Petersen², Erin Espeland³, Robert Kilian⁴, Joe Scianna⁵; ¹USDA-ARS Fort Keogh, Miles City, MT, ²USDA-ARS, Miles City, MT, ³USDA-ARS, Miles City, MT, ⁴USDA-NRCS, Miles City, MT, ⁵USDA-NRCS, Bridger, MT

ABSTRACT

How do we effectively rehabilitate land degraded by biological invasions? Many riparian areas on the Yellowstone River have converted to dense Russian olive stands, reducing agricultural value of these lands. To test if restoration is effective and necessary, Russian olive trees were removed from 1.9 ha site along the Yellowstone River in 2011, and a restoration planted in 2012. Four replicate 0.5 ha blocks were randomly allocated to one of 5 treatments; C – no re-vegetation, H - seeded herbaceous layer, S- herbaceous layer with planted shrubs, T- herbaceous layer with planted trees, and TS – herbaceous layer with planted trees and shrubs. Basal and canopy cover was measured in 2010 before Russian olive removal and in 2012-2014. Amount of bare ground and cover of annual brome, non-native forbs, and seeded species were analyzed using Proc Mixed (SAS 2009) with $P < 0.05$ as our level of significance. Bare ground was low pre-removal and decreased over time after an initial spike caused by the intensive mechanical disturbance of tree removal. Bare ground averaging 8.8% (±4.5 SE) measured in 2014 was statistically indistinguishable from the average 3.1% (±4.5) that was measured pre-removal. Annual brome cover was greater in 2010 (32±3%) and 2014 (25±3%) and lowest in 2012 (15±3%), and abundance was greater in T (27±4%) and TS treatments (33±4%) and lowest for S (14±4%) treatments. Non-native forb cover was also influenced by treatment: C (33±3%) and H (32±3%) treatments had greater cover than TS (22±3%), S (20±3%), and T (19±3%) plots. Seeded herbaceous species established with cover 5 times higher in 2014 (28±2%) than 2012 (5.5±2%). After just two years since active restoration, the herbaceous

seeding with planted shrubs had the lowest cover of undesirable forbs and annual bromes and highest cover of seeded herbaceous species.

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57. PHENOTYPIC AND MOLECULAR CHARACTERIZATION OF SIDEOAT GRAMA (*BOUPELOUA CURTIPENDULA*) POPULATIONS IN CHIHUAHUA, MEXICO. Carlos R. Morales-Nieto^{*1}, Carlos H. Avendano-Arrazate², Martin Martinez-Salvador³, Alicia Melgoza-Castillo⁴, Katia Gil-Vega⁵, Pedro Jurado-Guerra³, Adrian R. Quero-Carrillo⁶; ¹Universidad Autónoma de Chihuahua, Chihuahua, Mexico, ²INIFAP, Chiapas, Mexico, ³INIFAP, Chihuahua, Mexico, ⁴Universidad Autónoma de Chihuahua, Chihuahua, Mexico, ⁵CINVESTAV, Irapuato, Mexico, ⁶Colegio de Postgraduados, Texcoco, Mexico

ABSTRACT

Sideoats grama [*Bouteloua curtipendula* (Michx.) Torr.] is an important native species for cattle production. However, inappropriate grazing practices have reduced its genetic diversity. The morphological and genetic diversity of 51 populations of sideoat grama in Chihuahua State were explored and analyzed. Transplanting was performed under natural conditions; two years later, morphological characterization was performed. To assess genetic variability AFLP molecular markers were used. Principal component analysis (PCA) showed that the first three components (CP) explained 73.83% of variation. CP1 showed a significant correlation ($P \leq 0.0001$) in dry matter (88%), stem density (85%), tiller diameter (83%), height of foliage (82%), plant height (79%), and leaf length (65%). An AFLP analysis with four pairs of primers detected 186 bands; 80.67% (150 bands) had polymorphism. The highest percentage of polymorphism (93.75%) and polymorphic bands (48) was obtained with the primer combination of EcoRI-ACT + MseI-CTG. There is a potential to further implement genetic breeding programs assisted by AFLP molecular markers to identify populations with high forage potential. Sideoats grama population presented a high morphological and molecular variability. Based on high forage potential, ecotypes (444, 359 y 557) were selected to be included in grassland restoration programs.

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58. BIG SAGEBRUSH TRANSPLANTING SUCCESS IN CRESTED WHEATGRASS STANDS. Charlie D. Clements^{*1}, Dan Harmon²; ¹USDA, Reno, NV, ²USDA ARS, Reno, NV

ABSTRACT

The conversion of formerly big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*)/bunchgrass communities to annual grass dominance, primarily cheatgrass (*Bromus tectorum*), in Wyoming big sagebrush ecosystems has sparked the increasing demand to establish big sagebrush on disturbed rangelands. The establishment of long-lived perennial grasses is the best known method at suppressing cheat-

grass. The introduced crested wheatgrass (*Agropyron cristatum*) is the most competitive and widely used species to accomplish cheatgrass suppression. Seeding Wyoming big sagebrush is largely unsuccessful therefore transplanting of big sagebrush has become more popular. Most big sagebrush transplanting research has been conducted in Utah where warm-season precipitation is more prevalent and therefore spring-time transplanting efforts are recommended. In the cold desert of the Great Basin summer precipitation is very limiting. We conducted research at two separate sites in northwestern Nevada where we compare fall versus spring transplanting of Wyoming big sagebrush into crested wheatgrass stands. One hundred Wyoming big sagebrush transplants were sown and propagated in 1 Liter (1 qt) sized containers for 6 months and then transplanted to the field. Transplanting occurred in the middle of April and November in 2012 and 2013. Fall transplanting experienced the highest success, 62% (Peterson site), while spring transplants experienced the lowest success at 13% (Dry Valley). The Peterson study site received only 16.2 cm (6.4") in 2012 and 27.6 cm (10.9") of precipitation in 2013. The Dry Valley site only received 8.1 cm (3.2") and 14.2 cm (5.6") in 2012 and 2013, respectively. Precipitation following fall transplanting at these sites is more prevalent in the fall winter months (October-March) than spring and summer months (April-September) which we believe contributes to the significantly higher success of Wyoming big sagebrush fall transplants experienced in northwestern Nevada.

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59. CONSERVATION SEEDING AND DIVERSE SEED SPECIES PERFORMANCE. Charlie D. Clements^{*1}, Dan Harmon²; ¹USDA, Reno, NV, ²USDA ARS, Reno, NV

ABSTRACT

The rehabilitation of degraded big sagebrush communities infested with cheatgrass and other competitive weeds is a daunting task facing resource managers and land owners. In an effort to improve wildlife and livestock forage on degraded rangelands, the USDA-ARS-Great Basin Rangelands Research Unit in cooperation with private land owners, State and Federal agencies tested weed control practices, seeding methodologies and plant material testing of desirable species to improve degraded habitats. The site is located in northern Nevada, 70 km (43 miles) west of Orovada, Nevada. The site is near agronomic fields therefore weed control was conducted by discing the site in the spring of the year prior to cheatgrass seed maturity. The site was fallowed through the summer and seeded in the fall of the year (October) to various native and introduced species and seed mixes. Seed species used included 26 separate species (8 native grasses, 7 introduced grasses, 3 native shrubs, 2 introduced shrubs, 6 native forbs). Initial seedling emergence revealed that native shrubs and forbs were very unsuccessful, 0-30/m² (0-3.3/ft²). Native perennial grass species did not perform much better, with 'Secar' bluebunch wheatgrass, 37.8/m² (4.2/ft²) and Bottlebrush squirreltail, 32.4/m² (3.6/ft²), respectively. The seeded species that ex-

perienced the best initial seedling emergence were the introduced perennial grasses 'Ephraims' crested wheatgrass, 78.3/m² (8.7/ft²) and Siberian wheatgrass, 87.3/m² (9.7/ft²). By September 2012 the establishment of seeded species was greatly reduced from the initial emergence numbers. Introduced perennial grasses, 'Ephraims' crested wheatgrass, 0.90/m² (0.10/ft²), and Siberian wheatgrass 6.3/m² (0.70/ft²) and the introduced shrub 'Immigrant' forage kochia, 4.3/m² (0.48/ft²) performed the best. Properly selecting those seed species and seed mixes with the inherent potential to germinate, emerge and establish in arid environments can improve rangeland rehabilitation efforts.

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60. IMPROVING ECOSYSTEM SERVICES AND YIELD OF BIOENERGY FEEDSTOCKS WITH TOPOGRAPHICALLY MATCHED POLYCULTURES. Kwan Hong Teoh^{*1}, Cody J. Zilverberg², Arvid Boe¹, W C. Johnson¹; ¹South Dakota State University, Brookings, SD, ²South Dakota State University & Texas A&M, Temple, TX

ABSTRACT

The development of a cellulosic biofuels industry is likely to involve the cultivation of switchgrass (*Panicum virgatum* L.) monocultures throughout the U.S. Switchgrass fields will likely displace pastureland, woodland, or Conservation Reserve Program (CRP) land rather than highly productive cropland. This planting approach may further diminish natural habitats throughout the Northern Great Plains. Furthermore, marginal and ex-arable land is often variable in topography and soil condition. Natural grassland communities are also heterogeneously distributed along a topographic gradient according to habitat niches. A diversified feedstock planting that emulates natural communities may retain or increase field productivity with greater plant diversity. Diverse polycultures with more numerous functional groups (warm & cool season grasses and forbs) and greater structural diversity would provide numerous ecosystem services such as wildlife habitat, reduced runoff, and carbon sequestration. This research differs from prior feedstock evaluations in that multiple, polyculture mixtures will be planted according to species adaptations along environmental gradients. The experiment evaluated the performance of 4-species polycultures from 3 functional groups (warm & cool season grasses and forbs) grown with switchgrass at 3 slope positions (foot, mid, shoulder) and at different switchgrass seeding ratios (low, medium, high). This experiment hypothesized that polycultures optimized for slope position and seeding ratio will outyield switchgrass monocultures grown at the same slope position. Mixtures were also evaluated for (1) establishment success, (2) seasonal biomass yield, and (3) relative efficiency in resource utilization relative to diversity. Findings were from data collected during the first production year (2014). This research will aid producers in balancing production with environmentally beneficial farm practices using the selective planting of polyculture feedstocks.

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61. VEGETATION CHANGES TEN YEARS AFTER CATCLAW MIMOSA CONTROL WITH TEBUTHIURON IN SHORT GRASSLANDS. Fernando A. Ibarra-Flores^{*1}, Martha H. Martin-Rivera², Rafael Retes-Lopez¹, Fernando A. Ibarra-Martin¹; ¹University of Sonora, Hermosillo, Mexico, ²University of Sonora, Santa Ana, Mexico

ABSTRACT

Catclaw mimosa (*Mimosa laxiflora*) is a native, perennial half-size brush, which invades short grasslands, interferes with cattle grazing and reduces productivity. This study was conducted to evaluate vegetation changes after the application of Grasland 20P at rates of 0 and 1.5 kg i.a./ha to control high infestations of catclaw mimosa in a short grassland at Cananea, Sonora, Mexico. Local information regarding how soon forage production increases will last after bush control does not exist. Tebuthiuron was hand applied on triplicated 20 by 30 m plots during May of 2005. Plots were arranged on a randomized complete block design. Data was analyzed by ANOVA. Plots remained excluded from cattle grazing from 2005 to 2014. Brush and grass density of main species blue grama (*Bouteloua gracilis*), hairy grama (*B. hirsuta*) and sideoats grama (*B. curtipendula*) were compared. There were 6,560 plants/ha of catclaw mimosa in 2005, 95.5% of which were controlled by the end of 2007, but 2,085 new young plants/ha were back in the plots by the summer of 2014. This represents 31.8% of the original brush density populations. Plant density of main grass species significantly ($P \leq 0.05$) increased from 1.7 to 2.9 plants/m² on herbicide treated plots, and was very similar ($P \geq 0.05$) over time in the controls. Grass basal cover was 6.7 to 9.5% greater ($P \leq 0.05$) on herbicide treated plots as compared with the untreated checks. Although total forage production has been 590 to 1,025 kg D.M./ha greater ($P \leq 0.05$) during all years on herbicide treated plots, forage increases differences tend to be less dramatic over time. Annual forage production in the controls varied from 215 to 387 kg D.M./ha during the study period. Total forage production increases on herbicide treated plots during the last five years is about half of the production obtained during the first five years following herbicide application.

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62. ACACIA COCHLIACANTHA CONTROL IN BUFFELGRASS PASTURES IN THE MATORRAL AREA AT ALAMOS, SONORA, MEXICO. Fernando A. Ibarra-Martin^{*1}, Martha H. Martin-Rivera², Fernando A. Ibarra-Flores¹, Rodolfo Garza-Ortega³, Salomon Moreno-Medina²; ¹University of Sonora, Hermosillo, Mexico, ²University of Sonora, Santa Ana, Mexico, ³Dow Agrosciences, Hermosillo, Mexico

ABSTRACT

Chirahui (*A. cochliacantha*) is an aggressive tall-shrub which invades buffelgrass (*Cenchrus ciliaris*) pastures and reduces productivity. Prado herbicide (621.3 g i.a./Kg. Amynopyralid + 94.5 g i.a./Kg. Metsulfuron metil) is a new product from Dow Agrosciences in Mexico and no local data is available for its use. This study was conducted in summer of 2011 to

evaluate the efficiency of Prado herbicide and manual control by machete to reduce chirahui populations. Treatments applied were: Prado herbicide one doses on 100 liters of water, manual control by machete and the untreated check. Plot 10 by 30 m were used in a randomized complete block design with three treatments and 20 replications. Data was analyzed by ANOVA. Evaluated variables were: brush mortality, grass density, plant height, basal cover and forage production. All variables were evaluated during the summers of 2011 to 2013. Prado herbicide controlled 100% of chirahui and caused no phytotoxicity problems to either buffelgrass or native grasses present. Machete treatments controlled 15% of the chirahui plants but treated plants sprouted back and reach pretreatment levels after three summer growing seasons. Chemical brush control increased ($P \leq 0.05$) grass density, height, basal cover and the forage production of both buffelgrass and native grass species. Total forage production varied from 7.5 to 9.0 tons D.M./ha on chemically treated plots, from 6.5 to 6.8 tons D.M./ha on machete treated areas and from 4.3 to 4.9 tons D.M./ha on the untreated checks. Buffelgrass plots where chirahui was controlled produced additionally from 1.6 to 3.6 tons of D.M./ha/year. Manual control by machete is not recommended because forage production increases are short-lived and are economically not justified. Foliar applications of Prado herbicide are appropriated to reduce chirahui populations and increase productivity in buffelgrass pastures in the humid areas of southern Sonora, Mexico.

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63. EFFECTS OF BUFFELGRASS BLIGHT PYRICULARIA GRISEA ON PASTURES PRODUCTIVITY AT NORTH-CENTRAL SONORA, MEXICO. Patricia L. Barrios-Cardenas*¹, Fernando A. Ibarra-Flores², Martha H. Martin-Rivera¹, Salomon Moreno-Medina¹, Francisco G. Denogean B.³; ¹University of Sonora, Santa Ana, Mexico, ²University of Sonora, Hermosillo, Mexico, ³Universidad de Sonora, Santa Ana, Sonora, Mexico

ABSTRACT

Buffelgrass blight was first reported attacking grass plants in the Gulf of Mexico region but recently proper humidity conditions in some areas has caused problems on buffelgrass pastures on the Pacific Area. The study was conducted in Rancho el Aguila located in Santa Ana, Sonora, Mexico. The objective was to determine leaf blight effect on common buffelgrass forage and seed production. A three year old buffelgrass pasture with previous blight damage reported was selected. Fifty plants with and without apparent blight damage were selected for study. Percent leaf damage, plant height, total undamaged forage and seed production were measured during the summers of 2012 and 2013. Individual plants were considered as replicates and arranged in a completely randomized design. Data were analyzed by ANOVA. Precipitation was average during 2012 (312 mm) and 25% below average during 2013. Results show that 14% of the sampled plants showed light damage (less than 25% of foliage damaged), 47% moderate (25 to 50% of damaged fo-

liage) and 39% intense blight damage (more than 50% of damaged foliage). Blight damaged plants were 25 to 29 cm shorter ($P \leq 0.05$) as compared to unaffected plants during both years of evaluation. Leaf blight caused severe damage to plants and reduced forage production by 42.3%. Annual forage production averaged 516.0 grams D.M./plant on blight damaged plants and 895 grams D.M./plant on undamaged individuals. Total seed production was reduced by 28.9% on leaf blight affected plants and averaged 4.786 and 6.732 grams/plant on damaged and undamaged buffelgrass plants, respectively. Leaf blight damages common buffelgrass plants and significantly reduces forage and seed production on buffelgrass pastures during normal summers and may represent a severe threat during moist years where climatic conditions are more suitable for the pathogen to develop.

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64. DEVELOPING A RANGELAND MANAGEMENT PRACTICES DATABASE IN SAGE-GROUSE HABITAT. Lauren Connell*¹, Brenda Smith¹, Jessica Lambright², Garth Fuller³, Jay Kerby⁴, Tony Svejcar⁵, Chad S. Boyd⁵; ¹Eastern Oregon Agricultural Research Center, Burns, OR, ²Consultant, Eugene, OR, ³The Nature Conservancy, Bend, OR, ⁴The Nature Conservancy, Burns, OR, ⁵USDA-ARS, Burns, OR

ABSTRACT

The Greater Sage-Grouse (*Centrocercus urophasianus*) is a sagebrush-obligate bird currently being reviewed by the US Fish and Wildlife Service for protected status under the Endangered Species Act. A listing could have broad impacts on management and land use. Potentially-affected parties lack science-based best management practices to implement in sagebrush ecosystems. The Natural Resource Conservation Service awarded a Conservation Innovation Grant to The Nature Conservancy and the Eastern Oregon Agricultural Research Center to develop new tools for land managers to more effectively and efficiently manage and restore sagebrush steppe habitat in the Great Basin. Although much research has been conducted within these systems, plant community response to treatments are dependent on a complex combination of factors including soils, microclimates, invasive species, fire regimes, current habitat state, historical impacts, and more. We were interested in summarizing existing literature about the effectiveness and benefits of key management practices for sage-steppe ecosystems and sage-grouse habitat. As a result of this effort we developed a relational database of rangeland management practices research conducted in the western sagebrush steppe. We are not aware of a similar effort and the value of this database lies in its ability to produce a compiled literature review based on multiple search criteria including initial ecological site condition, plant species, applied treatment and study results. Creating a searchable database with the highly variable manuscript structure common to research presents major challenges, which we will outline in the presentation. The end result is a database that can be used by researchers to inform development of a Manager's Best

Practices Guide for sagebrush steppe and sage-grouse habitat and identify knowledge gaps of sagebrush steppe ecosystem management for further research.

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65. VEGETATION RESPONSE TO MOWING WYOMING BIG SAGEBRUSH PLANT COMMUNITIES IN THE GREAT BASIN. Matt Church*, Sherman R. Swanson; University of Nevada, Reno, Reno, NV

ABSTRACT

Significant amounts of arid sagebrush habitat in Nevada and the surrounding Great Basin is being converted by wildfire to plant communities dominated by introduced annual grasses and forbs. This habitat alteration adversely affects hydrology, soils, wildlife habitat, recreation, fire cycles, domestic livestock, and aesthetics. Once converted, this land is extremely difficult and expensive to convert back to a healthier state. In an effort to prevent this transition to introduced annual plants, the BLM, NRCS, and other public and private organizations have mowed thousands of acres of Wyoming Big Sagebrush plant communities across the Great Basin. Some of these mow treatments are conducted as fuel breaks for wildfire control. Others are conducted with the goal of increasing the perennial herbaceous understory in order to enhance resilience, wildlife habitat, watershed values, or aesthetics. Between 2010 and 2014, we have collected point-intercept data at 112 individual locations from 42 separate mowing projects in and immediately adjacent to Nevada in an attempt to determine the vegetation and ground cover effects of mowing, and also whether stated goals are being accomplished.

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66. OBSERVER TRENDS IN THE “PREPONDERANCE OF EVIDENCE” APPROACH TO INTERPRETING INDICATORS OF RANGELAND HEALTH. Sean F. Perry*, Sarah E. McCord; USDA-ARS, Las Cruces, NM

ABSTRACT

The Interpreting Indicators of Rangeland Health (IIRH) is a qualitative assessment used to evaluate ecosystem health on rangelands worldwide. The assessment provides an evaluation of three attributes of rangeland health: soil/site stability, hydrologic function, and biotic integrity to identify sites that are at a risk of degradation or have resource problems. To evaluate each ecosystem attribute, 17 indicators of range health (e.g., presence and amount of rills, vegetation composition, soil aggregate stability) are rated with respect to departure from reference condition for the study ecological site. The indicator ratings for each ecosystem attribute are then examined and an overall attribute departure from normal rating is determined. A “preponderance of evidence” is used to evaluate if an attribute is departed from reference condition. However, in practice, certain indicators may consistently receive more weight in rating attributes due to a) observer bias towards the impact of a particular indicator or b) low observer confidence in rating an indicator. We exam-

ine 1,244 IIRH assessments conducted between 2011 and 2013 throughout the Great Basin and show that some indicators (e.g., invasive plant species) have greater effect on attribute ratings than others (e.g., soil surface loss and degradation). These biases can skew the overall site evaluation and can have implications for land managers utilizing these assessments.

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67. CHARACTERIZING ASPEN REGENERATION BY ABUNDANCE OF UNGULATES, TOPOGRAPHY, AND TREE SPECIES COMPOSITION. Aaron C. Rhodes*, Sam St. Clair; Brigham Young University, Provo, UT

ABSTRACT

Herbivory regimes are changing globally. Loss of apex predators, increasing ungulate populations, and introduction of livestock create novel pressures for many ecosystems. In subalpine forests of the west, Aspen (*Populus tremuloides*) provides habitat and forage for both native and introduced ungulates, yet historically high ungulate populations may threaten aspen resilience. The objective of this study is to characterize the impact of ungulate herbivores on aspen regeneration and recruitment as a function of stand composition and topography at a regional scale. We chose paired 93 aspen and mixed aspen-conifer stands across 3 national forests in Utah. In each stand, we estimated animal abundance by fecal group counts, measured the height of aspen suckers (0-200cm), counted the density, and recorded percent browsed stems. Elevation, aspect, and slope, was extracted from a statewide 30mx30m DEM. We used model selection based on AICc to measure the importance of topography, stand type and animal abundance for aspen regeneration. We found that aspen regeneration density was positively correlated with elevation, aspen overstory density and was 25% higher in aspen stands. There was little support for ungulates reducing aspen regeneration density. Height was negatively correlated with all ungulate species, shorter at northern aspects, 7.5% shorter in mixed stands, and increased with elevation and slope. Browse damage was positively correlated with all ungulate species, and higher in mixed stands. We conclude that each ungulate species may have a negative impact on aspen regeneration and that these effects increase as animal density increases. Aspen regeneration is most successful in dense aspen stands, at high elevation, and on sloped terrain. While sparse aspen stands at low elevation and gentle slopes is less successful. These areas can be identified as a priority for land managers interested in mitigating the impact of ungulate herbivory.

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*Presenter

68. DISTINGUISHING BETWEEN ECOLOGICAL SITES AND STATES: RESULTS OF AN INITIAL LOW INTENSITY TRAVERSE. Christopher P. Dickey*¹, Paul J. Meiman², Maria Fernandez-Gimenez²; ¹MS Student at Colorado State University, Fort Collins, Fort Collins, CO, ²Colorado State University, Fort Collins, CO

ABSTRACT

The Learning from the Land project works with land managers and land management agencies to develop state and transition models to support adaptive management of rangelands in Colorado. We employ Ecological Site Descriptions (ESDs) created by the National Resource Conservation Service (NRCS) to guide our selection of communities for state and transition model development. In June of 2014, we met with stakeholders in Rio Blanco County, Colorado to discuss ecological site selection. We requested input from land managers and asked them to pose questions of interest that they would like us to investigate. Participants were particularly interested in the Mountain Loam ecological site. One question that arose regarding the Mountain Loam ecological site was whether aspen communities represent one state in the Mountain Loam state and transition model, or should be considered a separate ecological site. In August 2014, we conducted a low intensity traverse of 17 aspen or sagebrush dominated plots within the area of interest. At each plot, three 50 meter transects were run parallel to the direction of slope. Vegetation surveys were conducted along each transect at meter increments using the line-point intercept method and soil pits were dug at the center of each plot. Results from analyses of data collected in the low intensity traverse will be presented along with a discussion of how these results will be used to plan the high intensity survey to be conducted in 2015 to further develop the state and transition model(s) of interest.

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69. DROUGHT EFFECTS ON GRASSHOPPER COMPETITION AND RANGELAND PRODUCTION. David H. Branson*; USDA, Agricultural Research Service, Sidney, MT

ABSTRACT

Grasshopper populations are highly cyclical and respond to a combination of biotic and abiotic factors, including food availability. Water availability is frequently limiting in rangeland systems. Changing patterns of precipitation will likely modify interactions between grasshopper species and could affect grasshopper population dynamics. No manipulative research has examined how drought affects grasshopper competition in the northern plains. A manipulative experiment was conducted in mixed grass prairie in eastern Montana utilizing passive drought frames. The experiment was designed to examine the effect of intra and interspecific competition on a late developing grasshopper species that appears to respond to late summer moisture. Treatments included 50% drought and non-drought treatments in combination with intra and interspecific grasshopper competition treatments. Drought reduced plant biomass in control cages

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and in grasshopper herbivory treatments. Grasshopper survival was affected by drought and initial herbivore density, but differential impacts of interspecific competition were less evident. As climatic fluctuations and drought are common in the northern Great Plains, additional research is needed to examine how climate affects grasshopper population dynamics.

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70. DROUGHT AND GRASSLAND CONVERSION EFFECTS ON THE STABILITY OF PRIMARY PRODUCTIVITY IN CENTRAL ARGENTINA. Juan P. Martini¹, Diego F. Steinaker², Wade S. Anderson*³; ¹INTA EEA San Luis, 5730, Argentina, ²University of Regina, Regina, SK, ³Rancher, Private business, Chadron, NE

ABSTRACT

Conversion of native grasslands to cultivated pastures due to livestock intensification is a worldwide phenomenon that affects many ecosystem functions. In the temperate semiarid area of Central Argentina, a major land-use change is the conversion of native grasslands to exotic weeping lovegrass (*Eragrostis curvula*) pastures. We evaluated the relationship between above net primary productivity (ANPP) and annual precipitation on nine paired sites of native grasslands and tame pastures, distributed along a 300 km transect in the southern region of San Luis province, Argentina. Productivity and precipitation data for the period 2000-2010 were obtained by using MODIS/Terra and TRMM remote sensing. The annual ANPP was slightly but significantly reduced by 3% after conversion of native grasslands to weeping lovegrass pastures. In addition, the stability of ANPP, measured as the inter-annual ANPP standard deviation and coefficient of variation, was also significantly lower in introduced pastures than in more diverse grasslands. That may be explained by a differential response of these plant communities to seasonal variation on the precipitations. The ANPP of native grasslands and weeping lovegrass were both correlated with winter-spring precipitations, but under seasonal droughts, the ANPP was more severely reduced in tame pastures than in native grasslands. Thus, our results showed that negative effects of land-use change on ecosystem functions may be enhanced under climatic stresses.

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71. DO CHEATGRASS, SNAKE RIVER WHEATGRASS, AND CRESTED WHEATGRASS SENSE DIFFERENT AVAILABILITIES OF N AND P IN SOILS CONDITIONED BY A CHEATGRASS INVASION? Robert Blank*¹, Tye A. Morgan²; ¹USDA-ARS, Reno, NV, ²USDA, Reno, NV

ABSTRACT

Long-term invasion by cheatgrass often increases availability of soil N and P thereby fostering increased competitive ability. We designed an experiment to test if cheatgrass (*Bromus tectorum*, exotic annual), Snake River wheatgrass (*Elymus wawawaiensis*, native perennial), and crested wheatgrass (*Agropyron cristatum*, exotic perennial) all benefit from this

elevated nutrient availability. Soils from three cheatgrass invaded and adjacent non-invaded areas in northern Nevada were freshly-collected. Replicates were sown to each of the grasses and grown for 70 days. Following harvest, above-ground and root biomass were recorded and nutrients in above-ground plant tissue were quantified as well as natural abundance ^{15}N . Soils were homogenized and analyzed for several nutrient availability indexes. Above-ground biomass of cheatgrass and crested wheatgrass averaged over 2 times greater in soil conditioned by cheatgrass invasion relative their growth in non-invaded soil; biomass of Snake River wheatgrass was statistically similar in invaded and non-invaded soils. For all plants tested, tissue P concentration was greatest when grown in the invaded soils and used a greater proportion of the bicarbonate-extractable P pool in the invaded soils than non-invaded soils. Cheatgrass and crested wheatgrass growing in invaded soils used a significantly greater proportion of the 30-day mineralizable N pool relative the non-invaded soil; Snake River wheatgrass used similar proportions in the two soil types. Natural abundance of ^{15}N of plant tissue indicated that Snake River wheatgrass utilized more isotopically negative ^{15}N fraction from the invaded soil than did cheatgrass or crested wheatgrass. Overall, our data suggest that the native perennial Snake River wheatgrass uptakes available N in the invaded soils differently than does cheatgrass and crested wheatgrass.

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72. ESTIMATION OF SOIL QUALITY UNDER CONTRASTING LAND USES IN ALBERTA. Donald F. Schoderbek*, Guillermo H. Ramirez, Edward W. Bork; University of Alberta, Edmonton, AB

ABSTRACT

Agricultural landscapes, such as cropland, tame pasture, and native grassland provide a variety of ecological goods and services (EG & S). High soil quality (i.e. tilth) has been shown to optimize EG & S, such as carbon storage, soil stability, and runoff quality, in addition to stimulating plant production. Methods of estimating soil quality generally involve an approximation of the soil structure. In this poster, we present two methods for estimating soil quality: an established soil core procedure for macroporosity and unsaturated hydraulic conductivity based on an evaporation method after water saturation (HyProp); as well as a novel soil clod method using a 3D laser scanner to derive the fractal dimension of soil aggregation. We sampled adjacent (< 1 km apart) cropland, tame pasture, and grazed native grassland at several sites (n=7) across southern and central Alberta. These sites are distributed across a significant agroclimatic gradient (P:E ratio from 0.3 to >1), allowing us to sample several different crop and tame pasture/hay systems. Using these two methods, we then examined the relationship of soil quality and carbon storage, in addition to ancillary properties (e.g. pH, salinity, texture). Results from this study will serve to better inform the effects of soil quality on plant productivity across contrasting soil conditions and land uses, as well as demonstrating potentially less-expensive soil quality analysis methods.

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73. FATE OF C AND N INPUTS FROM DUNG PATS. Kenneth S. Evans*, Ana B. Wingeyer, Martha Mamo, Walter H. Schacht, Pamela J. Sutton, Kent M. Eskridge; University of Nebraska-Lincoln, Lincoln, NE

ABSTRACT

The distribution and subsequent decomposition of dung pat across the landscape are some of the many processes of nutrient cycling in managed grazing systems. Nutrient cycling can influence the diversity and abundance of species, forage quality, net primary production, and the fate of nitrogen and carbon. The goal of the research was to quantify and characterize the fate of nutrients during decomposition of cow dung and the influence of dung beetles in the decomposition process. We quantified mass loss of dung, soil nutrients below and around dung pats, and GHGs fluxes overtime. Results of GHG fluxes and soil nutrients will be presented.

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74. DOES WINTER HEIFER MANAGEMENT INFLUENCE DISTANCE TRAVELED AND REST TIME WHEN GRAZING NATIVE RANGE? Mark K. Petersen*¹, Jennifer M. Muscha², Andy J. Roberts², Richard C. Waterman²; ¹USDA-ARS, Miles City, MT, ²USDA-ARS Fort Keogh, Miles City, MT

ABSTRACT

Heifer fitness is a collection of traits including behavioral/metabolic adaption and genetic background. Type of development program for spring born heifers may influence how heifers cope with changes in rangeland pasture. Heifers were stratified to 1 of 2 winter development treatments at weaning: (1) fence line weaning on native range (NR) with self-fed salt-mineral protein supplement (n=118) or (2) weaned into a dry lot (DL) and fed corn silage diet formulated to gain 0.68 kg/d (n=53). Heifers assigned to DL were transported to pens in October 2013 while NR heifers were fence line weaned. The objective was to determine if differences existed in distance traveled, average speed, and time spent loafing after being separated for 6 months and maintained in either DL or NR and then were combined in a common pasture (April 9). An initial measurement occurred with DL and NR on April 1 with subsequent measurements occurring in common pasture for two measurements in April and once in May and August. A cohort of 21 heifers was individually fitted with QSTARZ CR-Q1100P GPS tracking recorders. Data were recorded until batteries were exhausted (36 hr). Distance traveled, average speed, and time spent loafing were all influenced by an interaction of date and development method (P<0.0001). On April 1, prior to recombining, heifers managed in DL spent less time loafing (6.8±2% vs 31.9±1.3%) but traveled (2.5km ±0.7) the same distance as NR (4.0km±0.6). On April 9 heifers were recombined in a common pasture. DL heifers traveled further (18±0.7 km/d vs 12.4±km/d) and faster (0.8±0.03km/hr vs. 0.5±0.02) but rested the same percentage of the day as NR. This study revealed that initial responses to a new pasture were different depending on winter management but in as little as 3 weeks distance traveled, resting time, and travel speed were similar.

75. IMPACTS OF PLANT COMMUNITY DIVERSITY AND DROUGHT TIMING ON RESILIENCE OF MIXED-GRASS PRAIRIES. Kayla M. Tarr*¹, Walter H. Schacht¹, Jerry Volesky²; ¹University of Nebraska-Lincoln, Lincoln, NE, ²University of Nebraska-Lincoln, North Platte, NE

ABSTRACT

Drought is a common occurrence on semi-arid grazing lands of the Great Plains. In this region, grazing mismanagement has resulted in less diverse and productive plant communities, potentially affecting resilience to drought. Land managers can be better prepared for drought by adopting practices that increase plant diversity. The objective of this study is to demonstrate differing levels of resilience in high and low diversity plant communities in response to droughts occurring in different seasons and for different durations. High diversity and low diversity plant communities were selected on privately managed ranches in the Sandhills (sandy soils) and Central Loess Hills (loamy soils) of Nebraska. Replicated plots were established within each plant community type and location, and the following treatments were applied during the 2014 growing season: (1) spring drought, April 1-June 30, (2) summer drought, June 1- Aug 31, (3) average seasonal precipitation, and (4) ambient precipitation. Rain-out shelters were constructed to limit precipitation received on drought treatments to 50% of the 30-year seasonal average. Initial ground cover and relative species composition of each plot was estimated using a line-intercept method before the spring drought was applied. Standing biomass was clipped in September as an estimate of above-ground plant production by plant functional group. We hypothesize that ground cover and plant production of Sandhills sites and low diversity communities will be more negatively impacted by drought than Loess Hills sites and high diversity communities. The first year results of this 3-year study will be presented and discussed.

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76. LONG-TERM FORB PRODUCTIVITY ON WYOMING BIG SAGEBRUSH ASSOCIATIONS; SOUTHEAST OREGON . Jonathan Bates*¹, Kirk W. Davies²; ¹USDA-ARS, Burns, OR, ²USDA - Agricultural Research Service, Burns, OR

ABSTRACT

Forbs are important components of ecological systems. In sagebrush steppe there is a general lack of information of long-term forb production dynamics and diversity. In this study we evaluated forb production dynamics for 10 years on 44 high seral Wyoming big sagebrush sites in southeast Oregon for the five main associations identified by the dominant bunchgrass: bluebunch wheatgrass (n=16), Thurber's needlegrass (n=12), Idaho fescue (n=5), needle-and-thread (n=4), and bluebunch-Thurber's needlegrass (n=7). Perennial forb production was greatest on the Idaho fescue association (101 ± 10 kg/ha), followed by bluebunch wheatgrass association (84 ± 8 kg/ha), bluebunch-Thurber's needlegrass association (78 ± 7 kg/

ha), Thurber's needlegrass association (46 ± 7 kg/ha), and the needle-and-thread association (8 ± 2 kg/ha). Perennial forbs represented between 17% and 23% of total herbage production on all but the needle-and-thread association which averaged but 2% of herbage production. Annual forb production was more variable in response to yearly growing conditions (e.g. available soil water, spring temperatures) than perennial forbs. Annual forb production was greatest on the bluebunch-Thurber's needlegrass association (35 ± 9 kg/ha), Thurber's needlegrass association (34 ± 13 kg/ha), and bluebunch wheatgrass association (31 ± 11 kg/ha), and lowest on the needle-and-thread (19 ± 7 kg/ha) and Idaho fescue (16 ± 6 kg/ha) associations. Annual forb production as a percentage of total herbage production ranged between 3% and 9%. Managers should be aware that in the Wyoming big sagebrush complex forbs are more responsive to inter-annual weather variation and events than disturbances such as fire or mechanical brush control treatments. Studies in Wyoming sagebrush steppe have shown a consistent lack of response by forbs to disturbance. Our study demonstrates the yearly variability in forb production that can be expected and the differences in forb productivity among Wyoming big sagebrush associations.

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77. NEW GENERATION SOIL EROSION AND SEDIMENT DEPOSITION MODEL FOR RANGELANDS. Steven D. Warren*¹, Helena Mitasova², Thomas Ruzycski³, Matthew Hohmann⁴, Niels Svendsen⁴, Robert Vaughn⁵; ¹US Forest Service, Provo, UT, ²North Carolina State University, Raleigh, NC, ³Colorado State University, Fort Collins, CO, ⁴US Army, Champaign, IL, ⁵US Forest Service, Salt Lake City, UT

ABSTRACT

The ability to accurately estimate the extent and spatial distribution of soil erosion and sediment deposition can be critical for determining the consequences of land management practices, and for predicting if, where, and the extent of ameliorative practices that may be needed when current land uses have resulted in significant land degradation. Unfortunately, most models have historically under- or over-estimated soil erosion and sediment deposition, particularly when applied to non-cultivated lands such as rangeland. Built on the backbone of the Universal Soil Loss Equation (USLE), the Unit Stream Power Erosion and Deposition (USPED) model was developed originally for the U.S. Department of Defense. It overcomes many of the deficiencies of most other models. In particular, it alters the manner in which topography is considered. It accounts for 3-dimensional topographic complexity, such as the convergence and divergence of slopes, rather than treating landscapes as a series of simple planes. Digital elevation models (DEM) are used to compute the contribution of topography. The model operates in a variety of geographic information systems (GIS) and at any spatial resolution. Estimates of erosion and deposition are made for each pixel in the 3-dimensional landscape. The model utilizes published databases for many of the model parameters. We use satellite imagery to spatially determine

the contribution of vegetative cover. The USPED spatially estimates both erosion and deposition as a change in sediment transport capacity across each grid cell. Limited field work is required only to validate model components and results.

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78. POLLINATOR DIVERSITY AND ABUNDANCE IN ALBERTA'S AGRICULTURAL LANDSCAPE. Cameron N. Carlyle*, Angela Phung, Ashton Sturm, Monica Kohler, Jessamyn S. Manson; University of Alberta, Edmonton, AB

ABSTRACT

Grasslands provide many ecological goods and services; among these is the support of pollinators by providing critical habitat. Pollinators are critical for the reproduction of many plant species and support many agricultural crops, but pollinator nesting success in these systems is reduced because of intensive soil disturbance. Grasslands cover about 9 M ha of Alberta and are imbedded in a complex agricultural landscape that includes annual crops, such as canola, that can have improved yields as a result of pollination by native insects. However, very little is known about the abundance and diversity of bees and other insect pollinators in grasslands or how they are impacted by cattle management. We surveyed pollinators and plant cover in native grassland and annual cropland (n=70) throughout Alberta's grassland regions. We will present preliminary data examining landscape, cattle management and regional factors affecting pollinator diversity and abundance. In a separate study, we are examining the complex relationship between herbivory, plant response and the impact on resources used by pollinators. These projects will benefit beef producers through recognition of the critical role grasslands play in supporting two ecosystem services, pollination and biodiversity, and provide management practices that could increase the productivity of some rangeland plants while supporting pollinator communities.

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79. SWEET CLOVER EFFECTS ON SOIL CRUST AND PLANT COMMUNITY COMPOSITION IN MIXED GRASS PRAIRIE IN SOUTHERN ALBERTA. Claire R. Kisko*, Ly-sandra A. Pyle², Edward W. Bork²; ¹University of Alberta, Edmonton, Canada, ²University of Alberta, Edmonton, AB

ABSTRACT

Sweet clover (*Melilotus* spp.) is an invasive biennial legume, commonly exploiting disturbed areas along roads and pipelines. In southern Alberta's Dry Mixedgrass Prairie, sweet clover plants are invading adjacent native grasslands, where they are larger statured than endemic forbs and grasses. As a result, the canopy of sweet clover changes the underlying microclimate, including decreasing light availability and altering soil moisture. In addition, a single sweet clover plant can create a crown ~ 3 to 6 cm wide in its second year. This crown can physically push litter and soil crust away from the point of origin. In this study, we evaluate changes in plant community and soil crust composition associated with sweet clover presence, as well as the role of environmental factors.

Relative plant species (canopy and basal) composition were measured for 28 individual sweet clover plants using 10x10 cm quadrats positioned at intervals of 5 cm, 15 cm, 25 cm, 55 cm, 80 cm and 105 cm from the parent plant, along 2 transects lying north and south of the plant. Soil moisture was measured at each interval. Finally, sweet clover seedlings within a 1 m radius of the plant were recorded to estimate local recruitment. Results of this study may be used to inform decisions pertaining to the management of sweet clover in semi-arid native grasslands, including the conservation of plant and microphyte biodiversity.

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80. UNDERSTANDING GRAZING INDUCED CHANGES IN CARBON STORES THROUGH MICROBIAL PATHWAYS AND PROCESSES. Daniel B. Hewins*¹, Xiaozhu Chuan², Donald F. Schoderbek¹, Mark P. Lyseng³, Barry Adams⁴, Scott X. Chang¹, Cameron N. Carlyle¹, Edward W. Bork¹; ¹University of Alberta, Edmonton, AB, ²University of Alberta, Edmonton, Canada, ³Grad student, Edmonton, AB, ⁴Government of Alberta, Lethbridge, AB

ABSTRACT

Grasslands are globally ubiquitous ecosystems that provide ecological goods and services including forage, biodiversity, and carbon (C) storage. Grassland carbon pools are documented as storing >30 % of carbon globally, and research suggests that there is potential to increase carbon storage via management practices at a rate of 0.5 Pg carbon y⁻¹. In Alberta, Canada, the Alberta Livestock and Meat Agency is funding research to develop programs that will reward livestock producers for protecting carbon similar to those rewarding conservation tillage. To support this, we have quantified the total carbon profile of native grasslands (n=120 sites with paired long-term grazed and ungrazed treatments; 240 plant communities) in Alberta's Aspen Parkland, Foothills Fescue and Mixedgrass Prairie. We measured total carbon in above and belowground vegetation, litter, organic soil and mineral soil horizons to 30 cm depths. Recently we have extended this work to include carbon transformations by studying litter decomposition of predominant increaser and decreaser species at a subset (n= 33) of representative plant communities. These communities are paired with either presence/absence of grazing (n=24) or a three-way comparison among management intensive grazing, continuous grazing and absence of grazing (n= 9). In this study we will measure the decay rate of plant material, changes in litter chemistry and study the activity of microbial decomposers, the proximate drivers of carbon cycling, within litter and associated soil organic matter. The importance of this study is twofold as we will study microbial communities, a large component of the live carbon pool, and microbial function, the driver of carbon cycling, all in the context of grazing management. Ultimately we will link these projects to develop a dynamic framework that will inform policy to reward producers for protecting existing carbon and implementing grazing management strategies able to increase carbon in litter and soil pools.

81. USDA NORTHERN PLAINS REGIONAL CLIMATE HUB. Justin D. Derner*¹, Linda Joyce², Rafael Guerrero³; ¹USDA-ARS, Cheyenne, WY, ²US Forest Service, Fort Collins, CO, ³USDA NRCS, Fort Worth, TX

ABSTRACT

On February 5, 2014, USDA Secretary Vilsack announced the selection of seven “Regional Hubs for Risk Adaptation and Mitigation to Climate Change”, to deliver science-based knowledge, practical information and program support to farmers, ranchers, forest landowners, and resource managers to support decision-making related to climate change. The Climate Hubs are needed to maintain and strengthen agricultural production, natural resource management, and rural economic development under increasing climate variability. The Climate Hubs will provide technical support to USDA agriculture and land management program delivery by offering tools, strategies and management options for climate change response. The Hubs will translate climate change projections into potential impacts on the agricultural and forestry sectors. Using this information, along with data on past trends, the Hubs will provide periodic regional assessments of risk and vulnerability in the agriculture and forestry sectors to help land managers better understand the potential direct and indirect impacts of a changing climate. The Hubs will provide outreach, education and extension to farmers, ranchers, forest landowners, and rural communities on science-based risk management through the land grant universities, Cooperative Extension, USDA service agencies, and public/private partnerships. The vision of the USDA Northern Plains Regional Climate Hub, which encompasses Montana, Wyoming, Colorado, North Dakota, South Dakota and Nebraska is: agricultural producers (farmers, ranchers and forest landowners) utilizing user-specific information, tools and management practices in enhanced decision making for adaptation strategies to weather variability for reduction of enterprise risk, increased resilience of working lands and enhancement of local communities.

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82. APPLYING ECOLOGICAL SITE DESCRIPTIONS TO LAND RESTORATION DECISIONS. Joel R. Brown*, Curtis Talbot; USDA NRCS, Las Cruces, NM

ABSTRACT

Information contained in Ecological Site Descriptions (ESDs) can provide a consistent and systematic basis for the application of management practices to restore range and forest land plant communities after disturbance. Regardless of whether degradation is a result of chronic misuse (overgrazing) or acute disturbance (fire), state-and-transition models (STMs) contained in ESDs and interpretations can direct on-the-ground application of technologies and management. The successful application of STMs requires well defined diagnostics for classifying land into unique ecological states and plant communities so that initial soil and vegetation conditions can be objectively assessed to develop a credible inventory. Transitions must clearly describe the ecological pro-

cesses and feedbacks that maintain undesirable ecological states and how management can be implemented to overcome inertia and restore desired plant communities. These processes should be explicitly linked to well-defined conservation practices, including indicators that can be measured to gauge progress toward objectives. Finally, an information system that can serve as a database for analyzing successes and failures is required to test restoration concepts and practices.

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83. LANDSCAPE-SCALE MANAGEMENT PLANNING: DISTURBANCE RESPONSE GROUPS AND ECOLOGICAL SITES. Tamzen K. Stringham*¹, Patti J. Novak-Echenique²; ¹University of Nevada Reno, Reno, NV, ²USDA-NRCS, Reno, NV

ABSTRACT

Ecological Site Descriptions (ESD) synthesize information concerning soils, hydrology, ecology, and management into a user friendly document. A crucial component of an ESD is the state-and-transition model (STM) that identifies the different vegetation states, describes the disturbances that caused vegetation change, and the restoration activities needed to restore plant communities. Many landscape-scale management planning activities such as fire rehabilitation occur at scales far larger than the individual ecological site scale therefore we have developed a robust method for aggregating ecological sites into groups that respond similarly to the same disturbances. An expert team of range and soil scientists follows a multi-step approach to response group development: (1) review MLRA characteristics, (2) establish guidelines for STM development, (3) sort ESDs into dominant cover type groups, (4) sub-divide cover type groups by climate, production and soil properties, (5) evaluate response to disturbances, and (6) define the soil-site concept for each group and select a modal ecological site. A draft STM is developed for the modal site prior to field investigation. The end product is a Disturbance Response Group (DRG) consisting of multiple ecological sites with one robust STM. The DRG can be mapped spatially within a MLRA and often consists of millions of acres. This technique is ecologically sound and provides management with a landscape-scale tool for multiple applications including monitoring, habitat restoration, fire rehabilitation and allotment planning.

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84. FUELS MANAGEMENT BY DISTURBANCE RESPONSE GROUPS. Cody Coombs*¹, Tamzen K. Stringham², Patti J. Novak-Echenique³; ¹Bureau of Land Management, Ely, NV, ²University of Nevada Reno, Reno, NV, ³USDA-NRCS, Reno, NV

ABSTRACT

State-and-Transition models (STM) describe the response of ecological sites to various management treatments including brush beating or mowing, pinyon-juniper chaining, hand felling, masticating and prescribed burning. Fuels management

*Presenter

planning occurs at scales larger than individual ecological sites, therefore the development of Disturbance Response Groups and their associated STMs has enhanced our ability to predict plant community response to treatment. BLM in collaboration with the University of Nevada, Reno and Nevada NRCS has been assessing multiple fuels treatment and wildfire responses within the context of STMs in order to improve future fuels and habitat improvement projects. Results of these investigations will be presented.

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85. POST-FIRE VEGETATION RESPONSE BY ECOLOGICAL SITE IN NEVADA. Patti J. Novak-Echenique*; US-DA-NRCS, Reno, NV

ABSTRACT

Wildland fire is a natural disturbance and an important driver of ecological change. With the development of State and Transition Models, post-fire vegetation response was documented on several ecological sites in five Major Land Resource Areas in Nevada. An expert team of rangeland scientists, soil scientists, wildlife biologists and fuels specialists with many years of experience working in Nevada examined and documented ecological site properties on wildfire and prescribed fire areas. Post-fire vegetation response is dependent on ecological site characteristics, pre-fire vegetation conditions, as well as post-fire climatic conditions and management decisions. Different ecological sites were found to exhibit varying levels of resiliency as were different states within the same ecological site. Understanding differences in resiliency is important in developing post-fire management scenarios.

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86. POST-FIRE RESPONSE UNDER DIFFERENT GRAZING MANAGEMENT SCENARIOS. Tamzen K. Stringham¹, Devon K. Snyder^{*1}, Chad S. Boyd²; ¹University of Nevada Reno, Reno, NV,²USDA-ARS, Burns, OR

ABSTRACT

After fire, the decision to rest or graze a pasture is a difficult one, particularly when managing for a variety of resource conditions and ecological sites. This research project aims to provide ecologically based understanding of the effects of various grazing management schemes on post-fire vegetation communities. Five exclosure plots were established in two different Disturbance Response Groups (DRGs) in Northern Nevada to examine effects of spring grazing, fall grazing, and rest (control) on vegetative response. Treatments were applied manually using weed eaters in May/June for spring treatments and September/October for fall treatments. In addition, natural grazing in one of the DRGs was studied as cows were allowed back in the allotment 8 months after fire. Measurements were taken on vegetation composition, basal gap, annual production, and density of shrub seedlings. Results will show plant community response to different lengths of rest and different seasons of use after fire. Project results will help land managers stratify

**Presenter*

post-fire management decisions across large landscapes based on pre-fire condition, measured plant community response, and quantified ecological thresholds. Preliminary results suggest natural grazing 8 months following fire significantly suppressed cheatgrass cover followed by growing season use. Additional results will be presented at the 68th annual SRM meeting.

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87. MANAGERS, MONEY, MODELS: HOW IT ALL FITS TOGETHER . Mindy Seal*; BLM, Ely, NV

ABSTRACT

Half the battle to developing models is finding the funding. Researchers and scientists often have a tender spot for models; managers -- maybe not so much. Managers often see models as intangible objects that get developed and then never get used. Models can be complex to use. Or considered outdated within years of their development. So how do you get managers' support for state and transition models? The BLM Ely District faced this very issue 3 years ago. This presentation will address how to persuade managers that State and Transition Models are worth the effort and cost; and who the real beneficiary is.

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88. STAYING CALM WHILE IMPLEMENTING CALM: ADAPTIVELY LEARNING FROM PARTICIPATORY RESEARCH IN NORTHWESTERN COLORADO AND WYOMING. Retta A. Bruegger^{*1}, Maria Fernandez-Gimenez², Crystal Y. Tipton², Cameron L. Aldridge³, Greg Brown⁴, Christopher P. Dickey⁵; ¹Colorado State University, Grand Junction, CO, ²Colorado State University, Fort Collins, CO, ³Colorado State University & USGS, Fort Collins, CO, ⁴Routt County Weed Program, Steamboat Springs, CO, ⁵MS Student at Colorado State University, Fort Collins, Fort Collins, CO

ABSTRACT

Collaborative Adaptive Landscape Management (CALM) has been promoted as the new paradigm for responding to change and unpredictability in complex, dynamic social-ecological systems. While the need for CALM is widely accepted, successful examples of how to integrate diverse knowledge sources and apply knowledge in an adaptive management framework lags behind. Learning from the Land, an interdisciplinary, participatory research and outreach project in northwestern Colorado and Thunder Basin, Wyoming, engages a variety of stakeholders in an adaptive management process to develop and refine state-and-transition models (STMs) that can be used to guide future management actions, and to increase understanding of the interaction of management, climate, and disturbances on transitions within and across ecological sites. We engage ranchers, agency land managers, Extension personnel and others via workshops and meetings throughout the research process. Engaging participants early and consistently has enabled us to test innovative, manager-identified hypotheses and gain crucial insights into fine-scale landscape history. Manag-

ers have provided land, equipment, and practical skills that have made management-relevant experiments possible. However, the time and effort required to cultivate stakeholder relationships currently limits the needed expansion from Collaborative Adaptive Management (CAM) to CALM. Further, successful collaboration with stakeholders requires that researchers share ownership of the research process. Researchers must work to make the process transparent and iteratively share results with stakeholders at an early stage of analysis, rather than waiting until all analyses are finalized. This is key to fostering stakeholder participation and input. Though not without challenges, Learning from the Land illustrates a process built upon genuine collaboration among managers and researchers, in order to increase the understanding of complex social-ecological systems, and make direct links between scientific research and action on the ground.

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89. COLLABORATIVE ADAPTIVE LANDSCAPE MANAGEMENT FOR DIVERSE STAKEHOLDER GOALS: A PARTICIPATORY GRAZING MANAGEMENT EXPERIMENT. Leslie M. Roche*¹, Lorien Jasny², Mark N. Lubell¹, Kenneth W. Tate³; ¹University of California, Davis, Davis, CA, ²National Socio-Environmental Synthesis Center (SESYNC), Annapolis, MD, ³University of California Davis, Davis, CA

ABSTRACT

Grazed rangeland ecosystems encompass diverse global land resources, and are complex social-ecological systems from which society demands both goods (e.g., livestock and forage production) and services (e.g., abundant and high quality water). Both quantitative and qualitative assessments indicate a key need for collaborative development, design, and testing of management hypotheses at scales most relevant to linked ecological and economic systems. To address this key need, our research team has partnered with diverse stakeholder groups to conduct a long-term, ranch-scale experiment evaluating the effectiveness of adaptive grazing management for multiple social-ecological services. We invited 55 rangeland stakeholders to two day-long workshops to identify land management goals and strategies for 485 hectares of annual, winter growing season rangeland at a University of California rangeland research facility in Northern California. These stakeholder participants included traditional ranchers running a livestock economic enterprise, conservation professionals who use grazing to pursue environmental goals, and professional rangeland managers who serve clientele with diverse goals. Participants in each workshop were divided into four groups (i.e., one homogenous group of each stakeholder type, as well as one mixed group) and asked to discuss goals, challenges to achieving goals, and management strategies they would like to see tested. Throughout the workshops, we used computer-based surveys to capture recommended goals, challenges and management strategies. We also used a network approach to examine the mental models and social learning processes within each of the four groups. Representatives from the workshops were asked to serve on an advisory board, which

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we have continued to work with in implementing, adapting, and examining the effectiveness of the stakeholder prescribed strategies. Here, we highlight lessons from this project, including ongoing results and benefits of this “bottom-up” network approach and the social and ecological constraints in integrating adaptive, landscape-level science and management.

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90. COLLABORATIVE ADAPTIVE LANDSCAPE MANAGEMENT: COMMUNAL GRAZING SYSTEMS IN CENTRAL MEXICO. Elisabeth Huber-Sannwald*¹, J Tulio Arredondo Moreno¹, Miguel Luna Luna²; ¹Instituto Potosino de Investigacion Cientifica y Tecnologica, San Luis Potosi, Mexico, ²Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias, Vaquerias, Mexico

ABSTRACT

Land use and land cover change in Mexico’s drylands has been highly dynamic in space and time concomitantly coupling and decoupling ecology, culture, economics, and politics between people and land. Most drylands in Central Mexico are communal rangelands, so-called ejidos, where most ejido members have the right to use the land mostly for cattle production. Dryland use is currently mostly dedicated to livestock production at the expense of most staple food, base food crops, native grass species and the provision of ecosystem goods and services associated with multifunctional landscapes. Changes in rural land tenure in ejido land triggered and accelerated by the 1992 reforms of Article 27 of the Mexican Constitution launched a wave of privatization of communal land with direct and indirect short and long term consequences on the multifunctional nature of dryland landscapes. While most ejidos maintain at least to some degree communal land ownership and communal use areas for risk avoidance, some ejidatarios benefit from an additional titling process both, to enter rental markets or to acquire a small-parceled pasture for cattle production. Parceling out and fencing in of small hectare-grazing plots and the establishment of water ponds, in former communal lands, however has been leading to severe fragmentation of rangeland landscapes with consequences on local and regional hydrology, rangeland ecological function, adaptive capacity and system resilience. Newfound interests to strengthen communal efforts should target rangelands as social-ecological systems and thus as providers of multiple ecosystem goods and services, whose demands while potentially greatly fluctuating, will eventually stimulate the generation and maintenance of highly diverse multifunctional landscapes. Also, fostering local knowledge systems will then naturally lead to communal (= collaborative) adaptive (to drought, price shocks, etc.) management and thereby enhance local food security, local livelihood development, and rural sustainability.

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91. PRESCRIBED BURN ASSOCIATIONS IN AN ADAPTIVE MANAGEMENT FRAMEWORK. Dirac Twidwell*; University of Nebraska - Lincoln, Lincoln, NE

ABSTRACT

Adaptive management is an approach to natural resource management that uses structured learning to reduce uncertainties for the improvement of management over time. The origins of adaptive management are linked to ideas of resilience theory and complex systems. It is not a panacea for wicked problems and is only appropriate in certain circumstances. Rangeland management is particularly well-suited for the application of adaptive management, having sufficient controllability and reducible uncertainties. Adaptive management applies the tools of structured decision making and requires monitoring, evaluation, and adjustment of management. Adaptive governance, involving sharing of power and knowledge among relevant stakeholders, is often required to address conflict situations. Natural resource laws and regulations can present a barrier to adaptive management when requirements for legal certainty are met with environmental uncertainty. However, adaptive management is possible as part of private lands management, as illustrated by the growth of landowner prescribed burn associations. We discuss how landowners have used prescribed burn associations within an adaptive management framework to overcome challenges and limitations to the use of prescribed fire. When applied appropriately, adaptive management enhances structured learning, and should be further explored as part of structured rangeland management decision-making.

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92. DEVELOPING A COLLABORATIVE RANGELAND MANAGEMENT SYSTEM FOR MONGOLIA. Bulgamaa Densambuu*¹, Budbaatar Ulambayar², Ankhtsetseg Battur², Brandon T. Bestelmeyer³; ¹Green Gold Mongolia, Ulaanbaatar, Mongolia, ²The Administration of Land Affairs, Geodesy & Cartography in the Ministry of Construction and Urban Development, Ulaanbaatar, Mongolia, ³USDA-ARS Jornada Experimental Range, Las Cruces, NM

ABSTRACT

In response to widespread reports of rangeland degradation across Mongolia, the donor-supported Green Gold Mongolia program has worked with the Mongolian government to institute a system of sustainable rangeland management practices. The core of the system is the formation of Pasture Users Groups (PUGs) that maintain customary arrangements of communal pasture use and transhumance, but that can cooperatively regulate livestock numbers, timing of use, and develop infrastructure. To facilitate the sustainable use and restoration of rangeland resources, Green Gold is developing ecological site descriptions (ESDs), an associated inventory and monitoring program, and pasture-use planning protocols to communicate the characteristics of degraded states, recommended carrying capacities for different ecological sites and states, and identify restoration strategies and timelines. The goal is for PUGs and national govern-

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ment to use ESDs as a basis for mapping, planning, and monitoring. Due to the institutional complexity of rangeland management in Mongolia, the success of this approach depends strongly on stakeholder collaboration at both local (herders, local technicians and land managers working for four separate ministries) and national levels (academics, ministry heads, parliament members, and the president's office). We describe the process by which we are working with stakeholders at different levels to develop a national PUG-ESD-based management system. We are close to developing durable rangeland management policy and institutional arrangements, but significant challenges lie ahead.

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93. CALMING THE RANGELAND CONFLICT: THE MALPAI BORDERLANDS GROUP. Nathan F. Sayre*; University of California, Berkeley, Berkeley, CA

ABSTRACT

The Malpai Borderlands Group was formed in 1994 by ranchers in a 1,250 square mile area in extreme southwestern New Mexico and southeastern Arizona, as a direct attempt to resolve the so-called rangeland conflict through collaborative, adaptive, landscape-scale management. The threats of suburban development, shrub encroachment, and insecure public land grazing permits together inspired a coalition of ranchers, state and federal agencies, scientists and environmental groups to put aside their various and long-standing differences in favor of an alternative approach. In several regards, the Malpai Group has achieved remarkable success: roughly two-thirds of the area's private lands are now protected from development by conservation easements, and federal grazing permits have been made more secure by scientific research, collaborative conservation projects, and collective agreements with agencies to protect endangered species. One of the Group's central goals—restoring the region's evolutionary fire regime—has been only partially and haltingly achieved, for reasons that indicate the limits of collaborative adaptive management in US rangelands today. Technologies of remote sensing, ecological site descriptions, and state-and-transition models are now being developed to help address these limits, although it remains unclear whether they will be sufficient to overcome what are fundamentally social and political obstacles.

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94. ADAPTIVE GRAZING MANAGEMENT FOR BEEF AND BIRDS IN THE WESTERN GREAT PLAINS. David Augustine*¹, Justin D. Derner², Maria Fernandez-Gimenez³; ¹USDA-ARS, Fort Collins, CO, ²USDA-ARS, Cheyenne, WY, ³Colorado State University, Fort Collins, CO

ABSTRACT

Sustainable grazing management strategies for the western Great Plains have been developed for forage and livestock production. However, ongoing declines and range contractions of many grassland birds alongside a desire to enhance perennial, cool-season grasses for increased productivi-

ty and vegetation structural heterogeneity has challenged managers to consider broader management objectives. Prior research has not addressed livestock movement patterns at scales relevant to ranchers or landscape disturbance patterns pertinent to grassland birds. As a result, there is considerable uncertainty (and controversy) about how plant community dynamics, grassland bird habitat and livestock production can be optimally balanced. In 2012, we initiated an adaptive grazing management experiment in shortgrass steppe of Colorado where 10 stakeholders representing ranchers, government agencies, and conservation organizations were assembled to 1) choose and prioritize desired ecosystem services, 2) determine criteria and triggers for livestock movement among pastures in an adaptive manner to achieve desired services, and 3) select monitoring approaches to assess management success and inform adaptive strategies. Pastures managed by the stakeholder group are paired with pastures managed using traditional, season-long continuous grazing at the same stocking rate in a replicated experimental design. The first two years of stakeholder meetings demonstrated the importance of in-person meetings to discuss varying perspectives on the system's potential response to grazing management. Increasing the spatiotemporal variability in cattle grazing intensity emerged as a key goal of the adaptive management treatment, with objectives for grassland bird recovery set at community/landscape scales, and for recovery of desired perennial cool-season grasses at ecological site/pasture scales. Technological needs include improved methods for rapidly summarizing and visualizing monitoring data at the landscape scale. The effort has revealed constraints on management imposed by the experimental design, while also validating the critical importance of control treatments and effective communication of monitoring data for adaptive management.

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95. COLLABORATIVE ADAPTIVE LANDSCAPE MANAGEMENT (CALM) IN RANGELANDS: DISCUSSION OF GENERAL PRINCIPLES. Brandon T. Bestelmeyer*¹, James R. Miller²; ¹USDA-ARS Jornada Experimental Range, Las Cruces, NM, ²University of Illinois, Urbana, IL

ABSTRACT

The management of rangeland landscapes involves broad spatial extents, mixed land ownership, and multiple resource objectives. Management outcomes depend on biophysical heterogeneity, highly variable weather conditions, land use legacies, and spatial processes such as wildlife movement, hydrological connectivity, and fire that interact with management actions. Given the high level of uncertainty in management responses and the importance of processes at the landscape level, collaborative adaptive management has emerged as an important framework for rangeland stewardship. Collaborative adaptive management emphasizes cooperative planning, learning, and adjustment of actions in response to new knowledge. The term "landscape" might usefully be added when cooperation, learning, and implementation involve processes and outcomes at the land-

scape level (collaborative adaptive landscape management, CALM). There is, however, little synthetic information about the application of CALM in rangelands. In this talk/discussion, we will draw upon core ideas raised during the preceding presentations on CALM projects to identify a set of general principles, tools, and best practices that can help to refine and inspire CALM approaches.

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96. OVERVIEW OF PRACTICES TO MINIMIZE WILDLIFE-LIVESTOCK CONFLICTS. Brian Bean*; Lava Lake Lamb, Hailey, ID

ABSTRACT

A suite of nonlethal deterrents and strategies are available to livestock producers to aid in the reduction or prevention of livestock-predator conflict. These tools include turbofladry, livestock guarding dogs, and light and sound deterrents as well as grazing management and animal husbandry strategies. As predators return to historic suitable habitat it is important that livestock producers, rangeland managers, and relevant agency officials are aware of the tools available and begin implementing them before conflicts arise. In 2008 producers, Defenders of Wildlife and local government started the Wood River Wolf Project, initiated to protect livestock and wolves based on evidence that reactively killing wolves alone failed to prevent future livestock losses. Working together, environmentalists, ranchers, scientists and government officials have nearly eliminated sheep losses to wolves in the Idaho project area while increasing stability of extant wolf packs. The project's methods include nonlethal deterrents and improved animal husbandry techniques, stakeholder trust-building and empowerment, and a unique community-based conflict transformation model. In the project's seven years, only 25 out of more than 25,000 sheep grazing annually in the project area have been lost, and no wolves have been removed.

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97. PREDATOR PROTECTION AND MARKETING STRATEGIES FOR SHEEP GROWERS. Dan Macon*; Flying Mule Farm, Auburn, CA

ABSTRACT

Flying Mule Farm, a small-scale commercial sheep operation in the Sierra Nevada foothills, employs an integrated non-lethal predator protection strategy. Using electric fencing, llamas, livestock guardian dogs, frequent pasture rotation and situational/environmental awareness, Flying Mule Farm coexists with domestic and wild predators, including domestic dogs, coyotes, mountain lions and a variety of aerial predators. The operation markets grass-fed lamb, mutton and woolen goods, as well as targeted grazing services, and its predator-friendly practices are part of the company's marketing strategy. Owner Dan Macon will discuss the specifics of Flying Mule Farm's predator protection and marketing strategies.

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98. STOCKMANSHIP AND REWILDING OF LIVESTOCK TO REDUCE AND PREVENT PREDATION. Kent A. Reeves*; The Whole Picture Consulting, LLC, Sacramento, CA

ABSTRACT

Stockmanship or low-stress livestock handling principles developed by Bud Williams are powerful tools for grazing lands management. The use of stockmanship to ‘rewild’ or train livestock to behave and move as a herd can also reduce and prevent predation of domestic livestock. Some predation of livestock is an inherent localized site factor. These factors include type of predator (lion, hyena, lynx, wolf etc.), predatory behavior (nocturnal, stealth, pack etc.), and habitat. Predation can be mediated by changing livestock behavior with stockmanship principles and traditional herding methods. Traditional herding methods of East Africa, Europe, Mongolia, and North America with the combination of stockmanship principles to reduce and prevent livestock predation will be discussed.



99. HUSBANDRY TECHNIQUES TO REDUCE LIVESTOCK DEPREDATION IN WOLF AND GRIZZLY COUNTRY. Hilary Zaranek*; Anderson Ranch; Tom Miner Association, North Yellowstone, MT

ABSTRACT

Raising cattle in southwestern Montana outside of Yellowstone National Park has led a community to creatively develop and practice proactive ranching methods to minimize conflicts between livestock and large predators. Additionally they seek to improve rangeland health and wildlife habitat and support sustainable ranching businesses across the landscape. To achieve these goals, the community seeks to open and create middle ground between all involved by focusing on creating ways to minimize the challenges of ranching with wolves and bears through progressive ranch management. Low-stress stockmanship, with an aim to encourage natural herding and mothering behaviors to protect vulnerable young from predators, as well as increased human presence from range riders is currently being practiced with an aim to reduce livestock-predator conflict and has produced encouraging outcomes. This presentation will discuss experiences with low-stress stockmanship and other husbandry techniques in wolf and grizzly country and implications for their use in additional contexts and circumstances.



100. STRATEGIC GRAZING MANAGEMENT: A NEW CENTERPIECE FOR LIVESTOCK-CARNIVORE COEXISTENCE, AND A CONTEXT FOR PREVENTATIVE TOOLS. Matt Barnes*; Keystone Conservation, Bozeman, MT

ABSTRACT

Livestock – large carnivore coexistence practitioners can be more effective by expanding from a direct focus on car-

nivores and predation-prevention tools to the broader social-ecological context of ranches and rural communities, especially livestock management. The most groundbreaking grazing management is inspired by nature, involving rotations with high stocking density and frequent movement, as recently shown but not yet widely adopted. Modeling livestock management after the grazing patterns and reproductive cycles of wild ungulates in the presence of their predators can improve rangeland health and livestock production—and increase the ability of ranching operations to coexist with native carnivores. The central anti-predator behavior of wild grazing animals is to form large, dense herds that then move around the landscape to seek fresh forage, avoid fouled areas, and escape predators. Strategic grazing management involving high stocking density and frequent movement, such as rotational grazing and herding with low-stress livestock handling, can improve rangeland health and livestock production, by managing the distribution of grazing across time, space, and plant species. Synchronized calving seasons (modeled on predator satiation in wild herbivores) can increase livestock production and reduce labor inputs, especially when timed to coincide with peak availability of forage quality. Such livestock management approaches based on anti-predator behaviors of wild ungulates can directly and synergistically reduce predation risk—while simultaneously establishing a management context in which other predation-prevention practices and tools can be used more effectively. Recent projects on ranches and National Forest allotments in the U.S. Northern Rockies have successfully increased stocking density with temporary cross-fencing and herding, or by rekindling the herd instinct using low-stress livestock handling; such herds have had no or very few conflicts with wolves or grizzly bears.



101. WILDLIFE-LIVESTOCK CONFLICT AVOIDANCE MEASURES: OBSTACLES TO IMPLEMENTATION. Craig Miller*; Defenders of Wildlife, Tucson, AZ

ABSTRACT

As predators reclaim more of their historic range, land managers, livestock producers, conservation groups, and government agencies must find solution-oriented approaches to minimizing conflict. While nonlethal deterrents and coexistence methods are proving effective, there are a variety of obstacles to successful implementation. Obstacles include conflicting management objectives between agencies with overlapping jurisdiction, fear of litigation, resistance to provide guidance to other permitted users, and a lack of flexibility to implement management tools and methods not previously identified in forest or allotment management plans. Certain policies, such as the non-essential experimental designation of the Mexican gray wolf, impede the use of nonlethal deterrents because interpretation of the rule has made wolf recovery a lower priority than other permitted land uses. Personnel changes within agencies, ranch ownership and conservation organizations make it difficult to achieve and maintain the necessary levels of trust. Removal of wolves, lethal

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or nonlethal, can lead to destabilized pack social structure which may result in an increase in depredations associated with naïve wolves and may require ranch managers and herders to relearn pack behaviors and adjust livestock management strategies accordingly. Identity-based conflicts between ranchers and other stakeholders can make problems less about wolves and livestock and more about who controls federal land and natural resources. Lack of familiarity with tools and techniques, as well as fear of being ostracized within communities also influence the success of nonlethal conflict avoidance projects. Finally, funding for nonlethal deterrents and conflict avoidance strategies is often a leading obstacle to implementation. Community-based partnerships offer great promise to overcoming most obstacles, but they must work within a larger, robust nationwide program to provide performance-based payments for ecosystem services and offset the costs of adopting new tools and technology to improve agricultural production. The Agriculture Act may be such a source.

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102. ESTABLISHING A COMMUNITY-OWNED AND OPERATED COEXISTENCE PROJECT. Sisto Hernandez*; Chair, Mexican Wolf/Livestock Coexistence Council, Whiteriver, AZ

ABSTRACT

In 2011 the U.S. Fish and Wildlife Service established The Mexican Wolf/Livestock Coexistence Council, an 11-member group of ranchers, tribes, conservation organizations and county coalitions to forge a long-term solution to wolf/livestock conflicts related to Mexican wolf recovery. The result is an innovative program which provides funds annually to affected ranchers based on proximity to wolf territory or core use area, the number of wolf pups that survive to December 31st of the same year, the number of livestock exposed to wolves, and the rancher’s participation in conflict avoidance measures. Funds may also be used to support conflict avoidance measures. This innovative community-owned and operated program, based on the collective experience of affected ranchers, regional conservationists and federal, state and tribal agency managers is a new model for a long-term, sustainable solution to wildlife–livestock conflicts.

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104. COMMUNITY-BASED RESOURCE MANAGEMENT ACROSS PRIVATE AND PUBLIC INTERESTS . Jim Stone*; Chair, Partners for Conservation; Rolling Stone Ranch, Ovando, MT

ABSTRACT

The Blackfoot Challenge is a landowner-based group that coordinates management of the Blackfoot River, its tributaries, and adjacent lands. The Blackfoot Challenge follows a consensus-based approach to include all public and private stakeholders: to coordinate efforts to conserve and enhance the natural resources and rural way of life in the Blackfoot Watershed of western Montana for present and future generations. Assuming a “ridge-top to ridge-top” approach,

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Blackfoot Challenge members have established committees and work groups to address evolving issues associated with the natural resources and rural way of life in the Blackfoot. Since 2002, the Wildlife Committee, in coalition with its numerous public and private partners, has established both the Carcass Pick-Up and Range Rider Programs, installed electric fencing around beehives and calving grounds, and utilized bear-resistant dumpsters to reduce predator activity throughout the watershed. The area has experienced a 93 percent reduction in grizzly bear conflicts since 2003.

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105. OUR DAUNTING NEW CHALLENGE: INTEGRATING TWO REQUISITE NEEDS FOR THE CONSERVATION AND MAINTENANCE OF RANGELANDS. Richard N. Mack*; Washington State University, Pullman, WA

ABSTRACT

Increasing demand for the resources derived from rangelands (e.g. forage, conservation of water and biodiversity) coupled with the growing threat from climate change to the composition, extent and sustainability of rangelands to provide these resources compels ecologists, range mangers and others to swiftly adopt an unprecedented dualism in the practice of their profession. On the one hand, we need to dispassionately examine and when necessary revise, augment and even replace those range practices that current and future science-based research signals as ineffective, inappropriate or even detrimental. Emergence and timely implementation of best practices and policies will be dependent as never before on conducting a critical examination of long held tools and tenets of rangeland science. Accomplishing that multi-faceted goal will in itself daunting. Our task becomes even more challenging given the need to cogently report our research through frank discussion with all stakeholders (land owners, ranchers, elected and appointed officials and especially the general public). Such outreach will strengthen the argument for the public as to the need for sustained and adequately funded research for preserving functioning, productive rangelands. This new role will be time-consuming, undoubtedly frustrating at times and require that we become effective in speaking to all segments of society – a role for which many of us were not originally trained. Unschooled as we may be now, the stakes are too high to neglect the need to convey the results of our research as well as the necessity of this research to the public.

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106. THE RELATIVE IMPORTANCE OF BIOTIC AND ABIOTIC FACTORS FOR DRIVING RESTORATION OUTCOMES IN RANGELAND SYSTEMS. Elise Gornish*¹, Jeremy J. James²; ¹University of California, Davis, Davis, CA, ²Sierra Foothill Research and Extension Center, Browns Valley, CA

ABSTRACT

Strategies to mitigate ecological and economic damage that will be incurred from climate and land use changes require

immediate and active implementation. However, current research may be insufficient to deliver the data that restoration practitioners need to design and implement successful intervention strategies on rangeland habitat. This may be due to the lack of a comprehensive understanding of the mechanisms driving recruitment in degraded rangeland systems, which are critical for making predictions of how populations in these habitats will ultimately respond to restoration efforts. In order to identify and predict general patterns of recruitment limitations in a way that would increase our ability to manage intervention outcomes, we conducted a multi-state experiment across degraded sagebrush-steppe habitat in the Great Basin, where we seeded out four perennial bunchgrass species into experimental sites. We followed the short-term patterns of early life history traits of the restoration species across biotic (density of cheatgrass, a common invasive species) and abiotic (weather and soil texture) gradients. We found that biotic and abiotic gradients modify population bottlenecks of restoration species in different ways. Abiotic gradients of soil type, and soil moisture constrain germination and establishment of seeded restoration species. However, the density of cheatgrass appears to restrict population growth rate by limiting first year survival of restoration species. This work highlights the value of providing the information that allows restoration practitioners to make predictions of how populations in degraded rangeland habitats will ultimately respond to restoration efforts across regions.

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107. WEATHER DATA, FORECASTING AND ADAPTIVE MANAGEMENT PLANNING FOR RANGELAND RESTORATION. Stuart P. Hardegree^{*1}, John T. Abatzoglou², Roger Sheley³; ¹USDA Agricultural Research Service, Boise, ID, ²University of Idaho, Moscow, ID, ³USDA- ARS, Burns, OR

ABSTRACT

Arid and semi-arid rangelands are characterized by high variability in seasonal and annual weather patterns, topography and soils. This variability significantly complicates restoration scenarios on rangelands that have been disturbed by frequent wildfire and introduced annual weeds. Prescriptive restoration practices designed to optimize site favorability are inadequate in the majority of years due to weather constraints. Restoration scenarios that focus on single-year intervention may also yield short-term or partial success that doesn't meet longer term objectives for establishment of diverse and resilient plant communities. Published restoration science is biased toward favorable weather conditions and should be interpreted in the context of longer-term site variability. Development of economically efficient and sustainable restoration in this environment will require long-term, ecologically based adaptive management planning and implementation, and strategic use of weather, climate and forecasting technology. Short term resources for fuels-reduction and post-fire stabilization and rehabilitation should be leveraged with longer-term restoration planning that includes contingencies for alternative weather conditions. Emerging

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technologies for site and application-specific seasonal forecasting may significantly enhance the economic efficiency of restoration practices on western rangelands.

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108. THE HISTORY, ROLE AND POTENTIAL OF INTEGRATING ECONOMICS INTO RESTORATION DECISIONS. L. Allen Torell^{*1}, Teresa Sedlacek¹, Joel R. Brown²; ¹New Mexico State University, Las Cruces, NM, ²USDA NRCS, Las Cruces, NM

ABSTRACT

In the current environmental era we are focused on the protection of nature and the reversal of rangeland degradation. Yet, economic studies that place a dollar value on improved rangeland health and estimate the conservation benefits realized because of restoration efforts are nearly non-existent. The minimal role of economics in restoration decisions occurs for two primary reasons. First, the valuation process requires an assessment of expected change, what is being gained, and what is being given up by taking a particular action. The long-term studies and measurements required to predict altered ecosystem provisioning because of restoration efforts are seldom available. Second, most conservation values are not revealed in an observable market and economic valuations must rely on questionable stated-preference methods, primarily survey questions about monetary amounts, choices, ratings and preferences. State-and-Transition Models (STM) and a national database of Ecological Site Descriptions (ESDs) have been developed to frame rangeland management decisions within a dynamic context. The STM framework has potential for providing the detail, probabilities and estimates of change required for economic analysis of restoration projects. Our presentation will explore the potential for expanding the role of economics in restoration decisions and demonstrate how the STM Framework might assist in estimating ecosystem provisioning and economic values for restoration projects. The limitations and level of completeness and detail required in order for STM models to be useful for economic studies will be highlighted along with other valuation obstacles.

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109. INTEGRATING ECOLOGY INTO DYNAMIC ECONOMIC MODELS TO SUPPORT RANGELAND DECISION-MAKING. Kimberly S. Rollins^{*}; University of Nevada, Reno, Reno, NV

ABSTRACT

Restoration and rehabilitation of rangelands involves potentially large up-front and continuing investments of resources at landscape scales, with uncertain long term results. Given that resources and budgets are limited, estimates of the economic costs and benefits of alternative management options – including the timing, location and sequencing of actions across a landscape – provide valuable information for achieving restoration and management goals. A particular challenge in estimating economic benefits and costs in the

context of rangeland rehabilitation, however, stems from the dynamic and stochastic elements that define the underlying ecological systems. Rehabilitation and restoration actions are often targeted at changing the dynamics of these systems so that they become more resilient to disturbances. Integrated approaches that incorporate ecological state and transition models into economic models can capture important dynamic elements and include uncertainty of whether a particular treatment will be successful, how the probability of success may vary with ecological states, timing, or other management actions, as well as other issues of concern. The goal of such integrated modeling is to provide a practical framework that allows the use of the best available science information to inform rangeland management decisions. This presentation demonstrates results from applications of integrated approaches to combine state and transition models for rangeland and other complex systems into economic models.

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110. SOCIAL-POLITICAL SOURCES OF UNCERTAINTY AFFECTING PUBLIC LAND RESTORATION DECISIONS. Mark Brunson*, Hilary Whitcomb; Utah State University, Logan, UT

ABSTRACT

Land managers' decisions to restore degraded or at-risk rangelands require a certain amount of faith: that we know enough about the site to be able to make the right choices, that seed will be available of sufficient quantity and viability, that weather conditions will be favorable to germination and establishment, and more. When restoration decisions are made for public lands, managers also must cope with uncertainty in societal realms regarding funding decisions, local citizen preferences, and interactions with stakeholders. This talk describes how factors in the social and political system can create barriers to planning and implementation of proactive and post-disturbance restoration activities, drawing upon research conducted in the Great Basin. Data come from interviews of land managers about barriers to post-wildfire recovery, surveys of managers and the general public, and content analysis of interest group comments on proposed restoration activities. Interviews revealed that barriers to improving rehabilitation and restoration after a wildfire include policies and funding cycles that constrain monitoring options, pressure from concerned publics, and pressure and action from interest groups, as well as sources of environmental uncertainty such as weather, climate change, and seed choices. Managers tended to perceive interest groups as being opposed to any management actions. Our analysis of environmental assessments showed that negative comments come from a small segment of interested stakeholders, and they often are not targeted directly at restoration. A public survey in 2013 showed that Great Basin residents strongly support active post-fire restoration, yet only 42% of managers surveyed in 2013 believed that their neighbors agreed with their restoration decisions. When considering proactive restoration, projects defined as "restoration" may be viewed differently from those defined as "fuels reduction,"

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even if the actual practice would be the same in either case. While some of these uncertainties will require policy intervention to address, others may be reduced by greater interaction between managers and the citizens living nearby.

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111. POPULATION AND POLITICS LIMIT RANGELAND RESTORATION OPTIONS IN SOUTHERN ETHIOPIA. David L. Coppock*; Utah State University, Logan, UT

ABSTRACT

The Borana Plateau is a high-elevation, semi-arid landscape. It has been inhabited for centuries by Borana pastoralists, who primarily herd cattle. The pastoral system has long-been regarded as one of the most sustainable in the region, but over the past 30 years destabilization has occurred via unplanned water development and steady growth in the human population. There have been increases in livestock numbers, but large die-offs regularly occur during droughts. The overall effect is a gradual ratcheting down of human welfare over time, with food insecurity and poverty increasing. Livestock pressure has contributed to widespread bush encroachment and soil erosion. In 2012 we started a research project founded on action research and community engagement to assess options to boost forage or livestock productivity. We currently have good and bad news. On the positive side, intense grazing pressure—with utilization rates often over 90%—is encouraging communities to creatively rethink their grazing-management traditions. Another plus is the remarkable recovery of perennial grasses in many sites when bush is removed or grazing protection provided. On the negative side, community assessments reveal that stocking rate is deemed uncontrollable. A new class of super-elite herd owners has emerged as a result of globalized livestock markets, and they are very resistant to destock. The vastly more numerous stockless poor who have been displaced must now survive on food aid. The rangeland environment requires massive restoration efforts that include protection of pond catchments, conversion of bushland to grassland, and re-creation of fodder reserves. This can only be attempted, however, after closely examining local governance—our current project focus. Efforts to catalyze change must consider how to create new incentives for destocking, stimulate "social compacts" among wealth classes, and assist traditional leaders and government policy makers to work together more effectively so that natural-resource management can be better administered.

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112. USING FIRE TO RESTORE RANGELANDS - ECONOMIC AND SOCIAL DRIVERS AFFECTING ITS APPLICATION. Urs P. Kreuter*¹, David Toledo², Carissa L. Wonkka³; ¹Texas A&M University, College Station, TX, ²USDA-ARS, Bismarck, ND, ³University of Nebraska Lincoln, Lincoln, NE

ABSTRACT

Grasslands and savannas in semi-arid regions of the world are fire driven ecosystems that provide many crucial eco-

system services, including serving as water catchment and filtration systems and providing habitat for animals that depend on herbaceous plants. Woody plant expansion associated with substantial changes in herbaceous plant communities is a phenomenon that is occurring across fire-adapted rangelands. Fire suppression policies have been a primary driver of increasing woody plant dominance and elevated atmospheric CO₂ concentrations appears to be accelerating this trend. To maintain open grasslands and savannas it is critical to reestablish periodic fire as a large-scale ecological driver within these ecosystems. However, there is substantial resistance among private landowners to using fire as a rangeland maintenance and restoration tool because of a lack of knowledge about the economic costs of alternative woody plant management tools, fear of liability for fire-related damages, and negative perceptions about the deliberate incineration of herbaceous plants used by grazers. We present results of research conducted in Texas to identify economic and social factors influencing the use of prescribed fire. We also evaluate the role of prescribed burn associations in increasing the application of prescribed fire by private landowners across landscapes. The information provided is based on research conducted in Texas, including an economic evaluation of alternative woody plant treatments and a survey of landowner perceptions regarding the use of fire, as well as broader studies of the legal liability of applying prescribed fire and data from prescribed burn associations in the Southern Great Plains.

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113. GRAZING LEASE CLINIC: CREATING AGREEMENTS FOR SUCCESSFUL RANCH OPERATIONS. Liya B. Schwartzman*; CA FarmLink, Sacramento, CA

ABSTRACT

Whether you are about to negotiate your first lease, renew an old one, or expand your operation, this workshop will help you get the terms and security you need from your agricultural lease. We will cover the legal and financial risks of poorly developed lease agreements, types of lease agreements, leasing best practices, lease development and negotiation, and specialized clauses for your unique situation. As the Central Valley Regional Coordinator for California FarmLink, Liya Schwartzman helps farmers and ranchers find land and negotiate leases. Learn about what to look for in a property and how to create a lease that builds trust between the landowner and rancher that can be sustained over the long haul.

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114. FIRE IN BIG SAGEBRUSH PLANT COMMUNITIES: GOOD OR BAD? Kirk W. Davies*¹, Jonathan Bates², Chad S. Boyd², Dustin D. Johnson³; ¹USDA - Agricultural Research Service, Burns, OR, ²USDA-ARS, Burns, OR, ³Oregon State University, Burns, OR

ABSTRACT

Fire is a natural ecological process that shifts dominance from woody vegetation to herbaceous vegetation in big sagebrush plant communities. Historically, infrequent fire created mosaics of differing levels of sagebrush and her-

baceous dominance across large landscapes. This provided a wide range of habitats that met the needs of many different species. Fire regimes have changed dramatically over the last century in big sagebrush communities. High elevation big sagebrush plant communities are experiencing longer fire return intervals, which allow conifer encroachment. Low elevation big sagebrush communities invaded by exotic annual grasses are experiencing more frequent wildfires. These fires often burn into adjacent un-invaded big sagebrush communities and facilitate exotic annual grass spread and subsequent dominance of these communities. Low elevation sagebrush communities need less frequent fire to limit the expansion and dominance of exotic annual grasses. In contrast, high elevation big sagebrush communities need fire re-introduced to halt and reverse conifer encroachment and to provide a diversity of habitats. However, the wide spread loss of sagebrush habitat and declines in sagebrush-associated wildlife species has resulted in a mentality that fire should not be re-introduced because of the short-term loss of sagebrush. These two diverging fire management needs have created confusion and often contrasting views of fire's role in big sagebrush communities. Further complicating the issue is that some big sagebrush communities are threatened by both conifer encroachment and exotic annual grass invasion. Invasive species, climate change, and anthropogenic development have altered the role of fire in the sagebrush ecosystem, but it remains an important ecological process that can promote diversity.

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115. ARE SAGEBRUSH ECOSYSTEMS FIRE SENSITIVE? SAGEBRUSH/MIXED-GRASS PRAIRIE COMMUNITY RESPONSE TO FIRE AND GRAZING. Ryan F. Limb*¹, Ilana V. Williams², Samuel Fuhlendorf³, Dwayne Elmore³, John Weir³; ¹North Dakota State University, Fargo, ND, ²Oklahoma State University, Asheville, NC, ³Oklahoma State University, Stillwater, OK

ABSTRACT

Ecosystems of the North American Great Plains are disturbance dependent. Both herbaceous and woody plant communities are dominated by species well adapted to frequent fire and grazing. Large sagebrush (*Artemisia* spp.) dominated communities, often noted for being fire intolerant, exist within the matrix of fire adapted plants within the Great Plains. The majority of sagebrush dominated communities in the western United States typically experience infrequent fire (>50 year fire return interval), but Northern Great Plains sagebrush communities can burn as frequently as every 10-20 years. Our objective was to evaluate fire effects on species composition in sagebrush communities both at a landscape and fine scale, within different grazing treatments on the Charles M. Russell National Wildlife Refuge in central Montana. Three grazing exclosures, situated in mixed-grass prairie and *Artemisia* spp. communities, restricted grazing in two grazing treatments, native ungulates and cattle, or cattle only. The non-exclosures area was utilized as a third grazing treatment. All grazing treatments were treated with

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prescribed fire such that a portion of the unit was burned and a portion was non-burned. Additionally, we burned 21 2x2-m plots for fine-scale plant community measurements. Pre-burn species composition and shrub abundance were recorded in early summer 2010 and again post-burn in 2011. Additionally, percent of area burned was estimated in the exclosures. Overall plant species composition remained unchanged following fire in all grazing treatments and small plots. An exception was big sagebrush, where mortality was 100% when exposed to fire. However, percent area burned (88, 75 and 55%) differed between the no-grazing, cattle-excluded and extant-grazing treatments respectively. Fire sensitive plants exist in fire-prone landscapes largely by occupying non-burned locals. Soil type and topographical features can provide fire refugia. Further, herbivory can alter fuel continuity and create temporary fire breaks minimizing landscape fire spread and providing plant community heterogeneity.

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116. THE CALIFORNIA FIRE SCIENCE CONSORTIUM AND THE FUTURE OF FIRE AND RANGE . Stacey S. Frederick*¹, Susan Kocher²; ¹California Fire Science Consortium, UC Berkeley, Berkeley, CA, ²UCANR, South Lake Tahoe, CA

ABSTRACT

There is a wealth of range-relevant fire science being consistently produced across the country. Accessing and using this information can be difficult given barriers with access, time, understanding, and applicability in a management context. The Joint Fire Science Program has funded a network of Fire Science Exchanges that now span all areas of the United States. The missions of these exchanges is to help alleviate these barriers and “to accelerate the awareness, understanding, and adoption of wildland fire science information by federal, tribal, state, local, and private stakeholders within ecologically similar regions.” This presentation will introduce the mission and applicability of these exchanges and will highlight examples of relevant research from the California Fire Science Consortium, the host state of the SRM 2015 Annual Meeting in California. This presentation will also aid in the final discussion panel of this session by showcasing the resources and science delivery methods currently in-use by the exchanges. From this baseline, the California Fire Science Consortium will facilitate a discussion that examines the effectiveness of different science delivery methods and discuss the needs of the range community for future fire science research.

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117. FIRE EFFECTS ON LIVESTOCK AND WILDLIFE: STRATEGIES FOR CAPTURING THE POSITIVE AND MITIGATING THE NEGATIVE. John D. Scasta*; University of Wyoming, Laramie, WY

ABSTRACT

Fire on rangelands is a complex paradox where vegetative biomass is critical as fuel, forage and habitat. This presentation will examine the positive and negative effects of fire on rangeland organisms and patterns with a particular focus on

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livestock and wildlife. Wildfires can have drastically negative effects that vary with intensity, extent, post-fire moisture availability, death loss, destruction, etc. Conversely, fire can positively enhance forage quality, reduce parasites and disease exposure, reduce physical dermatitis, manipulate animal distribution, reduce woody plant dominance, optimize habitat structure and composition, attract wildlife, etc. Re-incorporating fire at appropriate spatial and temporal scales in fire-dependent ecosystems has the potential to allow rangeland managers to capture the positive benefits while potentially mitigating the negative. This can be realized with prescribed fire that varies in seasonality, severity, and scale and allows for optimal animal-plant interactions.

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118. IMPACTS ON PRAIRIE-CHICKEN HABITAT FROM MANAGEMENT OF RANGELAND FUELS. Heath D. Starns*¹, Samuel Fuhlendorf¹, Torre J. Hovick¹, Eric T. Thacker², Dirac Twidwell³, Dwayne Elmore¹; ¹Oklahoma State University, Stillwater, OK, ²Utah State University, Logan, UT, ³University of Nebraska - Lincoln, Lincoln, NE

ABSTRACT

Long-term changes to historic fire regimes (from frequent fires to fire suppression) have resulted in the encroachment of woody plants into prairies of the Great Plains. An additional consequence of fire suppression is the occurrence of frequent severe wildfires associated with high levels of fuel buildup. In efforts to return to more historic fire regimes, prescribed fire has recently become a favored management practice among some stakeholders. When fire is applied in a patchwork pattern (patch-burning) across the landscape and paired with grazing by cattle, the result is heterogeneity of vegetation structure and composition, which has implications to fuels. Our study compares the effects of interacting fire and grazing to fire alone (no grazing) on fuel properties and prairie-chicken habitat. Four vegetation types are represented by four sites across Texas and Oklahoma: tallgrass prairie, shinnery oak, sand sagebrush, and gulf coastal prairie. Three of the sites incorporate patch-burning and grazing into their current management strategy, while the fourth uses prescribed fire alone (no grazing). Un-grazed areas are available at each site for comparison to areas with a combination of burning and grazing. By sampling areas with different times since fire, we can assess how the fire-grazing interaction affects fuel characteristics and parameters of prairie-chicken habitat. Preliminary data suggests that patch-burn grazing allows for conservation of prairie chickens, while at the same time maintaining fuels at lower levels for an extended period of time when compared to burning alone.

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119. REPEAT BURNING AND CATTLE GRAZING EXCLU-

SION IN PONDEROSA PINE FORESTS: LONG-TERM EXPERIMENTAL RESULTS. Becky K. Kerns*¹, Michelle A. Day²; ¹USDA Forest Service, PNW, Corvallis, OR, ²Oregon State University, Corvallis, OR

ABSTRACT

The reintroduction of fire and repeated burning are proposed as restoration tools and as a way to control fuels in dry western forests. These forests are also frequently used for livestock forage. Yet most prescribed fire experiments in forests exclude livestock, confounding application of experimental results. From 2002-2012 we have periodically examined vegetation response to repeated spring and fall burning (5-yr interval since 1997) and cattle grazing exclusion (since 2002) using four upland stands in the southern Blue Mountains, OR. Data were collected prior to seasonal utilization. We analyzed the cover of 18 plant groups using a randomized complete block split-plot repeat measures mixed model with season of reburn as the whole plot and grazing exclusion as the split plot. Fall and spring repeat burning (RB) had no effect on total cover, but grazing exclusion (GE) increased total cover (mean increase 6.6%). GE also increased the cover of 1) nonrhizomatous, non-N-fixing forbs, 2) rhizomatous forbs (only for fall burns), 3) sedges, and 4) non-resprouting shrubs (only when not burned). Total plant richness increased with GE, but only in areas burned in the fall. While neither GE nor RB impacted perennial grass density or cover, GE and fall RB increased maximum grass leaf height and flowing culm height, and fall RB increased flowering culm density. Fall RB did increase the cover of *Bromus tectorum* and *Ceanothus velutinus*. Fall and spring RB decreased sedge cover, and fall RB also decreased rhizomatous forb cover but only in areas open to grazing. While repeat burning may be reducing fuels, most native perennials are unresponsive and some are negatively impacted by the frequent reburning. Undesirable species like exotic annual grasses are slowly increasing, but overall cover still remains low. In contrast, many perennial plant species are increasing (cover and richness) in response to grazing exclusion.

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120. INCORPORATING ECOSYSTEM SERVICE VALUATION INTO RESEARCH DESIGN: A RANGELAND CASE STUDY. Robert A. Hrozencik*¹, James Pritchett²; ¹Colorado State University, Fort Collins, CO, ²CSU, Fort Collins, CO

ABSTRACT

A growing and sometimes controversial body of literature is the valuation of ecosystem services (ES). ES valuation is a key component in evaluating how human dimensions interact with landscape management and environmental policy decisions. Valuation measures and procedures are evolving but still incomplete. Specifically, the ecological economics literature provides a roadmap to ES valuation (e.g., de Groot et al. 2002). However, it fails to inform about the ecological data and processes that can best result in ES valuation. The resulting information gaps leaves ecosystem research practitioners without a guide for translating and scaling their

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ecological data into economically relevant terms (e.g. farm level decision making) especially during the research design phase. As a result, valuation becomes a research add-on that may not provide the needed metrics for economic analysis. This paper uncovers a best practice methodology for incorporating ecological data into economic models for ES valuation by reviewing the relevant threads of literature, and motivating these practices via a case study of the Learning from the Land (LFL) rangeland stewardship research project. Identifying a best practice methodology will allow for more effective research design and better research outcomes. LFL is an interdisciplinary research initiative comprised of rangeland and wildlife ecologists, economists, extension personnel and cooperating ranchers. The LFL team characterized ecological site descriptions using ecological data and local knowledge to create rangeland state and transition models (STM). The STMs developed were incorporated into a representative ranch economic model that demonstrates how rancher decision-making affects the provision of ES. ES values for each state within the STM are based on ecosystem monitoring indicators. On-farm ES values are elicited by restricting the ranch model to manage for particular ES and comparing those results to the unrestricted ranch model outcomes.

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121. EVALUATING RECREATIONAL USE AS AN INCENTIVE FOR HABITAT CONSERVATION ON PRIVATE LAND IN CALIFORNIA. Luke T. Macaulay*¹, Lynn Huntsinger², Reginald Barrett¹; ¹University of California, Berkeley, Berkeley, CA, ²University of California Berkeley, Berkeley, CA, CA

ABSTRACT

Private land plays a crucial role in the conservation of biodiversity in California, yet these lands are the least protected and most prone to environmental degradation. In 1930, Aldo Leopold recognized the potential to better conserve private land by an incentive scheme where recreational users would pay landowners for access to conserved wildlife habitat. While research has shown that significant funds are spent to utilize large areas of private land for wildlife-associated recreation, this study seeks to specifically understand whether this recreational use actually results in improved conservation practices. I use interviews with landowners to evaluate their motivations for management activities and determine whether those landowners with recreational utilization modify other land use activities or perform particular practices to enhance habitat conservation. Particular attention will be paid to government incentive programs such as California's Private Lands Management (PLM) program.

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122. SHIFTING RANCH OWNERSHIP AND CONSERVATION IMPLICATIONS IN CALIFORNIA: WHAT WE KNOW AND WHAT WE DON'T . Tracy Hruska*¹, Lynn Huntsinger²; ¹UC - Berkeley, Berkeley, CA, ²University of California Berkeley, Berkeley, CA, CA

ABSTRACT

Numerous studies have documented the coexistence of two different ranching communities in the western US: ranchers motivated primarily by profit and those motivated primarily by lifestyle. While significant overlap between the two makes distinctions blurry, there seems to be a shift toward land owners motivated more by perceived lifestyle benefits than by making money on farming or ranching. Simultaneously, the percentage of income earned off-ranch has been on the rise, and, at least in California, the average size of grazed parcels has shrunk, suggesting a shift away from large, full-time ranches to smaller, part-time ranches. This talk will discuss what implications these changes might have for the continuation of California ranching, for the maintenance of privately-owned open space, and for different aspects of conservation on those lands. Data will be drawn from existing literature, from surveys of California oak woodland owners, and from a recent survey of landowners in the Sierra Foothills. The aim is less to present answers than to focus discussion (and future research) on existing trends and a specific set of questions and possible policy changes. The overarching goal is to maintain support for ranching and the continuation of privately-owned open space in the face of economic and demographic changes.

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123. IDAHO PRIVATE GRAZING LEASE ARRANGEMENTS. N. Rimbey*¹, L. Allen Torell², Stephanie Kane³; ¹University of Idaho, Caldwell, ID, ²New Mexico State University, Las Cruces, NM, ³Washington State University, Pullman, WA

ABSTRACT

A telephone survey was conducted in the winter and spring of 2011-12 to determine private grazing lease arrangements in Idaho. A random sample of lessees and lessors of private forage was drawn from a client list provided by the Idaho Rangeland Resource Commission that included 4,365 potential graziers. Telephone contact information was gathered and the list refined to indicate 2,159 potential respondents. Postcards were mailed to potential respondents prior to phone calls. Data were collected using Wincati telephone interviewing software, with trained interviewers administering the survey. A total of 373 respondents were determined to be eligible and agreed to participate. Final response rate was 32.7%. Goals of the research were to determine lease rates and payment methods, landlord services provided with the lease and their impact on lease rate, basic leasing arrangements (written vs. oral; length of lease; forage type; water sources; and others). Data were summarized in terms of frequency of occurrence. Hedonic modeling techniques were used to value landlord services, regional differences, forage type and livestock class. Results indicate a high degree of variability in leasing arrangements, but were generally unso-

phisticated leasing arrangements (verbal, season-long, annual leases). The statewide average lease rate was \$16.04/AUM, which was not statistically different from USDA estimates. Daily care/management of livestock by the landlord increased rates by \$2.21/AUM. Two regions exhibited higher lease rates (Payette \$1.87 and Eastern \$1.43) and yearling cattle showed increased rates (+\$3.53) and sheep leases showed reduced rates (-\$2.59). Irrigated land as part of the lease also resulted in increased rates (+\$0.02 for each % of irrigated land).

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124. UTILIZING ANNUAL FORAGES IN SINGLE- AND DUAL-CROP SYSTEMS FOR LATE-FALL AND EARLY WINTER GRAZING. Erin M. Gaugler*¹, Kevin K. Sedivec¹, Dennis L. Whitted¹, Bryan Neville²; ¹North Dakota State University, Fargo, ND, ²North Dakota State University, Streeter, ND

ABSTRACT

Annual forages planted in late summer can provide an early winter grazing option to complement rangeland and serve as an alternative to dry lot feeding. From 2012 to 2014, three grazing treatments were tested on two cropping systems. A single-crop (annual cocktail forage crop) and dual-crop (cereal crop/annual cocktail forage crop) system were subjected to the following treatments: 1) full use, 2) 50 percent degree of disappearance and 3) no use. Mid-gestation beef heifers were assigned to paddocks for a grazing period that began in mid-October and was projected to last 60 days. The objective was to identify which treatment would best maintain soil health while also serving the nutrient demands of beef cattle. Cattle fed in a dry lot system served as the control. In 2012 and 2014, barley served as the cereal crop and yielded an average of 1681.25 and 2152 kg/ha, respectively. The cereal crop in 2013, oats and peas, was deemed as a production failure. In 2012 and 2013, all systems provided neutral or increased final body condition score (BCS) and average daily gain (ADG). Of treatment types, cattle performance was greatest on 50 percent use of the cocktail crop, resulting in a two-year ADG of 0.88 kg/day. The greatest return/head and return/hectare was experienced in 2012 with full use of the dual-crop system. A decrease in soil bulk density was experienced at a depth of 0-3 cm in all years and among all treatment types. It is hopeful that future data will continue to shed light on soil health and cattle performance under an annual crop regime.

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125. RANCH-LEVEL ECONOMIC IMPACTS OF CHANGING GRAZING MANAGEMENT TO PROTECT GREATER SAGE-GROUSE. N. Rimbey*¹, L. Allen Torell², John A. Tanaka³, David T. Taylor³, John Ritten³, Thomas K. Foulke³; ¹University of Idaho, Caldwell, ID, ²New Mexico State University, Las Cruces, NM, ³University of Wyoming, Laramie, WY

ABSTRACT

The greater Sage-Grouse (*Centrocercus urophasianus*) is a candidate species for listing as an endangered species.

Proactive policies and conservation measures that have been proposed to protect the species would potentially alter grazing policies on federal lands to include reductions in allowed grazing levels and with adjustments in seasonal grazing use of federal permits, particularly during the spring and fall months. In this paper we use profit-maximizing models developed for Idaho, Nevada, Oregon and Wyoming to estimate the economic value of public land forage to ranches that are highly dependent on public lands for seasonal grazing capacity. Optimal (profit maximizing) adjustments to reductions in allowed grazing uses of BLM permits were to substitute alternative sources of forage when possible and to reduce herd sizes. As would be expected, the less substitute forages that were available in the models and the higher the dependency on public land grazing in the current situation, the higher the estimated economic impact of changing BLM grazing capacities and seasonal forage uses. Spring BLM forage was found to have the highest annual economic value, ranging from about \$15/AUM in the Wyoming ranch model to \$50/AUM in the Oregon ranch model. Capitalized into a grazing permit value that reflects the capitalized contributions of the grazing permit to profit over a 40-year production period, the economic value of the BLM grazing permit ranged from about \$140/AUM to over \$600/AUM. Cash flow restrictions could not be met if all grazing on the BLM permit were eliminated. The highly-dependent public land ranches considered in the analysis would then be forced to reduce herd sizes to a level that would no longer be economically viable.

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126. ECONOMIC ANALYSIS OF MANAGEMENT OPTIONS FOLLOWING CLOSURE OF RANGELAND DUE TO SAGE GROUSE POPULATION. James Richardson¹, Brian Herbst¹, Thomas R. Harris^{*2}; ¹Texas A&M University, College Station, TX, ²Unievrsity of Nevada, Reno, Reno, NV

ABSTRACT

There is a growing probability that the sage grouse maybe added to the endangered species list. In Nevada and across the West, ranchers may see grazing land limits due to the sage grouse designation. The uncertainty of how much rangeland may be idled after designation has forced ranchers to consider alternative range management options. The most frequently discussed management options include: (1) reduced herd size, (2) lease more rangeland and maintain herd size, and (3) retirement. Certainly the amount of rangeland permits the rancher loses because of sage grouse habitat affects the ranchers' decision. A small reduction will allow the rancher to maintain most of his cowherd. However, larger reduction caused by sage grouse habitat that could cover most of the federal grazing land could encourage ranchers to make large reductions in herd size or retire. The purpose of this study was to analyze the economic consequences of reducing herd size on a representative ranch in Northeast Nevada if the ranch was faced with permanent loss of federal rangeland due to habitat protection for sage grouse. An economic model of a representative ranch with

650 mother cows in Elko County, Nevada was developed by Texas A&M Agricultural and Food Policy Center to analyze alternative scenarios of decreasing herd size as the federal grazing land was reduced due to habitat protection. Results of the stochastic financial ranch model showed that if the representative ranch was forced to reduce their herd size by more than 25 percent, the rancher might have to look at retirement or acquire more private or owned land to survive. The protection of the sage grouse at the cost of grazing land for cattle in the West could have a significant negative impact on the livelihood of ranchers across the region and their supporting industries.

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127. A HISTORY OF COLLABORATIVE CONSERVATION FOR RANGELANDS IN THE US. Nathan F. Sayre^{*}; Univer-sity of California, Berkeley, Berkeley, CA

ABSTRACT

Collaboration with livestock producers has been a professed goal of federal land management agencies since the beginning of public lands grazing lease systems in the early 20th century. But it has not always been achieved: non-cooperation and even conflict have long marked relations between permittees, livestock associations and the two major agencies, the Forest Service and the Bureau of Land Management. And in recent decades, other government agencies with regulatory roles, such as the US Fish and Wildlife Service and state game and fish departments, have further complicated the practical challenges of managing rangelands collaboratively. This paper describes the contexts that have produced and constrained collaborative efforts and initiatives for rangeland management from the 1890s to the present, including the key roles played by science and scientists in defining conservation itself. The rise of collaborative conservation since the 1990s has required overcoming the obsession with stocking rates that was enshrined in public rangeland administration and research roughly a century ago.

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128. THE CALIFORNIA RANGELAND CONSERVATION COALITION: BOOTS AND BIRKENSTOCKS WORKING TOGETHER TO KEEP RANCHERS RANCHING. Pelayo Alvarez^{*}; California Rangeland Conservation Coalition, Davis, CA

ABSTRACT

California has more than 14 million acres of rangelands within the Central Valley and the interior Coast Range. This area is a valuable natural resource for California as it includes a mix of oak woodlands, open grasslands, vernal pools, and wetland habitats. Most of these lands are privately owned and managed for livestock production. In addition to food, fiber and fuel, these rangelands provide multiple environmental benefits such as wildlife habitat, healthy watersheds, open space and recreational opportunities playing a vital role in supporting local economies. Some of the ranches in

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California have been in existence for more than one hundred years and are part of our rich historical heritage. California's rangelands are under severe threat from the pressures of land conversion and development. Every year 20,000 acres of rangelands in California are lost to urbanization an intensive agriculture. As each acre of rangeland is converted to other uses, vital environmental benefits are lost. In the summer of 2005, a group of ranchers, conservation organizations and government agencies met at a ranch in the San Francisco Bay Area and crafted the California Rangeland Resolution (Resolution). The Resolution is an effort to bring together disparate parties to conserve and enhance private working landscapes within the Central Valley, surrounding foothills, and interior coast range for all the environmental benefits they provide. Signatories to the Resolution formed the California Rangeland Conservation Coalition (Coalition). Today, the Coalition is comprised of more than 127 organizations. The goal of the Coalition is to protect and enhance rangeland habitats in the Central Valley while keeping ranchers ranching by applying the principles of collaborative conservation to research, outreach and policy initiatives. The Coalition has been successful at creating a place where all the stakeholders come together to address complex natural resources issues through dialogue and collaboration.

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129. PARTNERS FOR CONSERVATION - PROMOTING AND SUPPORTING LANDOWNER-LED CONSERVATION COLLABORATIONS. Dina Moore*¹, Steve Jester²; ¹Partners for Conservation, Kneeland, CA, ²Partners For Conservation, Blanco, TX

ABSTRACT

Partners for Conservation (PFC) is a national collaboration of local, landowner-led, landscape-scale collaborations, featuring large-scale public-private partnerships focused on sustaining working landscapes. The group originated from a landowner-led collaboration operating in western Montana that in 2006 received a grant to transfer their highly effective collaborative approach to other landscapes across the nation. As the group developed, it found similar, landowner-led collaborations that also desired to spread and support this community of practice. The organization was officially established in 2010 and operated as a volunteer group until a partnership with the National Wildlife Refuge Association allowed the hiring of a director in mid-2013. The group remains a landowner-led organization and is governed by a very active 12-member board of landowners each from a different state. Partners for Conservation has five pillars; 1. Landowner-led, 2. Collaboration gets work done, 3. Local lessons have national impact, 4. Support voluntary incentive-based programs and 5. Sustainability is a balance between ecology and economy. The organization focuses on activities and sets priorities based on these pillars. Unlike the collaborations represented within the membership, PFC does not implement place-based projects. The organization does work to promote "best management practices" of collaboration and works on activities and supports programs

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and policies that encourage and enable collaborative efforts on working landscapes. To deliver this vision the organization works at several scales. Nationally PFC works with agency partners to bridge the gap between landscapes and agencies that view collaboration as an important part of meeting organizational goals. The organization assists locally and regionally through workshops, meetings or other activities that improve understanding between landowners, landscapes and the various natural resource agencies and conservation partners. While challenges differ PFC has found that landscape stakeholders typically have more that unites than divides and that nationally effective collaborations share a number of attributes.

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130. INSIDE THE GATE: PERSPECTIVES AND EXPERIENCES OF WESTERN LANDOWNERS. Rick Danvir, Lesli Allison*; Western Landowners Alliance, Santa Fe, NM

ABSTRACT

Contrary to common perception, many private landowners across the West have a strong conservation ethic and an interest in helping to advance species recovery, including threatened and endangered species. Conservation efforts by private landowners are essential to the management, restoration and preservation of key wildlife movement corridors and habitats across the West. Unfortunately, many landowners fail to realize their desired conservation and economic goals. On occasion, their efforts can best be summed up as "No good deed goes unpunished". State and local agricultural tax policies, inflexible public-lands grazing policies on comingled private-public grazing allotments, inflexible and incompatible forest management practices on public-private land interfaces, lawsuits and appeals from environmental groups, and liability concerns from neighboring landowners are a few of the challenges impeding landowner participation and success in wildlife management and species recovery efforts. Case studies are used to highlight challenging barriers to landowner-initiated programs such as improving wildlife habitat and population management, species re-introductions, and maintaining migration corridors and connectivity of seasonal habitats. Our goal is to illustrate landowner perspectives, goals and opportunities, highlight barriers and challenges facing private lands conservation efforts, and stimulate audience discussion and solutions.

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131. AN INTEGRATIVE CONCEPTUAL FRAMEWORK FOR EVALUATING THE IMPACTS OF DEVELOPING UNCONVENTIONAL ENERGY RESOURCES ON RANGELANDS. Urs P. Kreuter*; Texas A&M University, College Station, TX

ABSTRACT

In 2010, a task force convened by the Secretary of Energy concluded that it is essential for the USA to immediately catalyze a domestic unconventional fuels industry to progress toward energy independence and to meet future food production needs. Rangelands, which dominate much of the

western half of the USA, represent a major source of alternative energy resources and are likely to be substantially affected by policies to become increasingly energy independent. However, the impacts of developing such energy sources are poorly defined. The Integrated Social, Economic and Ecological Conceptual (ISEEC) framework was developed by the Sustainable Rangeland Roundtable (SRR) to systematically identify biophysical-socioeconomic links that influence the delivery of ecosystem services and that are affected by alternative uses of rangelands. In this presentation I focus on three issues relating to the ISEEC framework: (1) How the framework can be applied to systematically compare the ecosystem service effects of exploiting rangeland-based biofuel, natural gas and wind energy resources; (2) How the framework can be used to select indicators for monitoring these effects; and (3) How data to quantify the economic indicators thus identified could be derived in order to operationalize them for monitoring purposes. While this approach does not provide a prescription for how society should move forward in developing unconventional energy resources on rangelands, it may enhance coordination between federal, state and local agencies that are attempting to set policies and regulations for the sustainable development of such resources.

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132. ENERGY DEVELOPMENT AND ECOSYSTEMS: EXAMINING ATTITUDES AND BEHAVIORS OF THE GENERAL PUBLIC. Gene L. Theodori*; Sam Houston State University, Huntsville, TX

ABSTRACT

Technological advances in horizontal drilling and multi-stage hydraulic fracturing are two primary factors associated with spawning the unprecedented shale gas boom during the past decade in the United States. Accompanying this tremendous surge in shale gas production is a barrage of controversies. One issue at the core of this debate is the fact that many natural gas reserves are located in or near environmentally sensitive areas. A second issue centers around the well stimulation/completion process known as hydraulic fracturing. Data collected in general population surveys from random samples of individuals in Texas and Pennsylvania are used to empirically examine both objective and perceptual issues associated with the exploration and production of shale gas. Specifically, these data are used to empirically examine perceptual issues associated with the exploration and production of natural gas in environmentally sensitive areas. Further, issues associated with the public's views on the process of hydraulic fracturing, the management and disposal of frac flowback wastewaters, and frac flowback wastewater treatment technologies are explored. Lastly, contributions made to self-reported knowledge of hydraulic fracturing by eight different sources and the amount of trust in each of the same sources to deliver unbiased, factual knowledge about the topic are investigated. The findings from this presentation should prove beneficial to rangeland professionals, as well as other natural resource managers and agency per-

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sonnel. Possible implications and recommendations of the results are advanced, as are suggestions for future research projects and outreach programs.

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133. ENERGY DEVELOPMENT AND ECOSYSTEMS: IMPLICATIONS OF BIOFUELS PRODUCTION ON RANGELAND RESOURCES. James Ansley*, Seong C. Park, Tong Wang; Texas A&M AgriLife Research, Vernon, TX

ABSTRACT

Because of water and nutrient limitations, vegetation production on rangelands is lower than other ecosystems that are being considered for biofuels production. Some rangelands simply do not have the production potential to be considered. Higher production rangeland regions, such as the Southern Great Plains (SGP) of Texas and Oklahoma, Tallgrass Prairie, or certain juniper-dominated areas in the Intermountain West may have biofuel potential, but these bioenergy sources should be viewed as secondary rather than primary because annual production is not sufficient for a sustainable bioenergy production operation. Our data from Texas indicates that honey mesquite (*Prosopis glandulosa*), a multi-stemmed woody legume, may have potential as a biofuel source because it overcomes nutrient deficiencies due to N-fixation, is drought tolerant, has relatively high regrowth potential following above-ground harvest, requires little post-harvest drying and has high energy content. We have described a bioenergy harvest system that considers total system land area required and regrowth harvest frequencies. Above-ground harvest methods that allow regrowth to be harvested are economically much more viable than whole plant extraction. Periodic mesquite harvest in selected patches (i.e., "brush sculpting") will result in ecosystem restoration via increased grass production, reduced soil erosion and increased structural diversity for wildlife habitat. Impacts of large scale harvesting of mesquite on other ecosystems services, such as wildlife habitat will be discussed. Mesquite appears superior to switchgrass and sorghum biofuels in GHG offset efficiency and GHG use efficiency once land use change effects are accounted for. Mesquite production on a per-land area basis is lower than these other feedstocks and therefore could not supplant them entirely, but may be suitable as a complementary feedstock to contribute to total biomass feedstock demand. A combination of planted switchgrass areas near mesquite (or juniper) clusters may provide the most optimal rangeland bioenergy option.

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134. UNCONVENTIONAL OIL AND GAS PRODUCTION AND WATER INTERACTIONS IN RANGELANDS. Robert B. Jackson*; Stanford University, Stanford, CA

ABSTRACT

Unconventional oil and natural gas extraction fueled by horizontal drilling and hydraulic fracturing (fracking) is driving an economic boom, with consequences described as "revolutionary" to "disastrous". Reality lies somewhere in between.

Unconventional energy generates income and, done well, can reduce air pollution compared to other fossil fuels and even water use compared to fossil fuels and nuclear energy. Alternatively, it could release toxic chemicals into water and air and slow the adoption of renewables. Based on research to date, some primary threats to water resources in rangelands and elsewhere come from surface spills, wastewater disposal, and drinking-water contamination through poor well integrity. For air resources, an increase in volatile organic compounds and air toxics locally is a potential health threat, but the switch from coal to natural gas for electricity generation will reduce sulfur, nitrogen, mercury, and particulate pollution regionally. Data gaps are particularly evident for human health studies, the extent to which natural gas will displace coal compared with renewables, and the decadal-scale legacy issues of well integrity, leakage, and plugging and abandonment practices. Critical needs for future research include data for 1) estimated ultimate recovery (EUR) of unconventional hydrocarbons; 2) the potential for further reductions of water requirements and chemical toxicity; 3) whether unconventional resource development alters the frequency of well-integrity failures; 4) potential contamination of surface and ground waters from drilling and spills; 5) factors that could cause wastewater injection to generate large earthquakes; and 6) the consequences of greenhouse gases and air pollution on ecosystems and human health.

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135. WIND FARMS AND WILDLIFE: SCIENTIFIC PROGRESS AND REMAINING CHALLENGES. William P. Kuvlesky*¹, Bart M. Ballard¹, Suzanne Contreras¹, Leonard A. Brennan¹, Michael Morrison², Kathy Boydston³; ¹Texas A&M University-Kingsville, Kingsville, TX, ²Texas A&M University, College Station, TX, ³Texas Parks & Wildlife Department, Austin, TX

ABSTRACT

Wind energy is renewable and therefore a popular clean alternative to fossil fuels. Consequently, it is a politically attractive alternative to oil and natural gas production so financial incentives have been provided to the wind power industry to encourage development of wind farms in the United States. The wind power industry has responded by increasing development of wind farms throughout North America. Unfortunately, this development has not always been accompanied by assessment of impacts that construction and operation of turbines have on wildlife resources. Often wind farms are sited in areas that represent important habitats to various wildlife species, and if impact assessment is accomplished it is often done in a manner that lacks scientific rigor. We recognized this in an earlier paper published in 2007 in which we identified challenges and offered specific recommendations. Therefore, the purpose of this paper is to discuss progress that has been made in assessing the impacts of wind farm development on wildlife in North America as well as identify specific challenges that remain. Particular emphasis will be placed on wind farm developments on rangelands, though wind farm research accomplished throughout North Amer-

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ica will be discussed and important work elsewhere in the world will also be mentioned. A very important issue that will be discussed is the almost complete lack of meaningful cumulative impact assessments that have been done for wind farm developments in North America.

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136. HOW ENERGY DEVELOPMENT AFFECTS MANAGEMENT OF BRITISH COLUMBIA GRASSLANDS. Lauch Fraser¹, Wendy Gardner*², Heath Garris²; ¹Thompson Rivers University, Kamloops, Canada, ²Thompson Rivers University, Kamloops, BC

ABSTRACT

British Columbia has experienced a rise of approximately 1.5 oC mean annual surface temperature over the past 50 years. Recent growth in the Canadian oil and gas industry has the potential to further contribute to global climate change, with greater increases in temperature and altered precipitation patterns. As a result, BC cattle producers must practice adaptation to manage their rangelands affected by present and future climate change. We present research that tests (1) the effect of climate change on BC grasslands; (2) management intensive grazing practices to mitigate elevated atmospheric carbon dioxide; and, (3) the use of assisted migration of grass genotypes to improve restoration success of grasslands impacted by the oil and gas industry, for example, pipelines. Cattle producers will need to alter management practices to respond to changes in forage productivity. However, certain range management practices have been shown to increase soil carbon storage, thus potentially mitigating global climate change. In addition, the use of drought-tolerant grass genotypes in grassland restoration may also mitigate an expected decline in forage productivity. By studying the effects of climate change on range management and grassland restoration now we have the best chance of adaptation and mitigation in the cattle industry.

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137. PROMISING RESULTS RESTORING GRASSLAND DISTURBANCES FROM ENERGY DEVELOPMENT . M. Anne Naeth*; University of Alberta, Edmonton, Canada

ABSTRACT

Grassland ecosystems around the world provide many important environmental services. They can support a diversity of plants and wildlife including rare species, reduce soil erosion, increase water infiltration, enhance groundwater recharge, and produce high quality forage for livestock. Agricultural, residential and energy industry developments threaten and continually decrease the area and health of grassland ecosystems. Pipelines and well sites and their associated roads and facilities have a number of impacts, including admixing of soil horizons, soil compaction, contamination of soils by hydrocarbons and salts, alteration of soil thermal regime, loss of vegetation cover and invasion by non native plant species. Although many energy developments are relatively small, they can contribute substantially

to habitat fragmentation due to their sheer number and the network of roads that they require. In some North American jurisdictions, the energy industry is required to reclaim disturbances to equivalent land capability. Research, over 30 years, demonstrates that successful reclamation is possible and must begin prior to construction. Careful consideration must be given to development siting, construction techniques including soil handling and storage and methods to minimize soil compaction by vehicles and equipment. Selection of appropriate plant species and revegetation methods based on site conditions leads to establishment of a diversity and abundance of native species facilitating restoration of grassland environmental services. Microsites and organic amendments aid in establishment of native species and conservation of soil water, nutrients and temperature regimes. This presentation will address key research results, how they can be applied to future energy developments and identify areas where further research is required.

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138. MOVING FROM RECLAMATION TO RESTORATION IN ALBERTA RANGELANDS: APPLICATION OF RANGE SCIENCE TOOLS AND POLICY. Susan E. McGillivray*¹, Marilyn Neville², Jane Lancaster³, Barry Adams⁴; ¹Government of Alberta, Edmonton, Canada, ²Graminea Services Ltd., Lundbreck, AB, ³Kestrel Research Inc., Cochrane, AB, ⁴Government of Alberta, Lethbridge, AB

ABSTRACT

Alberta's Energy industry has been disturbing native grasslands in Alberta since the early 1900's. In 1963 Alberta became the first province in Canada to enact legislation specifically focused on land reclamation. For the next roughly 40 years, the predominant goal of reclamation for the energy developments was to re-contour the landscape and stabilize the soil by seeding agronomic species or native cultivars. In the past several decades there has been a growing awareness of the disturbance impacts of various land use activities like oil and gas development on biodiversity and the health and function of Alberta's remaining native prairie rangelands and the need to develop reclamation practices that restore native plant communities. The path to restoration was long and continues. The following range science tools were developed in Alberta throughout 1998 to 2012 and have lead the advancement that occurred in the field of native grassland restoration in Alberta including: Range Plant Community Guides, Range Health Assessment Field Workbook, Grassland Vegetation Inventory, Foothills Restoration Forum, Ecological Site Restoration Risk Analysis report, 2010 Grassland Reclamation Criteria for Well sites and Associated Facilities, and Recovery Strategies for Industrial Development in Native Prairie (documents by grassland Subregions). These Tools were created by gathering the knowledge and experience of Government of Alberta Rangeland Agrologists, conservation groups, landowners, reclamation practitioners and the Energy Industry, along with data collected from long term range site monitoring and research on historical disturbance trajectories. When

these tools are applied in combination, they result in minimal disturbance techniques becoming standard practices for the oil and gas industry, one of the largest energy industries in Alberta's native grasslands. Where a site must be stripped to protect topsoil, the standard for restoring the site to the pre-disturbance early successional community, greatly increases the likelihood of full restoration. However, risks to restoration success are abundant. Reclamation criteria thresholds need to be tested, long term monitoring continued, and tools like the Recovery Strategies must be completed, implemented and maintained. These are just some of the essential steps to ensure the energy industry has the knowledge to establish successful restoration trajectories for native grassland ecosystems.

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139. POTENTIAL IMPACTS OF MINING AND OIL/GAS DEVELOPMENTS IN THE RANGELANDS OF NORTHERN MEXICO. Edmundo Garcia-Moya*¹, Angelica M. Romero-Manzanares², Humberto Ibarra Gil³; ¹Colegio de Postgraduados, Texcoco, Mexico, ²Colegio de Postgraduados-Campus Montecillo, Texcoco, Mexico, ³Facultad de Agronomía, Campus Ciencias Agropecuarias, Gral Escobedo, Mexico

ABSTRACT

Multiple use and sustainable yield have been the guidelines for natural resource management, rangelands included. Modifications to land tenure as a result to the Energy Reform privileges mining and oil activities on the rangelands, in spite their aptitude and potentials to produce goods and services demanded by society. The anticipated implications of this new legislation would be: land and water grabbing, soil disturbance, seismic events, contamination of land soil water air, modification of the biota, incidence of diseases and socioeconomic problems. Fracking is the new buzzword which calls us to debate for their ecological economic and social implications of it utilization in the exploitation of a nonrenewable resources such as minerals, oil, shale gas in rangelands.

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141. AN INTRODUCTION TO THE SAGEBRUSH STEPPE. Tony Svejcar*; USDA-ARS, Burns, OR

ABSTRACT

The sagebrush steppe is generally considered the most extensive rangeland biome in the western U.S., covering about 100 million acres. This area has undergone tremendous change in the past 12,000 years, especially the western portion. At its peak during the Pleistocene, Lake Bonneville (Great Salt Lake is the remnant) was about the size of Lake Michigan and was more than 1000 feet deep. Further west, Lake Lahonton was about 8% of Nevada's surface area. Lakefront property is a little more scarce these days. But one legacy of the past is that there is tremendous spatial variation in this region. There is also great variation from east to west within the sagebrush steppe. There is a trend toward

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increasing precipitation from west to east , but also a major shift in timing. The western sagebrush steppe has a winter/spring precipitation regime, whereas the eastern portion is more spring/summer. Care must be taken in making broad generalizations across the entire biome. For example, the cool season precipitation and warm season drought of the western sagebrush steppe makes it more prone to annual grass dominance and large wildfires. Some issues, such as annual grass responses to atmospheric CO2 will be in effect across the biome. Many of the presentations which follow are focused on the western portion of the sagebrush steppe, but the general approaches to management and restoration should be readily adaptable to the entire biome.

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142. SAGEBRUSH STEPPE RECOVERY AFTER WESTERN JUNIPER CONTROL; MANAGMENT CONSIDERATIONS AND RESEARCH PERSPECTIVES. Jonathan Bates*¹, Kirk W. Davies², Tony Svejcar¹; ¹USDA-ARS, Burns, OR, ²USDA - Agricultural Research Service, Burns, OR

ABSTRACT

In the western United States conversion of sagebrush steppe to piñon-juniper woodlands has several adverse effects including elevated soil erosion, altered wildlife habitat, and reduced herbaceous plant productivity diversity. In western juniper woodlands, woodland control using mechanical or fire treatments are effective actions to recover sagebrush steppe. Herbaceous cover, production, and diversity recovers in 2 to 10 years. Sagebrush recovery is variable though after fire it is likely a decadal process. Successful recovery depends on several elements including the density of residual perennial bunchgrasses, woodland phase treated, degree of weed presence, and method of treatment. Evidence indicates that there is greater potential for recovery of preferred plant communities by controlling trees in early to mid-succession (< 50-60 yrs old) phases. In these woodlands mechanical control offers a low level of disturbance that are appropriate for maintaining important habitat requirements for wildlife, reducing liability and smoke management issues, and often results in fewer post treatment management concerns. Small trees and juniper seeds are not well controlled by mechanical treatments which often requires woodland re-treatment within 10 to 30 years. Fire in early woodland phases has several advantages in that herbaceous response is more predictable, small trees are effectively killed, and areas may not require retreatment for extended time periods (40-100 years). The impacts of burning later phase, post-settlement woodlands (70-130+ yrs old) is less predictable because of depleted understories and the potential for greater fire caused mortality of desirable vegetation which may lead to weed dominance. Mechanical and low impact fire applications are often the best means for treatment of late phase woodlands. When late woodland phases are broadcast burned, seeding of sagebrush and competitive mixes of herbaceous plants should be considered to augment recovery.

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143. PREDICTING FIRE-BASED PERENNIAL BUNCHGRASS MORTALITY IN LOW ELEVATION BIG SAGEBRUSH PLANT COMMUNITIES. Chad S. Boyd*¹, Kirk W. Davies², April Hulet¹; ¹USDA-ARS, Burns, OR, ²USDA - Agricultural Research Service, Burns, OR

ABSTRACT

Maintenance and post-fire rehabilitation of perennial bunchgrasses is important for reducing the spread of annual grass species in low elevation big sagebrush plant communities. Post-fire rehabilitation decisions are hampered by a lack of tools for determining extent of fire-induced perennial grass mortality. Our objective was to correlate post-fire characteristics with perennial bunchgrass mortality at the plant and plant community scales. We recorded post-fire basal area, percent char, depth of burn, and soil color for 174 bunchgrasses across four ecological sites within a 65,000 ha summer wildfire in southeast Oregon and assessed plant mortality one year post-fire. Mortality varied by post-fire soil color and ecological site; soil colors associated with pre-fire shrub presence (black and gray) had up to 5 fold-higher mortality than brown soils typical of interspace locations. Models incorporating depth of burn and soil color correctly predicted mortality for 90% of individual plants; cover of brown soil explained 88% of the variation in bunchgrass mortality at the plant community scale. Our results indicate that soil color and depth of burn are accurate predictors of bunchgrass mortality at individual plant and plant community scales and could be used to determine spatial allocation of post-fire bunchgrass rehabilitation effort.

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144. USING LIVESTOCK GRAZING TO REDUCE WILDFIRE RISK AND SEVERITY IN THE SAGEBRUSH STEPPE. Kirk W. Davies*¹, Chad S. Boyd², Tony Svejcar², Jonathan Bates²; ¹USDA - Agricultural Research Service, Burns, OR, ²USDA-ARS, Burns, OR

ABSTRACT

Wildfire in Wyoming big sagebrush communities increases the risk of exotic annual grass invasion, results in short-term loss of forage, and decreases habitat for sage-grouse and other sagebrush-associated wildlife species for decades. Fuel treatments are needed to reduced wildfire risk and increase plant community resilience to fire and resistance to post-fire exotic annual grass invasion. Considering the expanse of the Wyoming big sagebrush ecosystem, grazing is probably the only logistically feasible treatment. We evaluated the effects of moderate grazing by cattle during the growing season on fuel characteristics and post-fire recovery. In another study, we investigated the effects of winter grazing by cattle on fuel characteristics and fire behavior. Grazing has the potential to reduce wildfire risk and severity in Wyoming big sagebrush communities. Grazing reduced fine fuel height, accumulation and continuity. Winter grazed areas were unlikely to burn until late August because grazing increased fine fuel moisture content. In contrast, ungrazed areas were dry enough to burn in late June to early July. Moderate grazing also increased the resilience of native

herbaceous vegetation to fire and decreased exotic annual grass invasion. Our results demonstrate that properly applied grazing can be an effective tool to reduce wildfire risk and severity and decrease the risk of post-fire exotic annual grass dominance.

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145. SEED ENHANCEMENT TECHNOLOGIES FOR OVERCOMING BARRIERS TO RESTORATION. Matthew D. Madsen^{*1}, April Hulet¹, Kirk W. Davies², Chad S. Boyd¹, Turmandakh Badrakh³, Jay Kerby⁴, Bruce A. Roundy³, Tony Svejcar¹; ¹USDA-ARS, Burns, OR, ²USDA - Agricultural Research Service, Burns, OR, ³Brigham Young University, Provo, UT, ⁴The Nature Conservancy, Burns, OR

ABSTRACT

Rangelands occupy over a third of global land area, and in many cases are in less than optimum condition as a result of past land use, invasive species, climate change, catastrophic wildfire or other disturbances. Often the only means of restoring these lands involves seeding desirable species, yet there are few cost effective seeding technologies, especially for the more arid rangeland types. The inability to consistently establish native plants from seed may indicate that the seeding technologies being used are not successful in addressing the primary sources of mortality in the progression from seed to established plant. Seed enhancement technologies allow for the physical manipulation and application of materials to the seed that can modify germination timing, emergence capability, and/or early seedling growth. In our presentation we will examine some of the major limiting factors impairing seedling establishment in North America's sagebrush steppe ecosystem, and demonstrate how seed enhancement technologies can be employed to overcome these restoration barriers. We discuss specific technologies for: 1) altering the timing of seed germination, 2) increasing soil water availability, 3) enhancing seedling emergence in crusting soil, 4) improving plantability and emergence of small seeded species, 5) enhancing seed coverage of broadcasted seeds, and 6) protecting seedlings from pre-emergent herbicides. Concepts and technologies in this presentation for restoring the sagebrush steppe ecosystem may apply generally to semi-arid and arid rangelands around the globe.

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146. PRECISION RESTORATION: A FRAMEWORK FOR IDENTIFYING RESTORATION BARRIERS. Jay Kerby^{*1}, Matthew D. Madsen², Chad S. Boyd², Tony Svejcar²; ¹The Nature Conservancy, Burns, OR, ²USDA-ARS, Burns, OR

ABSTRACT

Success rates reseeding native species on degraded sagebrush-steppe may be near 10%. Nonetheless, land managers annually spend millions attempting to reestablish sagebrush-steppe plant communities to protect watershed health, reduce wildfire risk, provide livestock forage and recover critical species habitat. Until recently, restoration of sage-

brush-steppe has largely adhered to traditional agronomic principles, focusing on changes to plant materials and farming technologies despite repeated failure. While these efforts have advanced our ability to restore native plant communities, we suggest that melding an understanding of underlying ecological barriers to native seedling survival with innovative technologies represents a transformative opportunity for sagebrush-steppe ecosystem conservation. Recent seed population demography research shows that seedling emergence may be a critical limiting bottleneck. Barriers to seedling survival during emergence are numerous and often spatially and temporally heterogeneous. However, identification of ecological barriers empowers development of engineering and management solutions tailored to overcome predictable obstacles to emergence. A partnership between ecologists with the USDA-Agricultural Research Service, The Nature Conservancy, and agri-business envisions a new approach to sagebrush-steppe restoration that emulates "precision agriculture" by melding spatial predictions of ecological barriers to seedling survival, principles of plant ecology, and innovative seed enhancement technologies.

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147. RESTORING SAGEBRUSH AFTER MEGA-FIRE. April Hulet^{*1}, Kirk W. Davies², Matthew D. Madsen¹, Chad S. Boyd¹; ¹USDA-ARS, Burns, OR, ²USDA - Agricultural Research Service, Burns, OR

ABSTRACT

Sagebrush restoration after wildfires has had limited success, and success likely varies considerably by method, site characteristics and interactions between them. Our objective was to compare different sagebrush restoration methods (broadcast seeding, broadcast seeding and packing, planting sagebrush seedlings, seed pillows, and natural recovery) across elevation gradients ranging from 1219 to > 2134 m (4000 to > 7000 ft). Seed pillows, or seed enhancement technologies were formed by mixing sagebrush seed and various hydrophilic filler materials, bio-stimulants, and plant protectants together and running the mixture through an extruder to produce 20mm X 20mm X 7mm thick pillows. We used 175 plots spread across approximately a million acres of sagebrush rangelands in Oregon that had burned in two mega-fires in 2012, to compare different sagebrush restoration methods. Restoration success of the different methods was then correlated with environmental and site characteristics. Across the elevation gradient, precipitation was on average 25% less than the 30 year average between December 2013 and May 2014 (192 mm compared to 257 mm, respectively). At low elevation sites (below 1524 m or 5000 ft) all sagebrush restoration methods had limited success (< 0.07 sagebrush plants per m²). As elevation increased, success of sagebrush restoration methods also increased. Preliminary results suggest that seed pillows improve sagebrush established at higher elevations (seeds pillows were on average 8-fold greater than natural recovery). Planting sagebrush seedlings had the highest density of sagebrush at higher elevations (average density of 2.3 plants per m²)

when compared to all other treatment methods. In order to evaluate which restoration method is most effective and efficient relative to environmental and site characteristics, this study will be repeated and monitored for multiple years with the expectation that this information will help land managers successfully restore sage-grouse habitat after wildfires by pairing restoration methods with site characteristics.

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148. PRE-EMPTIVE CONSERVATION OF SAGE-GROUSE HABITAT: THE HARNEY COUNTY EXPERIENCE. Dustin D. Johnson*¹, Chad S. Boyd²; ¹Oregon State University, Burns, OR, ²USDA-ARS, Burns, OR

ABSTRACT

In the run-up to the 2015 US Fish and Wildlife Service (USFWS) listing decision for greater sage-grouse it is important for rangeland professionals to engage in this issue because many of the problems currently impacting sage-grouse are the same issues that define major rangeland management challenges. Here we provide some highlights and lessons learned from our engagement with a diverse stakeholder group in crafting a greater sage-grouse Candidate Conservation Agreement with Assurances (CCAA) for Harney County, Oregon. The team responsible for drafting the Harney County CCAA was a diverse group of private landowners, USFWS, science advisors, state wildlife and land management agencies, NRCS, local conservation districts, BLM, agricultural commodity groups, conservation groups, and County Government. There are two important lessons we learned working with a diverse group on sensitive issues relating to sage-grouse. First, the process should begin by asking “what is the problem” ... “is this a grouse issue per se, an ecosystem issue, to what extent is it both?” By posing these difficult queries up front, our diverse group was able to focus much of its effort toward defining relationships between rangeland ecology, conservation actions, and sage-grouse habitat quality. Additionally, the issue of the bird vs. the ecosystem will likely come up at some point in the process anyway, so it is infinitely better to tackle this question up front to prevent movement in unproductive directions. A second lesson learned was discussing and agreeing upon the role of management factors in affecting sage-grouse habitat was greatly aided by the use of state-and-transition models. In fact, these relationships become almost self-evident if the models are constructed in a collaborative stepwise process. In doing so, we largely avoided protracted discussion over whether a given management factor (e.g., grazing or fire) has positive, negative, or neutral effects on sagebrush habitats.

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149. OUTREACH AND EDUCATION STRATEGIES TO IMPROVE SAGEBRUSH STEPPE CONSERVATION AND RESTORATION. Brenda Smith*¹, Roger Sheley², Tony Svejcar³; ¹Eastern Oregon Agricultural Research Center, Burns, OR, ²USDA- ARS, Burns, OR, ³USDA-ARS, Burns, OR

ABSTRACT

Eastern Oregon Agricultural Research Center (EOARC) has been investing in the development of a strong outreach and education rangeland management program. Technology transfer is critical if science-based management practices are ultimately adopted by managers to protect and improve sagebrush steppe ecosystems. This presentation will describe the strategies EOARC has utilized to increase adoption of science-based management. A priority in this effort has been to develop and produce user-friendly, decision support technology transfer for site specific management. Our outreach and education is designed around a systems-based framework for management following a step-by-step planning process. The focus is on increasing knowledge of key ecological processes occurring on sagebrush steppe rangelands, rather than on symptoms. Once an ecological foundation is presented the program emphasizes how to apply adaptive management to develop science-based management plans. It is important to guide end-users through the systems-thinking process and provide ecological principles on which to make management decisions. The program is reinforced with field-based activities to engage participants in systems thinking and how to integrate science into their management. EOARC and cooperators work together to present topics during outreach events using consistent terminology, giving clarity to our overall message of managing ecological processes that direct vegetation change. Key components of the outreach and education programs have been the use of landscape scale demonstrations, field schools and camps for intensive training. Curricula and programs have been developed for all levels of learners. Training and presentations are accompanied with useful written guidelines, informative videos and a website to provide strong decision support and ongoing learning. To continue to improve EOARC’s program offerings, participant surveys are collected after each event. The program is designed to introduce students and practitioners to a systems approach toward management and to support managers in applying science-based management for successful improvement of degraded sagebrush steppe.

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150. THE ROLE OF PLANT HYDRAULIC CONDUCTANCE IN EXPLAINING GROWTH AND WATER-USE RESPONSES TO DROUGHT. Troy W. Ocheltree*¹, Kevin E. Mueller², Dana M. Blumenthal², Kelly Chesus¹, Julie Kray², Dan R. LeCain²; ¹Colorado State University, Fort Collins, CO, ²ARS - Rangeland Resources Research Unit, Fort Collins, CO

ABSTRACT

Droughts have increased in both frequency and severity over the last century and pose threats to the productivity and functioning of rangeland ecosystems. Understanding how plants within these communities will respond to drought is

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a pressing concern if we are to be able to make informed decisions about how we are to manage these ecosystems in the coming decades. We made measurements on 10 common forbs and shrubs in a northern mixed prairie in order to better understand the water-use strategies of these species during a growing season. The species selected were growing in a northern mixed prairie managed by the ARS: High Plains Grasslands Research Station near Cheyenne, WY. The hydraulic conductance of leaves (KLeaf) quantifies the rate at which water can be supplied to leaves, which is fundamental process in the growth and survival of plants. Using these measurements, we estimated the sensitivity of plants to drought by monitoring the reduction in KLeaf as leaf water potential declined (indicating greater water stress). In addition to KLeaf, we measured photosynthesis, stomatal conductance, and mid-day leaf water potential to drought to quantify different water-use strategies and drought tolerance thresholds of plants. We will discuss how an understanding of these different water-use strategies can provide estimates of drought tolerance thresholds in plants and help inform predictions of changes in plant community in response to more frequent and severe drought.

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151. BUD DEVELOPMENT AND VIABILITY UNDER PRAIRIE DOG AND LIVESTOCK HERBIVORY. Aaron Field*¹, Kevin K. Sedivec¹, John R. Hendrickson²; ¹North Dakota State University, Fargo, ND, ²USDA-ARS, Mandan, ND

ABSTRACT

Axillary bud production is responsible for over 95% of reproduction in native perennial grass species. The impacts of herbivory on bud development are primarily attributed to livestock grazing, while herbivory by native wildlife, such as black-tailed prairie dogs (*Cynomys ludovicianus*), is not well understood. Extensive prairie dog populations on the Standing Rock Indian Reservation limit forage availability for livestock; however, control measures may be limited. Western wheatgrass (*Pascopyrum smithii*) is a perennial native grass that occurs both on and off of prairie dog colonies in the area. The impact of prairie dog and cattle grazing on western wheatgrass axillary bud production, viability, and determination were examined over a 2-year period at multiple landscape positions on the Standing Rock Indian Reservation near McLaughlin, SD. Collections throughout the growing period and a double staining procedure utilizing triphenyl tetrazolium chloride and Evan's blue allowed us to quantify the overall effect of each disturbance type, as well as the effect of the combination of the two on the vegetative reproduction of this species in northern mixed-grass prairie, with the goal of gaining a better understanding of the role of prairie dog herbivory in grass vegetative reproduction. Data collection and analysis is ongoing, with final results to be presented at the SRM 2015 annual meeting.

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152. MANAGING DIVERSITY IN MOUNTAIN RANGELANDS IN NORTHWEST CHINA. Victor R. Squires*; Freelance International Consultant (formerly Univ of Adelaide), Adelaide, Australia

ABSTRACT

Biodiversity is a multifaceted phenomenon involving the variety of organisms present, the genetic differences among them and the plant communities, ecosystems and landscape patterns in which they occur. Many factors affect biodiversity of plants and animals (including birds, fish and insects). Habitat loss is often characterized by vegetation fragmentation or the loss of connectivity in landscapes. The degree of fragmentation is a key indicator. It is noted that fragmentation of natural habitat due to overgrazing, opportunistic cropping and other modifying practices disrupts ecological processes such as energy cycling, creates sub-populations of species and isolates those sub-populations from one another. Biodiversity in Northwest China is discussed. Four specific issues are dealt with: (i) plant responses to grazing management (ii) plant invasions (iii) the responses to management of valued grassland biota (plants and animals); and (iv) the vulnerability of mountain ecosystems to climate change, Case studies from Qilian Shan (Gansu), Tian Shan (Xinjiang) are presented.

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153. RANGELAND BIODIVERSITY RESEARCH IN SUB-SAHARAN AFRICA LACKS ATTENTION TO SPATIAL AND TEMPORAL SCALES OF DISTURBANCE. Devan A. McGranahan*¹, Kevin P. Kirkman²; ¹North Dakota State University, Fargo, ND, ²University of KwaZulu-Natal, Pietermaritzburg, South Africa

ABSTRACT

Sub-Saharan Africa has extraordinary biological diversity across a breadth of rangeland habitats. As ecological disturbances, fire and grazing contributed to the evolution of many African rangelands, but current regimes are shaped by human impact and global environmental change. While considerable research documents the negative effects of altered disturbance regimes and land-use change on Africa's biodiversity, relatively little work describes how fire and grazing might be managed such that biodiversity conservation and human land-use can be reconciled. We review existing literature on fire and grazing impacts on non-game wildlife in Sub-Saharan Africa, including invertebrates, herptofauna, small mammals, and birds. Specifically, we focus on the paucity of research attention to spatial and temporal scale of disturbance. We suggest considerations for future work on biodiversity in Sub-Saharan grasslands and savannas, including 1) quantification of fire and grazing as regimes comprised of intensity and frequency, rather than qualitative categories of occurrence; 2) community-level sampling and analysis; 3) consideration of the spatial and temporal patterns of fire and grazing, with particular attention to heterogeneity and patch contrast; and 4) consideration of the interactive effects of fire and grazing, particularly at patch- and landscape-level effects on wildlife communities and habitat structure.

154. USING GEOSPATIAL ENVIRONMENTAL CHARACTERISTICS TO DETERMINE PLANT COMMUNITY RESILIENCE TO FIRE AND FIRE SURROGATE TREATMENTS. Nathan L. Cline*, Bruce A. Roundy, William Christensen; Brigham Young University, Provo, UT

ABSTRACT

Avoiding cheatgrass (*Bromus tectorum* L.) dominance following tree reduction treatments on woodland (*Juniperus* spp.)-encroached sagebrush (*Artemisia* spp.) communities is a priority for managers in the Great Basin. Perennial herbaceous and cheatgrass cover have been related to site resilience after treatment. Associating site environmental characteristics with cheatgrass and perennial herbaceous cover may aid managers with identifying sites that are more or less resilient to fire or fire surrogate treatments. We associated 43 site environmental characteristics with perennial herbaceous and cheatgrass cover previously collected at 45 treated and untreated Great Basin wooded shrublands. Site environmental characteristics were derived from 5 m digital elevation models (DEM), BIOCLIM, and ClimateWNA geospatial datasets. Associations were made by developing spatial regression models that indicate potential vegetation response to tree reduction treatments for 30 yr climate conditions. Preliminary results indicate that mean precipitation and temperature during the wettest month and quarter of the year had the strongest associations with cheatgrass cover following tree reduction. This investigation of environmental characteristics associated with cheatgrass and perennial herbaceous response in wooded sagebrush lands may allow us to better decide which sites to treat and whether seeding is needed or not in conjunction with tree reduction treatments.

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155. EVALUATION OF FINE FESCUE GRASSES IDENTIFIES RESOURCES FOR IMPROVED ECOLOGICAL FUNCTION UNDER RANGELAND STRESS ENVIRONMENTS. Jack E. Staub*, Matthew D. Robbins; USDA ARS, Logan, UT

ABSTRACT

Fine-leaved fescue (*Festuca* ssp.) grasses have potential for contributing to increased rangeland productivity given their comparatively high drought and heat tolerance. Therefore, plant performance trials were developed to evaluate geographically diverse fine fescue materials for their application to U.S. western rangelands. Plant materials from U.S., Middle Eastern, and Asian sources were visually evaluated in a field nursery in North Logan, UT and selections were made in 2009 based on plant vigor, biomass, and color. These selections were crossed in 2010 under controlled conditions as bi-parental matings (populations). Plants from 37 of these populations were transplanted with six commercial checks into replicated trials in 2011 at three locations (Malta, ID, Blue Creek, UT, and North Logan, UT) with a range of annual precipitation (200 mm, 350 mm, and 450 mm, respectively). Plants were evaluated for color (spring green-up), vigor, persistence, and biomass over two

years (2012-2013). When considering all traits over both years, four populations with parents originating from Turkey (*F. ovina*), Iran (*F. ovina*), Russia (*F. valesiaca*), and the U.S. (*F. ovina*) performed substantially better than 'Durar', the best performing commercial check, and 'Covar' depending on location. In the harshest (lowest precipitation) environment, the average performance of these four populations compared to 'Durar' was 155-177% for vigor, 78-89% for color, 208-385% for biomass, and 91-114% for persistence. These populations may be more suitable than 'Covar' and 'Durar' for forage production and rangeland reclamation in arid environments of the western U.S.

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156. IS THE WHITE-TAILED JACKRABBIT A BELLWETHER OF MOUNTAIN BIG SAGEBRUSH-GRASS COMMUNITY RESILIENCE IN NORTHERN NEVADA? Kent McAdoo*¹, George Gruell²; ¹University of Nevada Cooperative Extension, Elko, NV, ²U.S. Forest Service (Retired), Carson City, NV

ABSTRACT

According to mammalogists, anthropologists, historians, and newspaper accounts, white-tailed jackrabbits (*Lepus townsendii*) were once an important faunal component of mid-to upper elevation sagebrush-grass communities and meadows in northern and central Nevada. Some of these same accounts attribute the decline of this species to heavy grazing that occurred from the 1870s through the early to mid-20th century. Before Euro-American settlement, indigenous groups in some areas of the Great Basin used white-tailed jackrabbits extensively as a source of food and fiber. Throughout the West, there has been a gradual but marked reduction in the range of this species in areas where habitats have changed to favor black-tailed jackrabbits (*L. californicus*), a closely related species with a stronger shrub affinity. Where the two species occur sympatrically, white-tails typically use areas that are grass-dominated and/or higher in elevation than the shrub-dominated valley floors frequented by black-tails. In recent years, the authors have observed white-tailed jackrabbits moving into areas in northern Nevada that became dominated by native perennial grasses after wildfire, apparently expanding into these areas from remnant nucleus populations. However, similar fire-recovered areas in central Nevada that held white-tails historically have not apparently had colonization by this species, ostensibly due to the absence of nucleus populations. Because the perennial grass component to which white-tails are adapted is the cornerstone of sagebrush-grass community resilience, the presence of this species may be an indicator of ecological integrity and functionality, especially at mid- to upper elevations (for primarily mountain big sagebrush communities). As the perennial grass component ebbs and flows proportionately through plant succession, the abundance of white-tails, irrespective of cyclic population irruptions, may follow this same pattern. The authors will review the history of this species across its previous and current range in Nevada and overview proposed research to test this hypothesis.

157. RESILIENCE OF SANDHILLS GRASSLAND TO AN EXTREME WILDFIRE AND DROUGHT EVENT. Jack R. Arterburn^{*1}, Dirac Twidwell², David A. Wedin¹, Walter H. Schacht¹; ¹University of Nebraska-Lincoln, Lincoln, NE, ²University of Nebraska - Lincoln, Lincoln, NE

ABSTRACT

The Nebraska Sandhills, one of the largest contiguous grassland ecoregions remaining in North America, is characterized by sandy textured soils stabilized by fine root biomass from predominately warm-season grasses. Concern over the destabilization of the sand dunes have led to management approaches that seek to prevent disturbances, such as fire, that remove vegetation and expose bare ground. In 2012, extreme drought conditions (38% below the average for the growing season) coincided with one of the most extreme wildfire events observed in the area in recent decades. Considering that bison were not removed from the area and the drought continued for an additional six months following the wildfire, we hypothesized that the occurrence of wildfire and herbivory during this drought would result in the loss of stability in Sandhills grassland and a lack of recovery of grassland vegetation. Following the wildfire, we tracked the response of grassland productivity and structure in burned areas compared to adjacent areas not burned. Contrary to the local concerns shaping our hypothesis, grassland vegetation recovered rapidly following this wildfire and drought event. These findings demonstrate that Sandhills grasslands are considerably more resilient than currently believed.

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158. CATTLE GRAZING AND VEGETATION SUCCESSION ON BURNED SAGEBRUSH STEPPE. Jonathan Bates^{*1}, Kirk W. Davies²; ¹USDA-ARS, Burns, OR, ²USDA - Agricultural Research Service, Burns, OR

ABSTRACT

There is limited information on the effects of cattle grazing to long-term plant community composition and productivity following fire in big sagebrush steppe. This study evaluated vegetation response to cattle grazing over seven years (2007-2013) on burned Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis* (Beetle & Young) Welsh) steppe in eastern Oregon. Treatments, replicated 4 times and applied in a randomized block design, included no grazing on burned (NON-USE) and unburned (CONTROL) sagebrush steppe; and grazing at low (LOW), moderate (MODERATE), and high (HIGH) stocking. Vegetation dynamics were evaluated by quantifying herbaceous (canopy and basal cover, density, annual yield, reproductive shoot weight) and shrub (canopy cover, density) response variables. Differences in herbaceous response variables among LOW, MODERATE, and NON-USE treatments were nonexistent or minor and no major compositional changes occurred. The HIGH treatment had lower perennial bunchgrass cover and annual yield than other grazed and NON-USE treatments. Bunchgrass density remained unchanged in the HIGH treatment, not differing from other treatments, and

reproductive effort was comparable to the other treatments indicating these areas are potentially recoverable by reducing stocking. Cover and yield of *Bromus tectorum* L. (cheatgrass) did not differ among the grazed and NON-USE treatments, though all were greater than the CONTROL. Cover and density of *A.t. spp. wyomingensis* did not differ among the grazed and NON-USE treatments and were less than the CONTROL. We concluded that light to moderate stocking rates are applicable to sustainable grazing of burned sagebrush steppe.

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159. EFFECTS OF HERBIVORY-EPISODIC DISTURBANCE INTERACTIONS ON SHRUBS IN FORESTED RANGELANDS OF THE PACIFIC NORTHWEST. Bryan A. Endress^{*1}, Burak Pekin², Michael Wisdom³, Bridgett Naylor³, Catherine Parks³; ¹Oregon State University, La Grande, OR, ²Institute for Conservation Research, Escondido, CA, CA, ³USDA Forest Service, La Grande, OR

ABSTRACT

Ungulates exert a strong influence on the composition and diversity of vegetation communities. However, little is known about how ungulate browsing pressure interacts with episodic disturbances such as fire and stand thinning. We assessed shrub responses to variable browsing pressure by cattle and elk in fuels treated (mechanical removal of fuels followed by prescribed burning) and non-fuels treated forest sites in northeastern Oregon, US. Seven treatment paddocks were established at each site; three with cattle exclusion and low, moderate and high elk browsing pressure, three with elk exclusion and low, moderate and high cattle browsing pressure, and one with both cattle and elk exclusion. The height, cover and number of stems of each shrub species were recorded at multiple plots within each paddock at the time of establishment and six years later. Changes in shrub species composition over the six year period were explored using multivariate analyses. Generalized Linear Mixed Models were used to determine the effect of browsing pressure on the change in shrub diversity and evenness. Vegetation composition in un-browsed paddocks changed more strongly and in different trajectories than in browsed paddocks at sites that were not fuels treated. In fuels treated sites, changes in composition were minimal for un-browsed paddocks. Shrub diversity and evenness decreased strongly in un-browsed paddocks relative to paddocks with low, moderate and high browsing pressure at non-fuels treated sites, but not at fuels treated sites. These results suggest that in the combined absence of fire, mechanical thinning and ungulate browsing, shrub diversity is reduced due to increased dominance by certain shrub species which are otherwise suppressed by ungulates and/or fuels removal.

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160. MODELING GRASSLAND BIOMASS DURING A DROUGHT PERIOD USING MODIS SENSOR IMAGES AND RADIOMETRY. Nathalie Socorro Hernandez-Quiroz*¹, Carmelo Pinedo-Alvarez¹, Alicia Melgoza-Castillo¹, Victor Manuel Aguilar-Soto¹, Federico Villarreal-Guerrero¹, Marusia Renteria-Villalobos²; ¹Universidad Autonoma de Chihuahua, Chihuahua, Mexico, ²Universidad Autónoma de Chihuahua, Chihuahua, Mexico

ABSTRACT

The cattle industry in Chihuahua, Mexico is one of the most important economic activities in the State and relies mostly on native grasslands. These ecosystems present several problems: overgrazing, land use change and especially climate variability. These problems have been evaluated in the past with traditional methodologies. Recently, the use of remote sensing has yielded reliable estimations of biomass production in different geographical areas and times of the year. Images from different sensors can be calibrated with radiometric data measured on the field. This study developed a model of biomass production in the grasslands of Chihuahua State based on the integration of radiometry data and MODIS images. Data from 103, 117 and 107 sampling stations (each one including four subsamples) were collected from October 2011, 2012 and 2013, respectively. Values of NDVI from the images were validated against values of NDVI from radiometry data using linear regression. Values for 2011 was $R^2=0.69$, for 2012, $R^2=0.75$, and for 2013 was $R^2=0.69$. Then, values from radiometry were correlated to biomass production, giving a R^2 of 0.52, 0.55, and 0.41 for 2011, 2012 and 2013, respectively. The models generated for biomass were scaled to the MODIS images. The calculated production was 34.23 kg/ha, 80.23 kg/ha and 110.14 kg/ha for 2011, 2012 and 2013, respectively. Low values of biomass production obtained are a result of two consecutive dry years, where 2011 was historically the driest year in the last 50 years. Even though the 2013 precipitation was above the annual average, biomass production for this year was still low. Years with severe droughts may affect biomass production for longer periods. The methodology implemented in this study will be useful for monitoring large grassland areas subjected to drought.

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161. PHENOCAMS AS A PROXY FOR PRIMARY PRODUCTIVITY AND MODE OF DISCOVERY IN ARID GRASSLAND ECOSYSTEMS. Dawn M. Browning*¹, Michelle Mattocks², Craig Tweedie³; ¹USDA-Agriculture Research Service, 888003, NM, ²USDA-Agriculture Research Service, Las Cruces, NM, ³University of Texas, El Paso, El Paso, TX

ABSTRACT

Projected changes in rainfall for the western United States are uncertain with respect to seasonality and direction. Plant phenological patterns (initiation of growth and the production of flowers and fruit) are discrete plant responses to changing climate and indicators for ecosystem services such as net carbon exchange and pollination. Yet, phenology monitoring

is challenging across remote spatially extensive rangelands. To explore the performance of inexpensive technology for capturing phenological patterns in an arid upland grassland landscape in southern New Mexico, we coupled daily estimates of canopy greenness from digital cameras (i.e., phenocams) with weekly field observations of plant phenology to evaluate the role of phenocam metrics as a proxy for estimates of primary productivity. Daily phenocam greenness estimates and weekly field observations of phenology including ocular estimates of percent canopy greenness were made for deciduous C3 shrubs honey mesquite (*Prosopis glandulosa*) and C4 perennial black grama grasses (*Bouteloua eriopoda*) for three growing seasons (Feb 2012 – July 2014). We showcase tools for visualizing patterns in near-surface landscape phenology and highlight advantages and disadvantages of phenocams for phenology monitoring. Field estimates of canopy greenness closely corresponded with greenness index values providing confidence in interpretations of the greenness responses derived from phenocam images. Mesquite transitioned from minimum to maximum greenness over 15 days between 20 Apr and 5 May in all years. Black grama green-up quickly follows summer rain events over six days in 2012 and 2013. Daily depictions of greenness demonstrate that canopy development in this water-limited system occurs rapidly and that phenocams can provide data needed to characterize greenness; however field sampling once to twice weekly is required to monitor flower and fruit or seed production. Next steps are to incorporate these results with those from time series UAV imagery and satellite remotely sensed imagery.

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162. DIGITAL SOIL MAPPING AS A TOOL FOR QUANTIFYING STATE-AND-TRANSITION MODELS. Matthew R. Levi*¹, Brandon T. Bestelmeyer², Joel R. Brown³; ¹USDA-ARS, Las Cruces, NM, ²USDA-ARS Jornada Experimental Range, Las Cruces, NM, ³USDA NRCS, Las Cruces, NM

ABSTRACT

Ecological sites and associated state-and-transition models (STMs) are rapidly becoming important land management tools in rangeland systems in the US and around the world. Descriptions of states and transitions are largely developed from expert knowledge and generally accepted species and community level responses to external drivers. A major limitation of current STMs is the lack of quantitative data on vegetation dynamics to describe state transitions. Detailed soil property characterization is also needed to better understand soil-landscape controls of state transitions resulting from land use and climate drivers. We used spatiotemporal patterns of normalized difference vegetation index (NDVI) response to precipitation and soil properties in southeastern Arizona to determine how hydraulic soil properties mediate attributes of vegetation dynamics at a landscape level. Pixels in a time series of NDVI derived from Landsat reflectance data were clustered according to types of vegetation dynamics for each pixel-time series combination. Clustered time

series data were linked to a high-resolution digital soil map of physical soil properties related to soil moisture dynamics to help explain vegetation response patterns. Monthly PRISM climate data was used to interpret vegetation dynamics. Linking high-resolution soil property maps with vegetation dynamics at broad scales can be used to quantify the interactions between soil properties and land use/climate drivers on vegetation. This process can also be used for forecasting climate change effects on vegetation at relatively fine spatial scales.

163. MODELING LAND RESOURCE UNITS TO INFORM DEVELOPMENT OF ECOLOGICAL SITE DESCRIPTIONS IN THE SIERRA NEVADA, CA. Dave Evans*¹, Dylan Beaudette¹, Jon Gustafson²; ¹USDA-NRCS-CA, Sonora, CA, ²Natural Resources Conservation Service, Davis, CA

ABSTRACT

Ecological site description in forested environments is complex and often confounded by variations in climate and topography that drive forest productivity. The Sierra Nevada mountains of California, Major Resource Land Area (MLRA) 22A, offers a unique set of challenges due to the extreme elevation and latitudinal gradients. Both users and producers of ecological site descriptions (ESDs) may benefit from ESDs based on a finer-scale designation known as the Land Resource Unit (LRU). Hierarchically, the LRU is nested within the MLRA and specifies ranges for a specific climatic zone that can accommodate a suite of similar ESDs from a management perspective. During a pilot study, we employed an unsupervised classification of LRU zones using several coarse-scale climatic and topographic variables to determine the relevant climatic ranges for such zones. In order to assess the validity of the LRU classification, we will use ground truth data collected from the ongoing Sequoia-Kings Canyon (SEKI) National Park soil survey. During the summer months of 2012-2014, we visited nearly 500 points to collect detailed soils and vegetation data (including observed LRU zone). For our next step, we endeavor to determine the producer error rate for five of the LRU zones (those occurring within SEKI) and to identify other variables that may be useful in improving the classification accuracy. The park boundary is only a fraction of the extent of the entire MLRA and offers an ideal testing ground to develop LRU models for the entire Sierra Nevada.

164. TESTING ECOLOGICAL SITE CONCEPTS USING DIGITAL SOIL MAPPING AND HISTORICAL AERIAL PHOTOS. Michael C. Duniway*¹, Colby Brungard², Barry B. Baker³; ¹US Geological Survey, Moab, UT, ²Utah State University, Logan, UT, ³Colorado State University, Fort Collins, CO

ABSTRACT

Innovative approaches are needed to gather the data required for robust ecological site concept and state and transition model development. While expert knowledge plays

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an important role in developing ecological site descriptions (ESDs), coupled soil-vegetation data sets are required for refining and testing of ESD concepts. Often, ESD development is data limited, particularly in less intensively managed landscapes. Digital soil mapping approaches and historical aerial photos can help fill some of these data gaps. We present here a new approach for gathering the requisite data needed to analyze current vegetation-soil relationships and, most importantly, how vegetation-soil relationships have changed over the past 60 years in response to climate and management. The study area for this demonstration project is a 51,919 acre Colorado Plateau shrub and grassland ecosystem in southern Utah. Existing soil maps and associated ESDs suggest two potential reference communities are present in the study area (Wyoming big sagebrush and Fourwing saltbush). However, these two ecological sites are nearly identical in soil and landscape attributes. The goal of this effort was to evaluate if soil and/or landscape attributes differentiate these two sites or if the two communities are simply alternative states of the same site in this climate setting. The approach used was to create high resolution raster maps of soil properties and evaluate study area vegetation change using a combination of field data and object oriented image analysis of historical aerial photos. Analysis of vegetation change and overlaid soil property maps suggest these two ecological sites can be distinguished based on soil-depth. Additionally, raster maps of soil properties combined with these refined ESD concepts allowed for predictions of sub-map unit ecological site distribution. Results suggest digital soil mapping coupled with spatially explicit data on vegetation change can be used to refine ecological site concepts in data poor areas.

165. A COMPARISON OF TOOLS TO ASSESS GREATER SAGE-GROUSE HABITAT. Eric D. Sant*¹, Gregg E. Simonds²; ¹Open Range Consulting, Park City, UT, ²Open Range Consulting, Park City, UT

ABSTRACT

The looming possibility of a Greater Sage-Grouse listing under the Endangered Species Act has created a need to assess its habitat, sagebrush, range-wide at a variety of scales. These scales range from statewide to individual sagebrush shrubs. Current tools include remote sensing products that can assess conditions at the statewide scale, and traditional rangeland assessment methods that measure very detailed information but at a limited spatial scale. While these products can be appropriately and effectively used at the scale they are designed for, they lack the ability to evaluate habitat conditions at the scale most relevant to the life cycle of the Sage-Grouse. Continuous cover mapping of important functional groups of landcover is an alternative to the tools currently employed. The ground information for this tool is collected at the detailed plot level and then leveraged across the landscape using multiple scales of remotely sensed images.

166. USE OF HOME RANGE ESTIMATORS TO EVALUATE RING-NECKED PHEASANT HABITAT USE AT MULTIPLE SCALES. Jeffery W. Stackhouse^{*1}, Kevin K. Sedivec², Ben A. Geaumont³; ¹University of California Cooperative Extension, Eureka, CA, ²North Dakota State University, Fargo, ND, ³North Dakota State University, Hettinger, ND

ABSTRACT

Ring-necked pheasant (*Phasianus colchicus*; hereafter pheasant) habitat selection in southwestern North Dakota was monitored using radio telemetry. Movement and GPS (Global Positioning System) locations of 191 male and female pheasants were recorded weekly from July 2010 to April 2012. For pheasants with ≥ 20 GPS locations ($n=89$), home range was determined using two different estimators: minimum convex polygon (MCP) and kernel density estimation (KDE). The average home range size using the MCP and KDE estimates was 258 and 237 hectares, respectively. Habitat types were delineated from 2010 NAIP (National Agriculture Imagery Program) imagery and broken into 7 categories: croplands, Conservation Reserve Program (CRP) cover, rangeland cover, farmsteads with livestock, wetlands, shelterbelts, and other (areas that did not fall within above categories, including urban). Observed GPS points were overlaid on the digitized map in ESRI's (Economic and Social Research Institute) product ArcMap 10 to assess habitat selection of pheasants. For each observed point, one random point on the digitized map was generated using ArcCatalog 10 to define habitat availability. Habitat types from an overlay of random and observed points were used to create data for logistic regression analysis in SAS (Statistical Analysis Software). The habitat use analysis indicated a positive correlation for pheasant selection toward shelterbelts and farmsteads with livestock during the disparate winter of 2011 and the mild winter of 2012; however, data from winter of 2012 also suggested pheasant selection toward wetlands and CRP habitat types. Habitat use during spring, summer, and fall, showed positive correlations to CRP, wetlands, and wood habitat types. All analyses supported negative selection of pheasants toward rangeland cover habitat types.

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167. CALIFORNIA RANGELAND VEGETATION AND ECOSYSTEM SERVICES VARY WITH RAINFALL, NITROGEN DEPOSITION, INVASION, AND MANAGEMENT. Valerie Eviner^{*1}, Joanne Heraty¹, Kevin Rice¹, Carolyn Malmstrom²; ¹UC Davis, Davis, CA, ²Michigan State University, East Lansing, MI

ABSTRACT

For over 250 years, California's grasslands have been dominated by naturalized annual grasses. This vegetation state supports high biodiversity and provides most of California's forage. A newer vegetation state is dominated by recent invasive plants, which greatly decrease livestock production and biodiversity. Both of these vegetation states are dominated by annual plants, making them very susceptible to transitions in response to environmental conditions

and management. Restoration of a third vegetation state, native perennial grasses, potentially provides resilience to environmental variations. Our research investigated how environment (precipitation, soil nitrogen) and management (native restoration, clipping) impact transitions between vegetation states. Nitrogen additions, clipping, and high rainfall (especially late-season rainfall) result in conversion from the naturalized to invaded state. Drought conditions enhance native perennial grasses, and once these natives establish, they are very effective in suppressing the invasives. Vegetation states differ in their impacts on multiple ecosystem services. Compared with the naturalized state, the invasive state greatly decreases forage availability, but has little effect on other services. Tradeoffs exist between the services provided by the native perennial vs. both annual states. Native perennial grasses suppress invasion and enhance soil nitrogen availability. However, natives also enhance nitrogen leaching and soil compaction, while decreasing erosion control and soil water storage capacity. The effects of vegetation states on ecosystem services vary with management practices, environmental conditions, and season. For example, water infiltration rates tend to be higher in the naturalized state, compared to the invaded state. However, this trend reverses under fall clipping. Management practices and environmental variability interact to influence vegetation composition and the effects of vegetation on multiple ecosystem services. Understanding these interactions is a first critical step in developing effective management for vegetation and ecosystem services, particularly in an annual-dominated system exposed to high variability in precipitation.

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168. COLLABORATIVE DEVELOPMENT OF ECOLOGICAL SITE DESCRIPTIONS FOR ADAPTIVE GRASSLAND MANAGEMENT IN CALIFORNIA. Sheri Spiegel^{*1}, James W. Bartolome², Jon Gustafson³, Kendra Moseley Urbanik³, Michael D. White⁴; ¹University of California Berkeley, Berkeley, CA, CA, ²University of California Berkeley, Berkeley, CA, ³Natural Resources Conservation Service, Davis, CA, ⁴Tejon Ranch Conservancy, Lebec, CA

ABSTRACT

Achieving conservation goals in California's spatially and temporally variable grasslands requires management approaches that are both opportunistic and adaptive. Ecological site classifications and state-and-transition models are useful conceptual tools for such management. In 2008, when the Tejon Ranch Conservancy set out to develop an adaptive management plan to meet multiple conservation objectives for 240,000 acres of conserved lands, official, approved Ecological Site Descriptions were available for only a small fraction of sites to be managed. To describe and understand spatial and temporal dynamics across 100,000 acres of Tejon grasslands, the Conservancy partnered with the UC Berkeley Range Ecology Lab. Together we developed an "unofficial" ecological site classification based on top soils and topography at 57 study plots situated across the grassland landscape. Floristic surveys at the plots over

five years informed models of inter-annual change for each ecological site. In 2013, the Conservancy incorporated our findings into an extensive adaptive management plan, and in 2014, NRCS ESD specialists joined the partnership. Now we are working together to develop grazing trials to inform adaptive management, modify the models for wider interpretation, and provide baseline data for official Ecological Site Descriptions for the Tejon Ranch area.

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169. MANAGING LIVESTOCK TO MIMIC NATIVE UNGULATES FOR CALIFORNIA NATIVE GRASSLAND RESTORATION. Kent A. Reeves*¹, Aaron Lazanoff², Joseph Morris³; ¹The Whole Picture Consulting, LLC, Sacramento, CA, ²Cal Poly, San Luis Obispo, San Luis Obispo, CA, ³T.O. Cattle Company, San Juan Bautista, CA

ABSTRACT

Tule elk, *Cervus elaphus nannodes*, pronghorn, *Antilocapra americana*, and mule/black-tailed deer, *Odocoileus hemionus*, historically occurred throughout the native grassland and oak savanna vegetation types of California. Tule elk and pronghorn have been extirpated throughout most of their historic range in the state, and deer populations have changed dramatically. These changes in native ungulate populations have contributed to negative changes in ecosystem processes of community dynamics, water cycling, nutrient cycling, and energy flow. The T.O. Cattle Company (TOCC) has been managing holistically on over 2,023 hectares of heterogeneous landscape in coastal central California since 1993. TOCC has changed livestock management to mimic historic disturbance regimes of native ungulates. This includes amalgamation of livestock into large herds, relative rapid movement of animals timed to coincide with plant growth rates, stockmanship, herding animals with dogs and temporary fences, and livestock behavioral changes to mimic wild ungulates in the presence of predators. The re-introduction of natural disturbance regimes is critical to restoring natural communities and ecosystem processes and ultimately native grasslands. We will discuss changes to ecosystem processes that include: increased numbers, age diversity, and vigor of native grasses and oaks; increased vegetative cover of streambanks and recruitment of riparian plants; wetland expansion and improved water quality; rapid breakdown of dung; and longer growing season of grassland. Livestock nutrition and ranch economics will be discussed along with the potential use of livestock to improve the success of native ungulate reintroduction.

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170. RESTORING NATIVE PERENNIAL GRASSES BY CHANGING GRAZING PRACTICES IN CENTRAL COASTAL CALIFORNIA. Carlene Henneman*¹, Nathaniel E. Seavy², Thomas Gardali²; ¹Point Blue Conservation Science, Pescadero, CA, ²Point Blue Conservation Science, Petaluma, CA

ABSTRACT

The invasion of exotic annual grasses into California grasslands that were once dominated by perennial bunchgrasses has drastically altered ecological structure and function. To evaluate the efficacy of a planned grazing program to restore native perennial grasses, we conducted vegetation monitoring at TomKat Ranch in Pescadero, California. TomKat Ranch is 728 hectares (1,800 acres) with a cow-calf operation (a permanent herd) of approximately 100–150 head. Beginning in 2008 and continuing until 2011, the Ranch employed season-long, continuous grazing practices where cattle were allowed to graze over large portions of the ranch for several months at a time. In 2011, the ranch adopted a planned grazing approach where they increased cattle density by putting them in small blocks and moved them quickly through subdivided fields. To monitor changes in grassland plant community, we measured vegetation composition across all grasslands each July from 2011 to 2013. From 2011 to 2013, the number of vegetation survey units where native perennial grasses were detected increased from 8% to 80%. The cover of native grasses remained small, but increased in the survey units from 0% in 2011 to 3% in 2013. We hypothesize that planned grazing promotes perennial grasses by reducing the competitive advantage of invasive annual grasses and providing periods of rest, especially during plant flowering, that allows for native perennial seed production and increased plant numbers, vigor and size. We need to further understand the effects of intensity of grazing for native grass restoration at larger spatial scales.

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171. IMPROVING RECLAMATION SUCCESS THROUGH WEED MANAGEMENT AND SEEDED SPECIES SELECTION. Beth Fowers*, Brian A. Mealor; University of Wyoming, Laramie, WY

ABSTRACT

As part of the energy extraction process, soils are scraped from sites to access mineral deposits or to create level surfaces for drilling or mining activities. This disturbance kills plants, and makes it necessary to reintroduce desirable species once extraction activities are completed. Reclamation after disturbance of soils and vegetation associated with energy extraction is critical for ecosystem function and is required by law. Weedy annual species often dominate reclamation sites for the short-term, competing for resources with newly-seeded desirable vegetation. Our objectives were to: 1) evaluate herbicide effects on weedy and desirable species, 2) determine the effect of treatment timing (herbicide and seeding) on reclamation success, and 3) evaluate the performance of different species and seed mixes. Fifteen

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herbicide treatments and ten seed mixes were applied in a split-plot design to three sites in Wyoming to evaluate effectiveness of different reclamation practices. Most herbicide treatments targeted broadleaved weeds with the substitution of two treatments targeting annual grasses at one site. Seeding treatments were applied at two timings (fall, spring) across herbicide treatments to investigate establishment rates of specific species under different seeding times. Three years after treatment, herbicide impacts on annual forbs varied by seeded species at two of the three sites ($p < 0.05$). At the third site, herbicide and seed mix reduced annual forb cover independently ($p < 0.05$). Annual grass cover differed among seeded species ($p < 0.05$), suggesting variable competition among desirable species. Establishment of seeded species differed across sites and species ($p < 0.0001$). Season of treatment was important for both herbicide and seeding. Species with the greatest cover, biomass, and weed control included crested wheatgrass and Russian wildrye, followed by basin wildrye and western wheatgrass. The most effective herbicides included aminocyclopyrachlor products at various rates and timings.

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172. RESPONSE OF SEEDED NATIVE WILDFLOWER POPULATIONS TO SEASONAL GRAZING AT SACRAMENTO RIVER NATIONAL WILDLIFE REFUGE. Adrian F. Frediani¹, Susan Edinger-Marshall², Joe Silveira³; ¹The Nature Conservancy, Chico, CA, ²Humboldt State University, Arcata, CA, ³US Fish and Wildlife Service, Willows, CA

ABSTRACT

The Nature Conservancy and U.S. Fish & Wildlife Service have been working together for over 25 years to increase biodiversity at Sacramento River National Wildlife Refuge through horticultural restoration of various local floodplain habitats. Efficient management of these habitats is a critical consideration for land managers tasked with maintaining and enhancing ecological communities with limited resources. This study examined the efficacy of cattle grazing to improve seeded native wildflower establishment. Once a month, from March 2013 through October 2013, I measured total species composition and frequency of plants that produced reproductive structures for the four seeded species: Spanish lotus (*Acmispon americanus*), gumplant (*Grindelia camporum*), sky lupine (*Lupinus nanus*) and California poppy (*Eschscholzia californica*). Five treatment areas were surveyed: 1) ungrazed and never seeded with wildflowers, 2) grazed and never seeded with wildflowers, 3) ungrazed and seeded with wildflowers in 2010, 4) grazed and seeded with wildflowers in 2010, and 5) grazed and seeded with wildflowers in 2010 and reseeded in 2012. Cattle grazing increased the cover of Spanish lotus and the frequency of sky lupine plants in flower, but decreased the frequency of gumplant in flower or seed. None of the native wildflower species responded positively to the repeated seeding. Sky lupine, the earliest blooming species, had lower cover and fewer flowering plants in the twice seeded treatment area, which may be due to disturbance to the soil surface from the

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no-till seed drill during the germination period. Cattle grazing can be an effective tool for increasing site availability to support successional habitat management of floodplain grasslands, providing the grazing period does not interfere with critical growth phases of the seeded native wildflowers. A repeated seeding method of native wildflowers to enhance species availability did not benefit seeded native wildflower populations. Our interpretation of these results guides refuge habitat management.

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173. A CONSERVATION PLANNING TOOL FOR RESTORING ECOSYSTEMS IN THE SAGEBRUSH BIOME CONSIDERING FUTURE CLIMATE CONDITIONS. Jon Hauffer*, Scott Yeats, Carolyn Mehl; E.M.R.I., Seeley Lake, MT

ABSTRACT

Maintaining and restoring functional sagebrush ecosystems is a current management priority given the potential listing of sage-grouse under the endangered species act. Primary efforts have been to identify and map key areas that need to be maintained to conserve sage-grouse. What is also recognized is the need to restore functional sagebrush ecosystems in many areas where they have been degraded, and to identify future needs given likely impacts from climate change. We developed a sagebrush ecosystem restoration planning tool that uses the information contained in NRCS soils maps and data, as well as ecological site descriptions (ESD's) to identify sagebrush ecosystem restoration objectives. Specifically, this tool is designed to be a module of Natural Resources Conservation Service WEB SOIL SURVEY (WSS). WSS provides the capability to select a desired area and display a map of the underlying soils and ecological sites. The sagebrush ecosystem restoration module provides the ability to display the ecological sites relative to having - 1) "high", "moderate", or "low" sagebrush potential, 2) "tall", "moderate", or "no" sagebrush stature, and 3) a tabular description of the desired reference plant community for restoration. Linked with this tool, we developed a summary report of downscaled climate change predictions for each ecological site within the sagebrush biome, and evaluated these predicted changes for their potential effects on sagebrush plant communities. Potential future impacts caused by changes in precipitation and temperature on sagebrush species and grass species were evaluated, and potential locations where changes are likely to occur were mapped. Our evaluation showed few changes in sagebrush species are likely based on changes in precipitation, but that substantial changes in associated grass communities are likely due to shifts in temperatures.

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174. SEEDLING RECRUITMENT OF CONTRASTING LEGUME SPECIES IN ALBERTA'S PARKLAND AND MIXEDGRASS PRAIRIE IN RESPONSE TO LITTER AND DEFOLIATION. Lysandra A. Pyle*, Edward W. Bork, Linda Hall; University of Alberta, Edmonton, AB

ABSTRACT

Legumes are valued for improving forage quality and quantity; however, grazing can cause taller legumes like *Medicago* spp. to decline and favour shorter, grazing-tolerant *Trifolium* spp.. Long-term retention of beneficial legumes requires periodic recruitment from the seed bank. Hard seed coats enable legume seeds to stay dormant until suitable conditions develop. In theory, microsite availability for legume recruitment could be manipulated through management; for example, grazing can regulate the amount of competing vegetation and litter covering the soil, which in-turn modifies light intensity, soil moisture and soil temperature. We designed a legume demography study that tracked seedling emergence, survival and persistence of individual seeds from 6 legume species in 4 microsites that reflected contrasting management conditions. Microsite conditions were altered by removing litter, defoliation, litter removal plus defoliation, or left untreated. The legumes tested included 2 tame forage species [white clover (*Trifolium repens*) and alfalfa (*Medicago sativa*)], 2 invasive legumes [cicer milkvetch (*Astragalus cicer*) and sweet clover (*Melilotus officinalis*)], and 2 native species [purple prairie clover (*Dalea purpurea*) and American vetchling (*Vicia americana*)]. Legumes were planted in 40 x 40 cm plots under all conditions (4 Replicates of each) in both native and tame grasslands at two locations (Aspen Parkland and Mixedgrass Prairie). We simulated recruitment within each plot from the seed bank by planting 40 legume seeds per plot in mid May of 2014 just below the soil surface. Each seed (N= 15,360 total) was glued to a toothpick for repeated assessment. The fate of individual seeds were subsequently monitored throughout the growing season until recruitment halted after heavy frost. The results of this study will provide information on the relative recruitment of different legumes in response to environmental conditions, and will highlight opportunities to promote (beneficial forages) or impede (invasive) legumes, depending on management objectives.

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175. VARIATION IN COMPETITIVE ABILITY OF BOTTLEBRUSH SQUIRRELTAIL (*ELYMUS ELYMOIDES*) POPULATIONS. Rebecca K. Mann*¹, Kari E. Veblen¹, Thomas A. Monaco²; ¹Utah State University, Logan, UT, ²USDA, Agricultural Research Service, Logan, UT

ABSTRACT

In the western U.S., bottlebrush squirreltail (*Elymus elymoides*) is a frequent component of native seed mixes used to revegetate disturbed rangelands that are commonly at risk of invasion by cheatgrass (*Bromus tectorum*). Phenotypic variability among squirreltail populations has been documented, yet little is known about how these population-level differences influence the outcome of competitive interac-

tions between squirreltail and cheatgrass. Through a common garden greenhouse experiment, we measured variation among 19 populations of *E. elymoides* in their tolerance of *B. tectorum* competition using a standardized, biomass-based index. Preliminary analyses indicate that subspecies identity is significantly related to competition tolerance ($p = .003$), but within a subspecies, there is marginal variation among populations in their tolerance of competition. We also explore the relationship of competitive tolerance to a suite of squirreltail growth traits, including days to germination, root:shoot ratio, specific leaf area, specific root length, and leaf number. The aim of this research is to clarify the range and drivers of competitive ability within the *E. elymoides* species. Outcomes may aid future development of ecologically successful native plant materials for rangeland reseeding efforts and the identification of populations that may contain traits of conservation concern.

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176. HIGH CONCENTRATIONS OF CONDENSED TANNINS IN UTAH TREFOIL (*LOTUS UTAHENSIS* L.). Douglas A. Johnson*¹, Jennifer W. MacAdam², Kevin J. Connors¹, Jason M. Stettler¹, Shaun Bushman¹, Thomas A. Jones¹; ¹USDA-ARS-FRRL, Logan, UT, ²Utah State University, Logan, UT

ABSTRACT

Rangeland ecosystems in the western USA are increasingly vulnerable to wildland fires, weed invasion, and misuse. For many of these rangelands, revegetation/restoration may be required to improve degraded conditions, speed recovery, combat invasive weeds, and minimize soil erosion. Utah trefoil (*Lotus utahensis* Ottley) is a legume species native to the southern Great Basin and Colorado Plateau that occurs in southern Utah, southern Nevada, and Arizona. Utah trefoil is of interest in revegetation/restoration of degraded rangelands because it has the potential to biologically fix nitrogen, enhance native pollinator habitat, and provide nutritious forage for livestock and wildlife. In addition, several species in the genus *Lotus* contain condensed tannins (CT), which are known to prevent bloat, reduce parasites in the intestinal tract, and enhance amino acid absorption. Seeds of Utah trefoil were collected throughout its distribution from 19 sites in Utah, Nevada, and Arizona. Seeds from these 19 sites and 'Norcen' birdsfoot trefoil (*Lotus corniculatus* L.) for comparison were germinated and grown in a greenhouse. The greenhouse-grown seedlings were transplanted in common gardens at three sites in northern Utah. Forage was harvested from these common-garden sites during October, immediately placed on dry ice, freeze-dried, and ground. An acetone-enhanced butanol-HCl-iron spectrophotometric assay was used to solubilize and quantify sample CT. Concentrations of CT for the Utah trefoil collections ranged from 4-26% compared to about 1% for birdsfoot trefoil. Further studies are being conducted to clarify the chemical characteristics and seasonal dynamics of these tannins and determine if differences among collections are genetically based.

177. QUANTITATIVE REVIEW OF WILD HORSE DIETARY CONFLICTS WITH LIVESTOCK AND WILDLIFE ON WESTERN RANGELANDS. John D. Scasta*, Jeffrey L. Beck; University of Wyoming, Laramie, WY

ABSTRACT

Wild horse management on western rangelands is an ecological and sociological issue of escalating concern. Identifying potential dietary overlap between horses and livestock and wildlife will help inform management decisions to optimize multiple interests and guide innovative research questions. We conducted a review of microhistological fecal diet studies for wild horse, beef cattle, domestic sheep, elk, pronghorn and mule deer diet composition on interior rangelands of western North America. Our search yielded 33 studies from 12 states and 1 province with 197 unique species-season samples. To understand broad ecological interactions, we summarized plant species into graminoid, forb, and shrub functional groups. Using Principal Components Analysis (PCA), we compared functional group diet composition of these six herbivores for four seasons (spring, summer, fall and winter). The first PCA axis was always explained by the grass to shrub gradient between grazers and browsers except in the summer when forbs were equally as influential as shrubs. The first axis explained 58% to 72% of the variation depending on the season and the first two PCA axes explained 90% to 92% of total variation. Unexplained variation in the ordination was attributed to inter- and intra-annual precipitation variation and variation across study locations in precipitation and relative availability of plant functional groups. In the spring, wild horse diets only overlapped with cattle and in the summer wild horses only overlapped with cattle and domestic sheep diets. Fall and winter wild horse diets overlapped with cattle, sheep and elk with potential overlap with pronghorn. Wild horse diets never overlapped that of mule deer regardless of season. Wild horses consistently selected for graminoids and displayed the greatest functional group diet niche breadth in winter. Season, plant composition, and herbivore assemblage may all influence dietary competition between wild horses and other large herbivores sharing interior North American rangelands.

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178. CROSSING-OVER: MERGING GRAZING MANAGEMENT AND CARNIVORE BEHAVIOR AS PRACTICAL TOOLS FOR REDUCING LIVESTOCK CONFLICTS. Timothy Kaminski¹, Joe Englehart², Brad Ralston³, Brian DeLint⁴; ¹Mountain Livestock Cooperative, Livingston, MT, ²Cow Boss and Ranch Manager, Spruce Ranch and Grazing Cooperative, Longview, AB, ³Rancher and Top Hand, TL and Rocking P Ranch, Nanton, AB, ⁴Rancher, Quill Ranch, Cowley, AB

ABSTRACT

American interest in the expanse of grizzly bears and wolves on public land belies the economic and practical difficulties faced by ranchers and stockmen who must earn a living from it. Government reliance on outdated policy, perverse

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incentives and over-matched staffing impede the willingness found in working ranching communities to extend stewardship practices beyond that of grass and water. Absent a 21st century transformation in agency participation and land management practice, a new era of land stewardship benefitting people, sustainable agriculture and carnivore conservation cannot emerge. We introduce a ranch community led-endeavor unifying science with local knowledge. We appraise cross-over between ranchers' expertise about livestock and grazing management with biologists experience about carnivore biology and behavior as a cooperative mechanism useful toward commonly understood needs for improving range and livestock production while reducing large carnivore conflicts. Drawing on a decade of experience and carnivore-livestock data, we show that: 1) cross-over between ranchers' expertise with biologists' experience can inform human vigilance in managing livestock age and dispersion to limit livestock harassment and learning by large carnivores; 2) prey behavior and movement, mechanisms that evolved to stimulate carnivore pursuit and capture of prey, are predation risk influences exacerbated by outmoded grazing practices; 3) grazing management used as a proactive conflict reduction tool, when matched with spatial stability and social cohesion in wolf and grizzly bear family groups to reduce livestock losses, is advantageous to sustaining livestock grazing over behaviorally disruptive culling of individuals and cyclic large carnivore turnover; and 4) effectiveness of practical tools to reduce livestock vulnerability improve when properly scaled to seasonal carnivore home ranges. This work shows that land stewardship inclusive of a reverence for life can inspire an ethos that unites rather than divide rural and urban residents' willingness to embrace working ranch and large carnivore conservation. Foremost is earning and keeping trust. In our experience, crossing-over is the first step.

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179. LIVESTOCK MANAGEMENT FOR COEXISTENCE WITH LARGE CARNIVORES, HEALTHY LAND AND PRODUCTIVE RANCHES. Matt Barnes*; Keystone Conservation, Bozeman, MT

ABSTRACT

Ranchers can apply many of the same approaches that work for rangeland health and livestock production to reduce conflicts with large carnivores. Evidence synthesized from the rangeland, wildlife, and animal sciences suggests that modeling livestock management after the grazing patterns and reproductive cycles of wild ungulates in the presence of their predators can improve rangeland health and livestock production—and increase the ability of ranching operations to coexist with native carnivores. The central anti-predator behavior of wild grazing animals is to form large, dense herds that then move around the landscape to seek fresh forage, avoid fouled areas, and escape predators. Strategic grazing management involving high stocking density and frequent movement, such as rotational grazing and herding with low-stress livestock handling, can—if well planned and creatively managed—improve rangeland health and livestock production, by managing the distribution of grazing across

time, space, and plant species. Wild herbivores also have their young in short, synchronized birthing seasons (predator satiation). Short calving seasons can increase livestock production and reduce labor inputs, especially when timed to coincide with peak availability of forage quality. Such livestock management approaches based on anti-predator behaviors of wild ungulates may directly and synergistically reduce predation risk—while simultaneously establishing a management context in which other predation-prevention practices and tools can be used more effectively.

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180. PATCH BURN GRAZING MANAGEMENT AND GRASSLAND BIRD HABITAT IN THE WESTERN GREAT PLAINS. David Augustine^{*1}, Justin D. Derner², Susan Skagen³; ¹USDA-ARS, Fort Collins, CO, ²USDA-ARS, Cheyenne, WY, ³USGS, Fort Collins, CO

ABSTRACT

Combining prescribed fire and grazing management has been recommended as a tool to generate a heterogeneous vegetation mosaic for grassland birds. Past studies have focused on tallgrass prairies of the eastern Great Plains; less is known about fire-grazing interactions in semiarid grasslands of the western Great Plains. We conducted a patch burning experiment in shortgrass steppe (northeastern Colorado) comparing 3 unburned pastures with 3 pastures in which 25% of the area is burned each year. Burns were implemented in October or November of 2007 – 2010, and vegetation, cattle, pronghorn antelope, and grassland bird responses were monitored during 2008 – 2011. Burns removed >95% of standing dead biomass, and reduced vertical vegetation density in mid-June by 53% (1.8 + 0.2 cm on burns vs. 3.8 + 0.3 cm in unburned sites). Cattle preferentially grazed on the patch burns during the growing season, and pronghorn preferentially grazed on patch burns during the fall and winter. Vegetation structure on 2 - 4 year old burns was intermediate between recent burns and unburned pastures, such that attraction of cattle to burned patches did not increase structure in the unburned portions of patch-burned pastures. Grassland birds showed strong responses to the vegetation structure gradient produced by patch burn grazing management. In all four years of the study, Mountain plovers only occurred on current-year burns. Grasshopper sparrows only occurred in unburned grassland or patches burned >3 years ago. Lark buntings and western meadowlark densities were significantly reduced by patch burning, and reached peak densities in unburned pastures. McCown’s longspur and horned lark densities were unaffected by patch burning. Findings suggest patch burn grazing management can be an effective management tool to enhance mountain plover breeding habitat, but needs to be combined with other strategies to generate tall, dense vegetation cover for nesting habitat for species such as lark buntings and grasshopper sparrows.

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181. RANCHING AND ENDANGERED SPECIES CONSERVATION: THE BENEFITS OF RANCHING TO CALIFORNIA CONDOR RECOVERY. Scott Scherbinbski^{*1}, Laura Mendenhall², Rachel Wolstenholme³; ¹Pinnacles National Park - National Park Service, Paicines, CA, ²US Fish and Wildlife Service, Ventura, CA, ³National Park Service, Paicines, CA

ABSTRACT

The beneficial role of ranching to wildlife conservation is increasingly recognized by landowners and wildlife managers and is used to focus on a common goal of maintaining open, working landscapes. Ranching provides resources, such as habitat, drinking water at livestock troughs, and forage, for a diverse variety of wildlife, including the critically endangered California condor, *Gymnogyps californianus*. Carcasses and animal remains left in the field by ranching and hunting operations are important food sources for condors. Pinnacles National Park, a reintroduction site for condors, is surrounded by working rangelands. Condors released in to the wild are closely monitored to collect data on their habitat use, foraging patterns, and threats to their recovery. As condors range over wide expanses, it becomes difficult to constantly track their movements and observe behaviors, such as feeding. California condors can fly up to 100 miles in a single day of foraging, and because feeding may take place during a few minutes or several hours, monitoring strategies have limited ability to identify feeding events and food types. The use of GPS and GSM technologies to collect and store fine-scale data has increased our ability to document where condors are foraging and what they are foraging on. In reviewing data collected over the past 11 years of condor reintroductions at Pinnacles National Park, there is a clear trend. While foraging over areas surrounding Pinnacles, condors locate a significant proportion of food on privately owned lands with active ranching and hunting operations. When endangered species recovery is reliant on operations on private lands, we need to recognize the contribution made by those landowners. Pinnacles National Park has recognized these contributions and is working to develop partnerships with our ranching community to promote conservation of rangelands and the California condor.

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182. FEMALE LESSER PRAIRIE-CHICKEN RESPONSE TO GRAZING PRACTICES IN WESTERN KANSAS GRASSLANDS. John Kraft^{*1}, David Haukos², Joseph Lautenbach³, Jim Pitman⁴, Christian A. Hagen⁵; ¹Kansas State University, 66506, KS, ²U.S. Geological Survey, Manhattan, KS, ³Kansas State University, Manhattan, KS, ⁴Kansas Department of Wildlife, Parks, and Tourism, Emporia, KS, ⁵Oregon State University, Bend, OR

ABSTRACT

The Lesser Prairie-Chicken (*Tympanuchus pallidicinctus*; hereafter LPC) is a grouse species endemic to the grasslands of the southern Great Plains. In March, 2014, cumulative habitat degradation and subsequent population decline led to the listing of this species as “Threatened”

under the Endangered Species Act. The vast majority of the species range is on private grazed lands. Thus, the response of LPC populations to livestock grazing strategies need to be investigated and quantified for conservation planning. We investigated the effects of various grazing pressures on reproductive success and habitat use within Kansas grazed lands. During the springs of 2013 and 2014, individuals were captured on breeding/display grounds (leks) and fitted with either a 17-g VHF bib-style transmitter or a 22-g model 100 GPS Platform Transmitting Terminals (PTT). Locations of tagged birds, nest sites, and broods were recorded. Grazing data were collected via producer correspondence and vegetation surveys. Initial results indicate that functional grasslands are an important resource for LPC populations during all seasons. Furthermore, measures of LPC habitat use and reproductive success were positively related with lower values of grazing intensity (AUM and percent forage utilization rates). Analyses indicated loamy upland, limy upland, red clay prairie and saline subirrigated ecological sites were used more than other available range sites. Understanding and creating meaningful relationships between livestock production and LPC population demography will provide additional information for conservation and management.

183. USING CONTINUOUS COVER MAPPING AND TELEMETRY TO PRIORITIZE SAGE-GROUSE HABITAT CONSERVATION AND REHABILITATION. Gregg E. Simonds*¹, Eric D. Sant²; ¹Open Range Consulting, Park City, UT, ²Open Range Consulting, Park City, UT

ABSTRACT

With the potential listing of the Greater Sage-grouse under the Endangered Species Act, efforts to evaluate, prioritize, and mitigate Sage-grouse habitat will be necessary. By using large samples of radio collared birds and continuous cover mapping the needs of the bird can be quantified and expressed geographically. Habitat restoration and mitigation can then be directed to places that can be changed the most for the least amount of input. Near Roundup Montana over 100 birds were collared and over 500,000 acres were mapped using continuous cover mapping techniques. Between the two datasets a highly accurate assessment of Sage-habitat value was created.

184. GREATER SAGE-GROUSE SEASONAL MOVEMENTS AND EVALUATION OF UTAH'S SAGE-GROUSE MANAGEMENT AREAS. David K. Dahlgren*¹, Terry Messmer¹, Benjamin Crabb¹, Randy Larsen²; ¹Utah State University, Logan, UT, ²Brigham Young University, Provo, UT

ABSTRACT

The Utah Sage-Grouse Plan identifies conservation strategies to be implemented over the next decade within 11 Sage-grouse Management Areas (SGMAs). Since the late 1990s researchers from Utah State University (USU) and

Brigham Young University (BYU) have been conducting telemetry-based research on sage-grouse in Utah populations. This has resulted in over 20,000 sage-grouse seasonal location data points that were organized into one central database. We used spatial location data from 1998-2013 to assess seasonal movements and distances from leks in 13 study areas across Utah. Sage-grouse nests (n=943) averaged 2.22 km from the nearest lek and the 90th percentile was 5 km. Maximum distance for individual broods (n=958) averaged 3.71 km from nearest lek and the 90th percentile was 7.59 km. Movements from nest to summer locations (n=545) averaged 5.55 km, and the 90th percentile was 13.09 km. There is considerable variation in movement distances between populations, which likely reflects available usable space. For example, nest to maximum brood distances in study areas with more habitat space tended to have farther distances moved by broods. This demonstrated that, if given the opportunity, sage-grouse will use the space available to them. This finding supports the conservation objective of restoring areas (e.g., Phase I and II PJ treatment) in close proximity to current habitat. Individual sage-grouse moved considerable distances to meet their seasonal habitat needs. Our data suggested that buffers of 5 km (~3 mi) and 8 km (~5 mi) around leks may be needed to conserve at least 90% of Utah's sage-grouse nesting and brooding habitat, respectively. For all seasonal locations (including study areas outside SGMA boundaries) ~ 85% of nest, summer and winter locations were encompassed by current SGMAs. When weighted by lek counts in individual populations, SGMAs incorporate > 95% of Utah's studied greater sage-grouse populations.

185. EFFECTS OF JUNIPER ENCROACHMENT AND MANAGEMENT ON SAGE-GROUSE NEST SELECTION IN SOUTHEASTERN OREGON. John P. Severson*¹, Kerry P. Reese¹, Christian A. Hagen², Jeremy D. Maestas³, James T. Forbes⁴; ¹University of Idaho, Moscow, ID, ²Oregon State University, Bend, OR, ³Natural Resources Conservation Service, Redmond, OR, ⁴Bureau of Land Management, Lakeview, OR

ABSTRACT

Greater sage-grouse have experienced declines due to numerous factors, causing them to be considered for listing under the Endangered Species Act. One of the main factors is thought to be habitat alteration and fragmentation caused by conifer encroachment, but little research has been done specifically to evaluate the effect. For example, western juniper distribution in the Great Basin has increased ~10-fold since pre-European settlement, but, although juniper management is becoming more widespread, little is known about how juniper encroachment and management may actually affect sage-grouse. Our goal was to assess specific effects of juniper encroachment and management on nest-site selection at multiple spatial scales. We analyzed high resolution spatial data of individual juniper trees in proximity to >300 nests in southern Oregon to determine important spatial scales and effects of juniper characteristics from 0.2

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ha to 400 ha on nest-site selection. Our results indicate that various scales are important to sage-grouse nesting habitat and increased juniper coverage restricts nesting habitat. This information will be vital in determining how conifer encroachment effects sage-grouse populations as well as informing management. Studies evaluating the effects of conifer encroachment, such as this, will be integral to the Fish and Wildlife Service ESA listing decision in Fall 2015.

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186. WHO WILL MANAGE SAGEBRUSH HABITATS IN A FUTURE OF RAPID CLIMATE CHANGE? Andrew R. Kleinhesselink¹, Aldo Compagnoni², Jonathan B. Koch¹, Lexine Long³, Thomas Edwards⁴, Peter B. Adler¹; ¹Utah State University, Logan, UT, ²Rice University, Houston, TX, ³U.S. Geological Survey and Northern Arizona University, Flagstaff, AZ, ⁴U.S. Geological Survey and Utah State University, Logan, UT

ABSTRACT

Species distribution models (SDM) predict that areas with climate suitable for sagebrush ecosystems will shift northwards and shrink in size over the next century due to global warming. So far, however, there has been little discussion about how shifts in sagebrush distribution will be spread out across private and public land and across major land management agencies. We built a SDM for sagebrush fit to presence absence data from the SW and NW Regional GAP land cover datasets and used it to project the distribution of areas suitable for sagebrush at the end of the century based on climate models. Our SDM predicts that areas suitable for sagebrush will decline greatly in extent by the end of the century under both high and low emissions scenarios. Under a low emissions scenario, our SDM predicts losses of area suitable for sagebrush of over 40% on US Forest Service and BLM lands, 60% on non-federal lands, nearly 70% on National Park Service lands and over 90% on Department of Defense lands. Some new areas may become suitable for sagebrush on National Park Service and US Forest Service lands, but these gains are projected to be small compared to losses. Our analysis agrees with the dramatic loss of suitable habitat for sagebrush predicted by previous SDMs, but that these losses will not occur evenly over land management agencies. Sagebrush management may benefit from transferring institutional knowledge about these ecosystems from agencies that will lose sagebrush habitat to agencies that will gain sagebrush habitat in coming decades.

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187. PLANT POPULATION RESPONSES TO HISTORICAL CLIMATE VARIATION IN SAGEBRUSH STEPPE. Dave Iles*, Andrew R. Kleinhesselink, Eric M. LaMalfa, Rebecca K. Mann, Andrew Tredennick, Peter B. Adler; Utah State University, Logan, UT

ABSTRACT

The historical response of plant populations to climate variation may provide important clues about the sensitivity and

future performance of populations to changes in climate regimes. Such an understanding is necessary for prioritizing short- and long-term management efforts. To examine the relationship between annual climate and changes in cover of common grasses and sagebrush, we compiled long-term records of cover data from permanent vegetation plots across the western United States. Specifically, we asked 1) how has the cover of key sagebrush steppe species responded to historical inter-annual variation in climate, 2) under what climate conditions does cover increase or decrease for each species, and 3) how consistent are species responses across our study region? We performed the analysis by comparing the change in species' cover at each site in each year to the climate conditions experienced during that year. Cover of *Artemisia tridentata* decreased significantly in response to spring temperatures. Conversely, cover of *Bromus tectorum* and *Poa secunda* increased mostly in wetter years. Three other species (*A. tripartita*, *Pseudoroegneria spicata*, and *Hesperostipa comata*) showed very weak responses to annual climate. This analysis shows that species commonly found together may differ in their response to annual climate variation. The generally weak responses to annual climate variation we observed contrasts with the strong sensitivity to climate predicted by species distribution models and suggests that species' responses to climate may require long-term changes in climate or may be driven by other indirect effects of climate (such as fire frequency). This study outlines a method for using easily collected long-term data to investigate short-term population responses to climate variation; a potentially useful approach for managers tasked with understanding short-term consequences of climate variation.

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188. PIXEL-BASED MODELING OF PLANT POPULATION DYNAMICS AT MESO-SCALES: A TEST CASE WITH SAGEBRUSH (*ARTEMISIA*) SPECIES. Andrew Tredennick¹, Peter B. Adler¹, Cameron L. Aldridge², Collin Homer³, Dave Iles¹, Andrew R. Kleinhesselink¹, Eric M. LaMalfa¹, Rebecca K. Mann¹; ¹Utah State University, Logan, UT, ²Colorado State University & USGS, Fort Collins, CO, ³USGS, Boise, ID

ABSTRACT

Forecasting the impacts of climate change on plant communities over large spatial extents requires understanding population dynamics at similar extents. However, virtually all studies of plant population dynamics rely on demographic observations recorded at the meter to sub-meter scale. Local-scale demographic data make building population projection models an easy task, but it is very difficult to extrapolate small-scale studies to large spatial extents. Alternatively, large-scale trends in populations are easily detected using widely available monitoring data, but such data are rarely used to project future population states. We propose combining the best features of local-scale population modeling and large-scale monitoring data. Specifically, we describe a new approach for modeling population dynamics at large spatial extents based on the theory and mechanics of indi-

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vidual-based models (IBMs) as applied to a 27 year remotely-sensed time series of sagebrush (*Artemisia* spp.) cover at two sites in southwestern Wyoming (5 x 5 kilometer study areas). We fit regressions for pixel-level processes (30 meter resolution) analogous to growth, survival, and colonization by linking climate covariates to interannual changes in remotely-sensed cover. These regressions are the basis for a pixel-based model (PBM) which we used to forecast sagebrush cover at the landscape scale in response to altered climate. The PBM successfully reproduces the observed sagebrush cover distribution, with the simulated mean and standard deviation similar to the observed time-series distribution at both study areas. Based on outputs from climate models for the 2050-2100 period relative to the 1950-2000 period, our study area is projected to experience increased temperature and precipitation. Under projected future climate, we forecast a modest increase in sagebrush cover at one site and a modest decrease at the other. Positive growth responses may be most likely at high elevation sites near the thermal limit for sagebrush species.

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189. MODELING AND FORECASTING BIG SAGEBRUSH REGENERATION IN THE CONTEXT OF CLIMATE CHANGE. John Bradford^{*1}, William Lauenroth², Daniel Schlaepfer²; ¹USGS Southwest Biological Science Center, Flagstaff, AZ, ²University of Wyoming, Laramie, WY

ABSTRACT

Big sagebrush is a dominant component of many plant communities in the western United States. These ecosystems have been and continue to be reduced in extent and quality due to economic development, invasive species, and climate change, prompting concern about the long-term viability of sagebrush habitat and sagebrush-obligate wildlife species (notably greater sage-grouse). Several processes contribute to future sagebrush viability and geographic distribution, including regeneration. We used a process-based regeneration model for big sagebrush, which simulates potential germination and seedling survival in response to weather and edaphic conditions, to estimate current and future regeneration probabilities. Our results supported expectations of increased probability of weather and soil water conditions that support regeneration in wetter and cooler locations (typically northward and upslope) and decreased probability of regeneration in warmer and drier locations (typically southward and downslope). Our results highlighted that minimum and maximum daily temperatures as well as soil water recharge and summer dry periods are important constraints for big sagebrush regeneration. Climate change pushes soil water dynamics in areas of increasing regeneration probabilities to become more similar to the typical seasonal ecohydrological conditions observed within the current range of big sagebrush ecosystems. By contrast, in areas of declining regeneration probability, increasing winter and spring dryness represent a departure from conditions typically supportive of big sagebrush. Overall, our results are consistent with previous assessments of climate change impacts on overall ecohydrological suitability, i.e., we see consistent changes

in areas identified as trailing and leading edges. Decreasing regeneration probability underscores the potential futility of efforts to preserve and/or restore big sagebrush in some areas. Conversely, increasing regeneration probability suggests a growing potential for conflicts in management goals between maintaining existing grasslands by preventing sagebrush expansion versus accepting a shift in plant community composition to sagebrush dominance.

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190. CARBON CYCLING AND CLIMATE CHANGE IN SAGEBRUSH STEPPE. Lafe G. Conner¹, Kevin J. Horn^{*2}, Rory O Connor³, Richard A. Gill¹; ¹Brigham Young University, Provo, UT, ²Virginia Tech, Blackburn, VA, ³Kansas State University, Manhattan, KS

ABSTRACT

A vulnerability assessment is one tool that land managers can use to inform rangeland management decisions. As part of a distributed vulnerability assessment of the impact of climate change on sagebrush steppe ecosystems we evaluated the impact of climate change on carbon cycling in mature sagebrush ecosystems. We used ecosystem carbon values from the SageSTEP (<http://www.sagestep.org/>) project to parameterize the DayCent (<http://www.nrel.colostate.edu/projects/daycent/>) model simulations of carbon fluxes. We used projected values of daily weather from a full suite of climate change models (http://gdo-dcp.ucllnl.org/downloaded_cmip_projections/) to simulate a range of climate change scenarios. We also evaluated the effect of fire on ecosystem carbon through a state change from a mature sagebrush ecosystem to an annual grass dominated ecosystem. We found that sagebrush ecosystems continued to provide carbon storage in most of the years modeled, indicated by a positive net annual ecosystem carbon balance, and there was little difference in storage potential associated with different climate change scenarios. We found that the amount of carbon stored varied by site and by initial input values. There are two major implications for land management. First, that carbon storage potential is site specific. Second, that disturbance, such as fire and agricultural or urban development, are likely to have greater impact on the carbon-storage potential of sagebrush ecosystems than climate change alone.

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191. WILDFIRE IN SAGEBRUSH STEPPE ECOSYSTEMS: CAN PAST FIRE REGIMES HELP PREDICT THE FUTURE? . Jennifer L. Pierce^{*1}, Kerrie Weppner¹, Mike L. Pellant², Katherine T. Gible¹; ¹Boise State University, Boise, ID, ²BLM, Boise, ID

ABSTRACT

Paleo-vegetation studies show that even prior to anthropogenic influence, sage steppe communities were dynamic, and sometimes susceptible to replacement by other vegetation communities (including forests) under changing climatic conditions. Likewise, some forest communities (e.g. pinyon

and juniper) have expanded northward in the past several thousand years with warming climate conditions. While fire has been a natural part of sagebrush steppe ecosystems (sage-steppe) from thousands to millions of years, human fire starts, land-use change and invasive species have substantially altered the natural fire cycle in recent times. Before Euro-American settlement in the western US in the 1800's, fires in sage-steppe were generally smaller and less frequent than today. With settlement, widespread grazing reduced fine fuels and likely promoted expansion and densification of woody species such as sagebrush and juniper. This, along with fire exclusion, may have created a 'fire deficit' (Marlon et al., 2012) that is now being aggressively remedied by a warming climate and invasive species. In the early 1900's, the arrival and subsequent expansion of cheatgrass (*Bromus tectorum*), has produced an annually renewable continuous cover of dry fuel; in recent decades, fires exceeding 100,000 acres in rangelands are common; fires of this size were extremely unusual prior to the 1980's. Increased use and development in rangelands by people has increased human-caused fires, especially along roads and in recreation areas. Finally, a changing climate is driving longer and hotter fire seasons. These factors combine to create a vicious cycle: hot, dry, fire seasons and plenty of natural and human ignitions spark fires in sage steppe ecosystems, cheatgrass fuels larger and more frequent fires, and following fire, cheatgrass out-competes sagebrush to re-establish quickly in burned areas. These cheat-infested areas then provide more fuel for fires and further increase expansion of cheat at the expense of sagebrush.

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192. CLIMATE CHANGE VULNERABILITY OF SAGEBRUSH STEPPE: SYNTHESIS AND RESEARCH NEEDS. Peter B. Adler*; Utah State University, Logan, UT

ABSTRACT

Student teams participating in our climate change vulnerability assessment took a variety of different analytical approaches to assess potential impacts of climate change on sagebrush steppe ecosystems. While teams using species distribution models found evidence for fairly dramatic changes in sagebrush distributions, teams using other approaches, ranging from mechanistic recruitment models to paleoecological data, tended to project more modest impacts of climate change. The apparent inconsistencies in these results reflect the different assumptions and objectives of the different analyses. Nevertheless, the complexity of the approaches and the diversity of the projections poses challenges in communicating the results to managers. We draw two conclusions from our experience. First, while projections of species distribution models offer valuable information, they should not form the sole basis of vulnerability assessments. Second, to increase confidence in our projections, we need new research to integrate results from a variety of models. I will describe a new approach our team is now pursuing to compare predictions from a series of correlative and mechanistic models.

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193. UNDERSTANDING THE CATTLE INDUSTRY FOR RANGELAND CONSERVATION. Karen Sweet*; GLCI California, Livermore, CA

ABSTRACT

Through presentations and discussions, ranchers and non-ranchers will better understand the global ranching industry and its relationship to sustainable and healthy rangeland conservation. With the world population officially hitting 7 billion people earlier this year and projected to reach 9.5 billion by 2050 farmers and ranchers must continue to find ways to sustainably feed a growing world population using fewer natural resources. Concurrently, thousands of rangeland acres are annually removed from food production and active management. In order to provide food with responsible conservation activities, rangeland owners, stewards and other decision makers and advisors will need to be increasingly efficient and flexible, utilize the best of science and technology, information and human resources, and recognize their dual role of conservation and production of food and other services.

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194. LEGACY EFFECTS OF PHENOLOGICALLY-TARGETED SIMULATED GRAZING EVENTS IN DROUGHT-IMPACTED SEMI-ARID RANGELAND. Carolyn M. Malmstrom*¹, Valerie Eviner²; ¹Michigan State University, 48824, MI, ²UC Davis, Davis, CA

ABSTRACT

Semi-arid rangelands in California face multiple threats from interactions of invasive weeds and drought. To assist ranchers in improving rangeland forage and economic productivity, we partnered with local stakeholders to examine the effects of phenologically-timed grazing to control late-season weedy invasive grasses and promote more desirable forage species. In previous work, we found that simulated grazing (clipping) conducted in spring when forage species reach physiological peak most strongly decreased forage biomass and increased weed cover in rangeland plots. In contrast, fall clipping of standing dry grasses increased forage biomass and reduced weed extent, as predicted by our rancher collaborators. However, May clipping just prior to weed seed production reduced weed biomass most. Here we report on the legacy effects of this three-year period of clipping treatments as evident four years after treatments ended (seven yrs after treatment start), during an extended drought. We monitored vegetation within a one-acre field from which livestock but not rodents were excluded. Most strikingly, we found that plots previously clipped in May now contained notably less yellow starthistle (YST, an undesirable invasive forb), but ~2X more weedy grass biomass than the other treatments. This reversal in weedy grass dominance demonstrates the value of longer-term studies in assessing the trajectories of response to disturbance. In this specific case, we suggest that the weedy forbs and grasses share an antagonistic relationship, likely due in part to differences in their seasonal needs for water availability. While May clip-

ping initially reduced weedy grass biomass, it also reduced YST establishment. Subsequent recolonization by weedy grasses thus was likely less constrained by their weedy forb competitors, and weedy grass biomass rebounded to higher levels than elsewhere. The observed legacy effects underscore the importance of anticipating responses to management mediated by competition among weedy species from different functional groups.

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195. MANAGING TANGLEHEAD IN SOUTH TEXAS WITH PATCH BURNING AND GRAZING. Megan K. Clayton^{*1}, Erasmo Montemayor², Robert K. Lyons³; ¹Texas A&M AgriLife Extension Service, Corpus Christi, TX, ²Natural Resources Conservation Services, Hebbronville, TX, ³Texas AgriLife Extension Service, Castroville, TX

ABSTRACT

Tanglehead (*Heteropogon contortus*) is a native, warm-season, perennial bunchgrass which is found in sandy prairies in South Texas. It provides palatable forage for livestock in the growing season and decreases under heavy grazing. It can also provide good nesting cover for birds and fawning cover for deer. However, in recent years, with the removal of cattle and conversion to strictly wildlife management on many ranches in these sandy prairies, tanglehead has become a monoculture creating dense grassy areas that are not useful for wildlife. In the late-winter and early-spring of 2014, patch burning was initiated on two ranches in Jim Hogg County, Texas. Grazing exclosures and transects were established in burned and unburned areas on both ranches to monitor tanglehead response to grazing following burns. Additionally, clippings from burned and unburned sites and cattle fecal samples were collected during the study to monitor changes in nutrition. Cattle were fitted with GPS-collars to monitor use of burned and unburned areas during three week intervals, three or four times throughout the growing season. During the month following burns, there were no differences in number of GPS-points/acre between burned or unburned plots on either site. However, in subsequent months, burned areas had as much as 2-6 times more GPS-points/acre.

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196. TARGETED GRAZING AND HERBICIDE FOR DALMATIAN TOADFLAX AND GEYER LARKSPUR MANAGEMENT. Julia M. Workman^{*}, Brian A. Mealar; University of Wyoming, Laramie, WY

ABSTRACT

Rangeland weeds are said to have greater economic impact on livestock producers than any other pests, by reducing forage, adversely affecting livestock, or increasing management costs. Some weeds, like the perennial forb Dalmatian toadflax (*Linaria dalmatica* [L.] Mill.) are invasive and considered noxious in much of the West. In contrast, the native perennial forb Geyer larkspur (*Delphinium geyeri* Greene) is limited in distribution but associated with high spring cattle mortality

^{*}Presenter

where present. Targeted grazing may be used to reduce weed impacts. However, research that evaluates grazing's effectiveness at controlling these two species is limited and sometimes conflicting. Our objectives were to determine effects of targeted sheep grazing on Dalmatian toadflax, Geyer larkspur, and the desirable plant community, and to compare grazing against several herbicide treatments. Ewes grazed in cells containing both target weed species, in four treatments of varying density and timing with stocking rate held constant. We also evaluated two spring herbicide treatments. We measured cover, biomass, and weed density two months after the first treatment and analyzed data with a one-factor ANOVA. All grazing treatments initially reduced larkspur density and then limited regrowth, with larkspur density in herbicide treatments intermediate between grazing treatments and the non-treated check two months after defoliation ($p < 0.0015$). Perennial grass biomass was reduced in most grazing treatments ($p = 0.0009$), whereas cover increased in herbicide treatments ($p = 0.0013$). Immediately after treatment, more than 80% of Dalmatian toadflax stems in all grazing treatments had been impacted, but we detected no treatment effects on any toadflax variables two months after defoliation ($p > 0.58$). These are preliminary results from the first year in a two-year study.

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197. TOWARDS HERBICIDAL CONTROL OF BUFFELGRASS. John H. Brock^{*}; Arizona State University Polytechnic, Mesa, AZ

ABSTRACT

Herbicide trials for the control of buffelgrass (*Pennisetum cilare*) were conducted at Arizona State University Tempe in 2008, 2009 and 2010. The first two trials were broadcast sprayed. In 2010 the plants were sprayed to "canopy" wet. Some of the herbicides applied in 2008 and 2009 initially looked promising, but within about a year, the majority of the buffelgrass plants had returned to normal growth status. In September 2010, herbicides that previously showed some effectiveness for buffelgrass control, were applied in a 2 % herbicide solution sprayed to a foliage wet condition, with 1 % seed oil as a surfactant. Fourteen months after the 2010 treatment, several herbicides are showing excellent buffelgrass canopy mortality. Those herbicides include; glyphosate, imazapyr, nicosulfuron, sulfometuron, and a combination of nicosulfuron plus sulfometuron. Nicosulfuron and the treatment combining nicosulfuron plus sulfometuron had scores of 100 % mortality, compared to 89 % mortality from glyphosate. At 760 DAT from the 2010 herbicide applications, sulfometuron, imazapyr and sulfometuron plus nicosulfuron provided 100 % buffelgrass mortality. The treated plots had no live plant material, dry plants parts persisted on the plots. Untreated plots yielded 3,889 lbs/ac of plant matter, a significant fuel load. Future research needs to evaluate graminicides for buffelgrass where native desert plants are present.

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198. MONITORING FOR INVASIVE PLANTS ON ALASKA REINDEER RANGE. Jennifer Robinette*; University of Alaska, Fairbanks, Fairbanks, AK

ABSTRACT

Invasive plants cause large problems on range lands around the world. However, little is known about the role invasive plants play on Alaska’s reindeer range land. In 2012 University of Alaska Fairbanks Reindeer Research Program and Bureau Land Management developed a 25 year project to monitor changes in vegetation due to disturbances like grazing and climate change. This year I developed a monitoring protocol to survey for invasive plants at the existing study sites with the use of grazing exclosures to evaluate the interaction of grazing, climate change disturbance and invasive plants. I surveyed a total of 0.04 acre at each site. I use circular transects inside and outside of the grazing exclosure. I have surveyed 0.02 acre that is undisturbed by both human and animal, 0.01 acre that is disturbed from construction activities and periodic monitoring of the site and 0.01 acre that is disturbed by grazers. No invasive plants were found when surveying one site in 2014. Conservation of natural ecosystems are critical. Monitoring range land for invasive plants will help alert land managers and owners to a problem that is pervasive to most rangelands of the world. Simply by monitoring I will raise awareness leading to mitigation that prevent infestations.

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199. WHITE-TAILED DEER (ODOCOILEUS VIRGINIANUS), A BIOLOGICAL CONTROL FOR NOXIOUS WEEDS IN NORTH DAKOTA. Melissa C. McCann*¹, Kevin K. Sedivec¹, Kent Belland², Jim Bennington³, Ryan Limb¹, Dennis L. Whitted¹; ¹North Dakota State University, Fargo, ND, ²North Dakota Army National Guard, Bismarck, ND, ³North Dakota Army National Guard, Devils Lake, ND

ABSTRACT

Targeted livestock grazing is traditionally used to manage weedy vegetation or undesirable vegetation, gaining popularity over the past 10 – 15 years. Similar to targeted grazing of livestock, wildlife may be trained or enticed to eat undesirable vegetation. The purpose of our study was to evaluate white-tailed deer consumption of Canada thistle (*Cirsium arvense*) using two separate feeding studies on Camp Grafton North, a National Guard Training Center near Devils Lake, North Dakota. The first study took place in 2013 and 2014. Canada thistle was ground using a small Wiley mill and pelleted at different concentrations (25%, 50%, or 75%) with a concentrated feed mixture (corn, soybean meal, molasses). White-tailed deer were provided the pellets of different thistle concentrations over a week long timeframe. Data was collected to observe total percent of consumed pellets for each concentrate level. The results show that all three pellet types were consumed. However, the 25% and 50% pellets were consumed at a slightly higher rate than the 75% pellets. In 2014, we conducted a second study measuring the height of Canada thistle plants before and after an application of

Raffinate molasses or Day Tank (regular) molasses. The Canada thistle plants were separated into three categories: healthy (none to minimal consumption), partially consumed, and mostly consumed plants. There were few changes in the results between the before and after heights of the control across all three plant categories. However, the Raffinate molasses created a noticeable loss of healthy plants (82.5%) with a gain of partially (9.9%) and mostly consumed (72.6%) plants. The data from the Day Tank shows a loss of healthy plants (68.4%) and a gain in both partially (19.6%) and mostly consumed (48.8%) plants. More research is needed to determine if white-tailed deer can be used as a biological control for Canada thistle.

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200. EFFECTIVENESS OF SPRING CUTTING AND GLYPHOSATE FOR YELLOW FLAG IRIS MANAGEMENT ALONG THE NIOBRARA RIVER. Jordan Spaak*¹, Paul J. Meiman¹, Brennan Hauk², Peter Budde³; ¹Colorado State University, Fort Collins, CO, ²National Park Service, Rapid City, SD, ³National Park Service, Fort Collins, CO

ABSTRACT

Yellow Flag Iris (YFI) (*Iris pseudacorus*) is a non-native, invasive plant that is causing substantial changes to the ecology and adjacent riparian habitat of the Niobrara River in Sioux County, Nebraska. Native plant species are being replaced by YFI, which in turn affects waterfowl, fish, and domestic livestock. Options for invasive plant management along the Niobrara River, like most riparian wetlands, are quite limited. Previous studies on the effectiveness of imazapyr and glyphosate on YFI, suggest that imazapyr is more effective. However, use restrictions related to irrigation diversion limit the feasibility of using imazapyr. This study is being conducted to determine the extent to which cutting iris early in the spring improves the effectiveness of subsequent glyphosate application for reduction of YFI. We are also interested in determining the extent to which cutting and herbicide treatments affect the survival of *Carex nebrascensis* and *Juncus arcticus* planted after herbicide application and the ability of these native plants to compete with surviving or recolonizing YFI. Forty-eight, 2- x 2-m study plots are being assessed, with six treatment combinations, replicated eight times, over an approximate 1 mile stretch of the riparian area. The treatment combinations include all combinations of early spring cutting (cut and uncut), spring herbicide application (sprayed at an 8 percent rate with glyphosate and unsprayed), and planting natives (planted and unplanted). Iris density was recorded three times throughout the growing season. Results from analyses on the effects of cutting and herbicide on YFI density, and native plant survival from the first year of the study will be presented.

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201. MODELING POTENTIAL DISTRIBUTION OF INVASIVE NATAL GRASS (*MELINIS REPENS*) IN CHIHUAHUA, MEXICO. Alicia Melgoza-Castillo^{*1}, Martha Balandran¹, Carmelo Pinedo-Alvarez¹, Ricardo Mata-Gonzalez²; ¹Universidad Autonoma de Chihuahua, Chihuahua, Mexico, ²Oregon State University, Eugene, OR

ABSTRACT

Invasive Natal grass (*Melinis repens*) is an exotic species that is increasing in the state of Chihuahua, Mexico. Although this grass is present in all Mexican states, there is not a control or management plan for this species. This study was developed in order to model its potential distribution, which can help monitoring and supporting management decision making. A total of 122 presence registers of Natal grass and climatic variables from Worldclim were used to elaborate a Species Distribution Model (SDM) using the Maxent program. The SDM calculated by Maxent showed good model quality; AUC= 0.96. The variable bio 7 (temperature range) presented the highest contribution to the model. Jackknife analysis demonstrated that when eliminating this variable, the model significantly reduces its performance. Our results suggest that Natal grass is likely to invade most of the south part of Chihuahua State, at the west will move into foothills with oak and pine and at the east into grasslands.

202. CARBON ON THE RANGE. Robert Parkhurst^{*1}, Whendee Silver², Billy Gascoigne³, Dick Kempka⁴, Jeff Creque⁵; ¹Environmental Defense Fund, San Francisco, CA, ²University of California, Berkeley, Berkeley, CA, ³Ducks Unlimited, Fort Collins, CO, ⁴The Climate Trust, Portland, OR, ⁵Carbon Cycle Institute, Marin, CA

ABSTRACT

Rangeland ecosystems cover approximately one third of the land area in the U.S. These vast lands offer a unique opportunity for landowners looking to generate a new revenue stream through the sequestration of carbon in the soil. Recently two new voluntary carbon offset protocols have been approved by the American Carbon Registry which allow land owners and managers to generate revenue from increases in the soil stored on their land. This session will focus on the science of these opportunities and how they are shaping the future of rangeland management.

203. EFFECT OF NITROGEN FERTILIZER ON ANNUAL RANGELAND SPECIES COMPOSITION. Josh Davy^{*1}, Morgan P. Doran², Nikolai Sweitzer³, Theresa A. Becchetti⁴, Sheila Barry⁵, Jeremy J. James⁶; ¹UC Cooperative Extension, Red Bluff, CA, ²UC Cooperative Extension, Fairfield, CA, ³UC ANR, Browns Valley, CA, ⁴UC Coop Extension, Modesto, CA, ⁵UC Cooperative Extension, San Jose, CA, ⁶Sierra Foothill Research and Extension Center, Browns Valley, CA

ABSTRACT

We evaluated the effects of nitrogen fertilization on spe-

cies composition on grazed annual rangeland in California. Treatments included rates of 30 and 60 pounds of actual nitrogen in the form of ammonium sulfate, combined with seasonal timings of fall and early spring. Treatments were applied during the 2012/2013 growing season at three different locations and then monitored the following spring in 2014. Each experimental site was grazed, though small differences in grazing strategy existed. Analyzed with all three sites combined, all treatments reduced medusahead (*Taeniatherum caput-medusae*) composition ($P=0.01$) except for the lowest rate applied in the fall. No significant difference in medusahead existed between the two higher rates and the lower rate applied in the spring which had a mean of 15% medusahead basal cover, as compared to the control at 23% basal cover. The lower rate applied in the fall had 18% medusahead likely having some reduction in medusahead, but not significantly reducing basal cover. All treatments, ranging from 28-32% basal cover, had significantly higher filaree (*Erodium* spp.) over the control at 22% ($p<0.01$), with no difference between treatments. Slender oat (*Avena barbata* Link) basal cover was only increased in the two lower rate treatments ($P<0.01$), though this increase was only from one to five and six percent. Interestingly the two fall treatments reduced medusahead from six to three percent, with no difference between the control and the two spring treatments. When comparing all three sites little or no difference was seen in annual ryegrass (*Lolium multiflorum*), native wildflower species, soft brome (*Bromus hordeaceus* L.), catsear (*Hypochaeris radicata*), hare barley (*Hordeum murinum*), or bare ground, though differences did exist at individual sites.

204. AGRICULTURAL LAND-USE DIFFERENCES IN SOIL CARBON CONTENT AND STABILITY IN ALBERTA. Donald F. Schoderbek^{*1}, Daniel B. Hewins¹, Cameron N. Carlyle¹, Scott X. Chang¹, Barry Adams², Edward W. Bork¹; ¹University of Alberta, Edmonton, AB, ²Government of Alberta, Lethbridge, AB

ABSTRACT

Conversion of native grassland to cropland and tame pasture is decreasing the area of rangeland in the northern Great Plains, and currently only ~ 40% of Alberta's native grasslands remain. Furthermore, some climate change models predict that crop growing conditions will improve in northern temperate zones, placing remaining native grassland under a greater threat of conversion. Rangelands provide numerous ecological goods and services, such as carbon storage, which can be reduced by cultivation. However, current carbon offset policy in Alberta only supports demonstrable increases in soil carbon from cropland practices such as reduced-tillage, but not the maintenance or increase of soil carbon on native grasslands. This policy may have the inadvertent effect of bringing additional native grasslands into crop production. In order to quantify the benefit of native grasslands for carbon storage, we compared soil carbon content and stability in grazed native grasslands with adjacent (< 1 km) cropland and/or tame pasture (n=30). Sites

were typically “broken” prior to 1935, allowing us to quantify long-term effects of cultivation. Sites were distributed along a large agro-climatic gradient (P:E ratio from 0.3 to >1) in Alberta, Canada, encompassing a variety of crop and tame pasture systems. We sampled soils and vegetation, determined soil carbon content, and assessed soil carbon stability using particle size fractionation. Results of this study will serve to better understand the long-term effects of cultivation and native grassland conversion on carbon storage.

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205. LITTER DECOMPOSITION RATES OF DIFFERENT GRASS SPECIES ACROSS A BROAD ENVIRONMENTAL GRADIENT IN ALBERTA’S RANGELANDS. Xiaozhu Chuan*¹, Daniel B. Hewins², Edward W. Bork², Cameron N. Carlyle², Scott X. Chang², Barry Adams³; ¹University of Alberta, Edmonton, Canada, ²University of Alberta, Edmonton, AB, ³Government of Alberta, Lethbridge, AB

ABSTRACT

In rangeland ecosystems, plant litter decomposition supports plant productivity and soil fertility through carbon (C) and nutrient cycling and moisture conservation. Previous studies in rangeland ecosystems suggest that grazing can affect decomposition rates, and therefore, have important impact on biogeochemical cycles. To better understand this relationship, including the specific impact of grazing on shifts in plant species composition, we initiated a two-year study at 15 sites with paired (grazed and non-grazed) plots within four natural subregions including Dry Mixedgrass, Mixedgrass, Foothills Fescue and Central Parkland in Alberta, Canada. We are measuring litter decomposition rates of nine litter types, including four grazing-tolerant ‘increasers’ and three grazing-susceptible ‘decreaser’ species, a local community litter mix and cellulose paper as a standard, in grazed and non-grazed rangeland. We will present our first six-month of data to test the following hypotheses:

1. Decomposition rates across natural subregions will be strongly controlled by climate due to differences in precipitation and temperature among regions. We expect litter will decompose more rapidly in warmer and wetter regions due to higher microbial activity.
2. In general, ‘increasers’ will decompose more rapidly than ‘decreaser’, because these rapidly growing species tend to have less complex chemical structure that is more easily decomposable.
3. Decomposition rates will be higher under the grazing treatment due to enhanced biological activity.

Ultimately, we aim to understand the effects of grazing and associated changes in the plant community on decomposition rates and subsequent C storage across a range of natural subregions. This study will detail how changes in decomposition occur in plant communities due to grazing, and how subsequent changes in microbial activity may alter decomposition rates, and potentially reveal mechanisms through which management can improve C storage, soil fertility and plant productivity in rangelands.

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206. ARE INVASIVE SPECIES AFFECTING THE CARBON POOLS OF SOUTHERN ALBERTA GRASSLANDS? Mark P. Lyseng*¹, Edward W. Bork², Cameron N. Carlyle², Daniel B. Hewins², Donald F. Schoderbek², Barry Adams³, Mike Alexander⁴, Jennifer Richman³, Darlene Moisey⁵, Mike Willoughby⁶, Craig DeMaere³; ¹Grad student, Edmonton, AB, ²University of Alberta, Edmonton, AB, ³Government of Alberta, Lethbridge, AB, ⁴Government of Alberta, Pincher Creek, AB, ⁵Government of Alberta, St. Paul, AB, ⁶Government of Alberta, Edmonton, AB

ABSTRACT

Invasive plants is problematic for their effects on forage quality, species diversity and timing, but their effects on carbon pools is unclear. Invasive species can be functionally different from native species, which may change the amount of carbon in four carbon pools (above ground biomass, litter, roots and soil). We measured carbon in each of these pools and plant community composition inside and outside of 120 long-term cattle exclosures located across a wide range of agroclimatic and soil zones in southern Alberta. Above and belowground carbon data was related to plant community composition, including the abundance and identity of invasive species. The variation in site characteristics allow us to pin point regions and conditions where invasive species are having more of an effect on the C and N. Results of this study could have management implications for maintaining carbon stores and conservation of grasslands.

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207. THE EFFECT OF PLANT COMMUNITY CHANGE ON SOIL ORGANIC CARBON CYCLING IN A NORTHERN GRASSLAND. Daniel B. Hewins*, Tanner Broadbent, Edward W. Bork; University of Alberta, Edmonton, AB

ABSTRACT

Grasslands cover > 40 % of the Earth’s surface and contain ca. 30 % of soil organic carbon (SOC) globally. Due to their large size and reserves of SOC, there has been recent interest in improving estimates of SOC pools and their dynamics under management. Previous work shows that grazing and climate have the potential to alter plant communities, which may affect SOC cycling in soils. To better understand how community changes affect SOC, we studied the effect of grazing and moisture availability on the microbial extracellular enzymatic activity (EEA) that ultimately controls SOC cycling. We sampled soils to 10 cm depth within a long-term simulated grazing and grassland watering study taking place in Mixedgrass Prairie vegetation at the Rangeland Research Institute’s Mattheis Ranch near Brooks, Alberta, Canada. Our two study sites sit on contrasting ecosites (upland loamy sand soil and a low-lying sandy loam soil). At each site there are replicate plots where simulated summer-long grazing (i.e., clipping) at different frequency (high, low and control) and intensity (high, low) have been applied in conjunction with watering treatments (elevated and ambient). After three years of treatments we observed clear divergence in plant

community composition and structure under these treatments (i.e., increaser and decreaser grasses). To assess the effect of defoliation, moisture and associated plant community shifts on carbon stores, we measured SOC, nitrogen, soil organic matter content, soil moisture and EEA in our samples. We hypothesize that SOC cycling via EEA will be greater in plots where moisture is high and defoliation is high (frequency and intensity) due to a biological response tied to the rapid turnover of defoliation tolerant increaser grasses. We will present our findings in the context of simulated grazing intensity and frequency, moisture treatments and changes in community production and diversity.

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208. NITROGEN MINERALIZATION IN TWO MOUNTAIN BIG SAGEBRUSH PLANT COMMUNITIES: AN ECOLOGICAL PROCESS-BASED KEY TO STATE-TRANSITIONS? Crystal Y. Tipton*, Troy W. Ocheltree, Maria Fernandez-Gimenez; Colorado State University, Fort Collins, CO

ABSTRACT

In their state-and-transition model (STM) for the Mountain Loam (now Deep Clay Loam) ecological site in northwest Colorado, Kachergis et al. (2012) propose the existence of alternate stable states in the mountain sagebrush steppe separated by functional thresholds. The model includes a transition from mountain big sagebrush shrubland with a diverse understory (“Diverse”), to heavy mountain big sagebrush shrubland associated with sparse understory (“Dense”) in the absence of shrub management and fire for more than 60 years. While the loss of herbaceous understory would tend to reduce vulnerability to fire and reinforce shrub dominance on Dense states, this cycle does not provide a mechanism that would explain the switch from negative feedbacks that maintain a Diverse understory, to positive feedbacks driving understory loss and favoring shrub dominance in Dense. Identification of the ecological processes involved in such a switch would provide evidence for the existence of functional thresholds in this system and provide key information for potential restoration pathways. We hypothesize that the loss of herbaceous understory in the transition from Diverse to Dense states can be attributed to a shift from fast to slow N-cycling rates as relatively recalcitrant sagebrush litter comprises an increasingly greater proportion of the litter pool over time. To test this hypothesis, we measured N mineralization rates in both states through a series of in situ soil incubations over the 2014 growing season. We also compared the relative contributions of herbaceous and sagebrush litter to litter pools in each states. Results of these analyses and discussion of implications for modeling and management will be presented.

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209. DOES LITTER MATTER: IMPACTS ON SOIL TEMPERATURE AND MOISTURE IN HIGH STOCK DENSITY GRAZING. Emily R. Helms*, Alexander Smart, Sharon Clay, David Clay, Michelle Ohrtman; South Dakota State University, Brookings, SD

*Presenter

ABSTRACT

High stock density or “mob grazing” is an intensive grazing management technique in which animals are moved frequently (once to many times/day) from paddock to paddock. Practitioners of this technique claim improvements in grassland ecological function due to trampled vegetation and long rest periods. The objective of this study was to determine if this technique results in any measurable change to nutrient cycling (in the form of litter decomposition) or soil abiotic factors. This study was conducted at four diverse study sites in South Dakota: Quinn (West Central), Chamberlain (Central), Eureka (Northeast), and Volga (East Central). Study sites differed in stocking densities, grazing dates, vegetation composition, and climate conditions with mob grazed areas being compared within a site to ungrazed and bare-ground (litter removed) areas. Soil sensors that measured temperature and moisture every hour were installed at a 5.1 cm (2 inch) depth. Permeable bags that contained either old litter (previously grazed vegetation) or new litter (standing vegetation that would be trampled when grazed) were placed on the soil surface in all treatments upon completion of mob grazing. Litter bags were removed at first frost to determine litter decomposition, and final temperature and moisture measurements were recorded. In 2013, litter decomposition was similar among treatments at all sites except at the Chamberlain site where ungrazed and mob grazed treatments had higher litter decomposition than the bareground treatment. Moisture and temperature data showed marginal treatment differences at all sites. Data from 2014 has also been collected and is still being analyzed. Final results will help determine the role litter plays in moisture and temperature of grassland soils post-grazing, and the effects those play on litter decomposition.

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210. ENERGY DEVELOPMENT IN RANGELANDS PART 1: A CALL FOR A DISCIPLINARY SHIFT. Dirac Twidwell*¹, William K. Smith², Julia Haggerty³, Steven Running⁴, David Naugle⁴, Samuel Fuhlendorf⁵, Eric T. Thacker⁶, Carissa L. Wonkka⁷; ¹University of Nebraska - Lincoln, Lincoln, NE, ²Luc Hoffman Institute, St. Paul, MN, ³Montana State University, Bozeman, MT, ⁴University of Montana, Missoula, MT, ⁵Oklahoma State University, Stillwater, OK, ⁶Utah State University, Logan, UT, ⁷University of Nebraska Lincoln, Lincoln, NE

ABSTRACT

With rangelands being one of the greatest sources for novel scales of energy development, it is clear that actions are needed to understand how energy development alters various economic, cultural and ecological services in these regions. We discuss the disciplinary shift needed from the modern rangeland professional to understand the impacts of energy development in rangelands. This requires moving past traditional utilitarian approaches associated with a solitary ecosystem service, such as livestock production or harvest, and toward an approach that embraces energy de-

velopment as one of multiple ecosystem services that can be derived from rangeland landscapes. Sustaining multiple services, however, requires management that can effectively assess the tradeoffs of energy on food, fiber, water, disaster avoidance, and biodiversity within a dynamic framework built around concepts of complex adaptive systems.

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211. ENERGY DEVELOPMENT IN RANGELANDS, PART 2: IMPACTS ON ECOSYSTEM SERVICES. Brady Allred^{*1}, Dirac Twidwell², William K. Smith³, Julia Haggerty⁴, Steven Running¹, David Naugle¹, Samuel Fuhlendorf⁵, Eric T. Thacker⁶, Carissa L. Wonkka⁷; ¹University of Montana, Missoula, MT, ²University of Nebraska - Lincoln, Lincoln, NE, ³Luc Hoffman Institute, St. Paul, MN, ⁴Montana State University, Bozeman, MT, ⁵Oklahoma State University, Stillwater, OK, ⁶Utah State University, Logan, UT, ⁷University of Nebraska Lincoln, Lincoln, NE

ABSTRACT

With rangelands being one of the greatest sources for novel scales of energy development, it is clear that actions are needed to understand how energy development boosts or degrades various economic, cultural and ecological services in these regions. We discuss the disciplinary shift needed from the modern rangeland professional to understand the impacts of energy development in rangelands. This requires moving past traditional utilitarian approaches associated with a solitary ecosystem service, such as livestock production or harvest, and toward an approach that embraces energy development as one of multiple ecosystem services that can be derived from rangeland landscapes. Sustaining multiple services, however, requires management that can effectively assess the tradeoffs of energy on food, fiber, water, disaster avoidance, and biodiversity within a dynamic framework built around concepts of complex adaptive systems. We present the trade-offs in ecosystem services associated with oil and gas development across the Great Plains. We highlight the loss of net primary productivity (NPP), land area, and water resulting from increased infrastructure and resource extraction. From 2000 to 2012, approximately 12 teragrams of dry biomass have been lost to oil and gas. Three million hectares have been converted to well pads, roads, and storage facilities. Hydraulic fracturing has consumed an estimated 7,187 to 33,903 million cubic meters of water. As energy growth continues, rangelands will be faced with the cumulative impacts of oil and gas development and be forced to abandon long held paradigms in both agriculture and conservation for energy exploitation. It is imperative that rangeland ecologists, managers, and policy-makers understand the ecological consequences of the modern energy boom, and the many trade-offs among economic benefits, ecosystem services, and overall human well-being that we now face.

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212. INCREASING DIVERSITY OF NATIVE BIOFUEL PLANTINGS USING SIMPLE MIXTURES. Cody J. Zilverberg^{*1}, Kwan Hong Teoh², W.C. Johnson², Arvid Boe²; ¹South Dakota State University & Texas A&M, Temple, TX, ²South Dakota State University, Brookings, SD

ABSTRACT

Monocultures of the perennial prairie grass, switchgrass (*Panicum virgatum*), are expected to supply feedstock for advanced biofuels. Although switchgrass is able to produce high biomass yields across a wide range of topographic sites, other native species might outyield switchgrass within their zones of adaptation. Such species could enhance diversity and ecosystem services provided by biofuel fields. In a small-plot, replicated experiment, switchgrass and members of three functional groups (warm-season grass, cool-season grass, and forb) were planted in monocultures at three slope positions (shoulder, mid, and foot) of a working farm in eastern South Dakota. The field had previously been in a corn (*Zea mays*)-soybean (*Glycine max*) rotation. Species used for each functional group varied with slope position. Species were matched with slope positions where they were best adapted. At each position, switchgrass was also combined with each functional group in binary mixtures such that switchgrass consisted of 33 or 67% of each mixture. All plants were transplanted into the field in mid-June 2012 and harvested in autumn of 2012-2014 (anticipated). Through 2013, results indicated potential for several species, especially warm-season grasses and cup plant (*Silphium perfoliatum*), to mix favorably with switchgrass while equaling or exceeding switchgrass monoculture biomass production ($p < 0.05$). As a group, cool season grasses performed poorly relative to switchgrass. Across the landscape in 2013, biomass could have been maximized by planting a little bluestem (*Schizachyrium scoparium*; 67%)-switchgrass (33%) mixture at the shoulderslope, a big bluestem (*Andropogon gerardii*) monoculture at the midslope, and a cup plant monoculture at the footslope. Alternative high-yielding combinations of species could be selected to meet other objectives, such as maximum species richness, functional groups, or economic returns. Future research should apply the concepts developed in this experiment to additional species and field-scale plots.

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213. ALPHA AND BETA DIVERSITY ON RECLAIMED MINE-LANDS IN CENTRAL NORTH DAKOTA. Stefanie L. Bohrer^{*1}, Ryan F. Limb¹, Jay Volk²; ¹North Dakota State University, Fargo, ND, ²BNI Coal, Center, ND

ABSTRACT

Reclamation following anthropogenic disturbance often aims to restore native plant biodiversity. Strong laws are in place to regulate mine-land reclamation following coal extraction which includes components of required re-spread (topsoil/subsoil) depths, seed mixes and slopes among many others. These laws mandate recently mined areas be reclaimed back to productive landscapes where all aspects of the eco-

system can flourish. Subsoil and topsoil are re-spread and increasingly planted with diverse warm and cool season grass mixes, however historically excluding forbs. Both soil and the diverse seed mixes are typically spread homogeneously across landscapes creating high local-scale diversity (alpha), but low landscape-scale diversity (beta). Existing seed banks in direct re-spread areas of topsoil, and seed rain are thought to augment the vegetation successional trajectories and increase both alpha and beta diversity over time. Our objective was to evaluate the small and large-scale vegetation patterns across a 40-year reclamation gradient. We hypothesized that both alpha and beta diversity would increase with time since reclamation. Plant communities were sampled on 18 post-mine reclaimed and five native reference sites in central North Dakota mixed-grass prairie. Species composition and canopy cover were recorded at two locations in each reclamation year using a 1x1-m² quadrat at 2-m intervals along a permanently marked 70-m transects. We determined the inherent small scale dissimilarity of vegetation along with the average patch size and the highest mean dissimilarity between patches using dissimilograms based on the relative Sørensen dissimilarity index in PC-ORD 6.0. Relative plant community patch size on reclaimed lands over four decades will indicate the landscape-level success of the current ecosystem-based reclamation strategy.

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214. A NOVEL METHOD FOR REMOVING CHEATGRASS CONTAMINANTS FROM RECLAMATION SEED. William C. Rose*, Brian A. Mealor, Andrew Kniss; University of Wyoming, Laramie, WY

ABSTRACT

Disturbance increases potential for infestation of new areas by weeds such as cheatgrass (*Bromus tectorum*). Reclamation is implemented in an effort to restore native vegetation, however, cheatgrass often contaminates seed used for reclamation. Because cheatgrass germinates more rapidly and at colder temperatures than many native grasses, it may be possible to remove cheatgrass by exploiting germination differences. We initiated a sequence of experiments where native grass and cheatgrass seeds underwent a wet germination treatment followed by a drying period. We used three cheatgrass populations and six native grass species in four replicates of fifty seeds each. During the first experiment, we evaluated three different germination temperatures (3, 6, and 12°C), for 20-days. We held treatment temperature constant (6°C) in the second experiment and compared four different treatment lengths (8, 10, 12, and 14 days). To evaluate treatment effects on germinability, we reinserted all seeds into growth chambers set at optimal temperatures for germination after a 14-day drying period. ANOVA revealed a significant two-way interaction ($p < 0.0001$) between species and temperature in the first experiment and between species and length of treatment in the second experiment. During the first experiment, cheatgrass germinated earlier and more rapidly than native species at all three tempera-

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tures. No cheatgrass survived drying after the 6°C and 12°C treatments. More nontreated seeds germinated compared with treated seeds among all species except blue grama. The 3°C treatment had no effect on the germinability of blue grama seeds. Blue grama germinability was unaffected by treatment duration in the second experiment, and thickspike wheatgrass was only affected by the 14-day treatment. Cheatgrass removal was limited in the second experiment. Our results indicate germination differences may be exploited to reduce cheatgrass contaminants in some native grass species.

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215. EVALUATING DIRECT HERBICIDE IMPACTS ON DESIRABLE SPECIES USED IN RECLAMATION. Beth Fowers*, Brian A. Mealor; University of Wyoming, Laramie, WY

ABSTRACT

Disturbance caused by mining requires reclamation to return the area to a desirable state. Managers must think about a variety of issues including weed management and desirable species establishment. Herbicides are commonly used to control weeds that would compete with seeded species if left uncontrolled. Because common weed species on reclamation sites are often broadleaf annuals, herbicides are typically broadleaf specific. Reclamation seed mixes are often composed of grass, forb and shrub species. However, forb and shrub establishment may become challenging when broadleaf herbicides are used. Unintended impacts of herbicides on desirable species may inhibit the progress of reclamation. Our objective was to evaluate direct impacts of herbicides on 12 desirable species and two weed species common in reclamation. In a greenhouse experiment we applied 10 herbicide treatments at three timings (pre-emergence and two post-emergent timings) in a factorial arrangement set in a randomized complete block design. Species included 10 desirable grasses, two desirable forbs, and two broadleaf weeds. We recorded damage ratings weekly and harvested aboveground biomass from all plants 30 days after the final herbicide application. The response of different species was affected by timing of herbicide application, where pre-emergence treatments resulted in the lowest biomass ($p < 0.0001$). Herbicide effects varied by herbicide application timing similarly across all species ($p < 0.0001$). Various species were also impacted by the herbicides differently, across all timings ($p < 0.0001$). Herbicides causing the least damage included saflufenacil and aminocyclopyrachlor+chlorsulfuron at a low rate, particularly with crested wheatgrass and streambank wheatgrass. Species most negatively affected by herbicides (including aminocyclopyrachlor+chlorsulfuron at a high rate and imazapic) were blue flax, alkali sacaton, and the weed species. Understanding potential herbicide impacts on seeded species may illuminate some problems facing reclamation projects.

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216. USING MULTI-CRITERIA ANALYSIS TO MICROSITE WIND TURBINES. Leticia A. Varelas*¹, John A. Tanaka¹, Ben Rashford², John Ritten¹; ¹University of Wyoming, Laramie, WY,²Univeristy of Wyoming, Laramie, WY

ABSTRACT

The Chokecherry and Sierra Madre (CSM) wind energy development is a proposed 1,000 turbine project in south-central Wyoming. The site is located across a checkerboard of private and federal lands. As a result, the Wyoming Bureau of Land Management (BLM) is charged with evaluating the potential impacts of the CSM project. For most public lands, management decisions are based on the multiple-use concept. Different land uses are often competitive, requiring land managers to make trade-offs to meet certain objectives. Multi-criteria analysis (MCA) is a spatial decision framework that allows managers to evaluate the trade-offs that exist between land-use alternatives and impacted ecosystems. In the CSM area, the primary concerns are wildlife impacts, soil erosion, invasive plants, viewshed, existing land uses, and local community impacts. Micrositing is the process used to locate individual wind turbines. The goal of this study is to create a MCA to microsite wind turbines in optimal areas for the CSM project. We first identify suitable turbine site locations that meet the requirements for wind energy generation as well as physical site needs. For each suitable location, we map the expected impacts of turbines on ecological, social, and economic systems. Finally, we use ant colony optimization, a heuristic modeling approach, to microsite individual wind turbines in the CSM.

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217. HABITAT SELECTION BY PRONGHORN EXPOSED TO WIND ENERGY DEVELOPMENT ON WINTER RANGE. Jeffrey L. Beck*, Kaitlyn L. Taylor, Shannon E. Albeke; University of Wyoming, Laramie, WY

ABSTRACT

Increasing demand for wind-generated electricity has raised concerns about potential impacts to wildlife. In some rangeland systems, ungulate populations are increasingly encountering wind-energy facilities in winter. This issue is particularly critical given that these animals already experience harsh environmental conditions and depleted body reserves during this time of year, when activities associated with wind energy may cause further stress. We evaluated pronghorn (*Antilocapra americana*) response to wind energy development over 3 winters (2010, 2010–2011, 2011–2012) in south-central Wyoming, USA, to better understand potential impacts of wind energy development on wintering ungulates. We obtained data from 47 adult female pronghorn equipped with GPS-transmitters and developed resource selection functions for pronghorn at both the population and individual scales. At the population scale, pronghorn selected for areas closer to wind energy facilities and with lower slopes, variability in snow depth, and density of fences. For 37 individuals whose home ranges encompassed wind energy facilities, coefficients for distance to nearest wind energy facility

did not differ from zero across all 3 winters, suggesting wind energy development did not influence individual pronghorn habitat selection. In addition, pronghorn daily net displacement did not increase closer to wind energy facilities ($r^2 = 0.001-0.012$) during each winter. Avoidance behaviors and increased movement rates previously documented in ungulate populations in relation to energy development are commonly associated with increased human presence within oil and gas fields. Low traffic rates observed within wind energy facilities in our study may have contributed to the lack of avoidance observed by pronghorn. However, pronghorn response may deviate from our findings if larger-scale wind energy developments encompass higher levels of human activity (i.e., increased traffic rates and longer construction periods) than those associated with our study.

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218. APPLICATION OF STOCKMANSHIP TO ACHIEVE RANGELAND MANAGEMENT GOALS. Derek W. Bailey*, Mitch Stephenson; New Mexico State University, Las Cruces, NM

ABSTRACT

Stockmanship or low-stress livestock handling techniques developed by Bud Williams can be powerful tools in rangeland management. Proper stockmanship improves livestock producers' abilities to readily move livestock from one pasture to another and facilitates application of husbandry practices. More importantly, stockmanship can be used to manipulate livestock distribution and target grazing. On public lands, stubble height standards are used to minimize adverse impacts of livestock on riparian areas and fishery habitat. Herding cattle from riparian areas at midday can result in greater stubble heights of riparian graminoids compared to free roaming livestock controls. Placing low-moisture block (LMB) protein supplements can increase cattle fidelity to target areas when forage is dormant, but protein LMB is much less attractive when forages are actively growing and forage quality is high. The combination of stockmanship and strategic supplement placement can be used to focus cattle grazing in rugged terrain and/or areas far from water. Focused cattle grazing has the potential to improve forage quality and habitat for wild ungulates and help manage fine fuels and the risk of catastrophic wildfire. The efficacy of this practice is greatest when first applied. In the second year of a 2-yr study, cattle showed less fidelity to target areas than during the first year. However, cattle continued to use rugged terrain and areas far from water during the second year. Selection and use of adapted animals will likely work synergistically with stockmanship. Anecdotal observations suggest that cattle adapted for rugged terrain (hill climbers) readily respond to low stress handling techniques. Although labor intensive, low stress herding can be successfully used to manipulate livestock grazing distribution even when other management techniques may not be feasible.

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219. STOCKMANSHIP PRINCIPLES AND PRACTICE FOR MANAGING RANGELANDS. Richard McConnell*, Tina Williams; Hand n Hand Livestock Solutions, Bolivar, MO

ABSTRACT

Using teaching techniques developed by Bud Williams and video to demonstrate and expand on each point, we will cover the following: 1) factors affecting our communication with animals, 2) stockmanship basics - learn to read and react to what the animals are telling you, 3) your attitude – what a difference it makes, 4) natural instincts of livestock; 5) we do not want to be seen as a predator, 6) pressure and release, 7) the difference between taming and teaching livestock, 8) release is important, 9) your positioning, 10) our job is to create a situation where we have less stress on our animals, 11) what you will gain from better stockmanship, and 12) how these principles apply to placing livestock on rangelands. These stockmanship techniques must be learned, practiced, and applied by every stock-handler who wishes to “place” livestock on unfenced lands. Placing livestock isn’t a beginner-level skill. You must learn the basics of good stockmanship, apply them to all aspects of working with your livestock, train your livestock to take pressure, and drive them at all times using proper communication so they feel comfortable and will stay where you place them (rather than move off because it’s not a good place to be due to how you handled them). Finally, when placing animals their movement needs to be stopped in such a way so they will stay where you put them until you return, and you must return before they run out of feed or water and move them to a new location (trust must be maintained).



220. STOCKMANSHIP, GRAZING ASSOCIATIONS AND PUBLIC LANDS MANAGEMENT. Steve Cote*; Cattle Sense, Paris, TN

ABSTRACT

Overgrazing and over resting of upland range are occurring on most allotments reducing potential bio-diversity. Riparian areas also lose diversity when cattle keep returning to them during the same grazing season. Attempts to resolve riparian area condition on public range by intensified riding and administrative actions has been largely unsuccessful, leading to contention and more animal health problems such as pneumonia. Range planning that will enhance or protect diversity is not hard to accomplish but high control over the stock is usually integral. Bud Williams Stockmanship is a proven tool for achieving high control over the stock. Cattle will come together as one herd so where you find one you find them all, riparian loafing becomes a thing of the past and the herd stays where you want them. This has been successfully implemented on a number of allotments in central Idaho, using collaborative planned grazing. The knowledge of how to achieve significant improvements in range condition and get extraordinary control over stock even on steep mountain range exists. The challenge that remains is how to get all riders and entire grazing associations to adopt it and stick with it (we have met the enemy and it is us).

*Presenter

Achievement of widespread range improvements as well as widespread animal health benefits will likely require a high adoption rate of low stress handling. This presentation will show the major steps of past efforts that have been successful, including an outline of the techniques, principles and tips of range planning and livestock handling.



221. PRINCIPLES IN STOCKMANSHIP AND HORSEMANSHIP. Steve Cote*; Cattle Sense, Paris, TN

ABSTRACT

Range riparian health, as well as upland bio-diversity concerns are significant issues facing ranchers and agencies on western public lands and are difficult if not impossible to solve with traditional management (intensified riding efforts and administrative actions). Low stress livestock handling (Bud Williams Stockmanship) has been shown to be a low cost and extremely effective tool to enhance riparian areas and restore biodiversity in uplands but for reasons that are unclear, it has a low adoption rate with riders and ranchers. This results in millions of acres of bio-diversity improvements going unrealized. It is also costing millions of dollars per year in lost grazing (cuts in number or grazing season) to ranchers and it has increased costs for grazing administration. Stockmanship has been shown to decrease respiratory diseases markedly (to near zero) which cost cattle producers an estimated 500 million annually nationwide. More aids to teaching stockmanship that increase the adoption rate are needed; however, one item of promise came about from talks with people who readily adopted it and become accomplished quickly. All had a high degree of belief that it works and all had the ability to relate stock handling to horsemanship principles. Good horsemanship principles and techniques have become highly accepted in the past 30 years whereas good stockmanship is well behind, although both existed in the past it appears. The correlation between stockmanship and horsemanship principles has been tested and appears to be strong and the principles of both will be compared in this presentation. Widespread adoption of Bud Williams Stockmanship could result in huge positive changes in range/riparian conditions in the western US.



222. LOW-STRESS HERDING IMPROVES HERD INSTINCT, FACILITATES STRATEGIC GRAZING MANAGEMENT AND COEXISTENCE WITH CARNIVORES. Matt Barnes*; Keystone Conservation, Bozeman, MT

ABSTRACT

Range riders can improve grazing management for rangeland health, livestock production, and coexistence with wildlife, including large carnivores, by applying strategic grazing management, especially in combination with low-stress herding. Strategic grazing management is based on the patterns of wild grazing animals in the presence of their predators, which tend to increase group size (comparable to stock density) and movement over landscapes (comparable to

grazing management). Managing livestock based on these patterns appears to reduce predation losses. Partnering with progressive ranchers, we compared and combined two approaches to herding cattle at relatively high stock density in the Northern Rocky Mountains of western Montana. We applied two similar but distinct close herding methods to go from these scattered groups to a single herd at increased stock density. In Phase 1, we used night penning and daily herding to enforce constantly high stock density. In Phase 2, we used low-stress herding to train the co-mingled heifers to function socially as a single herd. Both phases were successful. Phase 1 involved constant enforcement of high stock density, but did not kindle the herd instinct, probably because it wasn't the cattle's idea. Phase 2 successfully kindled the herd instinct, training the co-mingled heifers to forage in progressively larger groups until a single group formed. Kindling the herd instinct with low-stress herding required more skill, and significant initial labor, but less labor overall. Cattle apparently did not interact with potential predators in either phase. This and other projects suggest that stock density, increased rider presence, and low-stress livestock handling interact to reduce both encounters with large carnivores and the likelihood that such encounters result in predation.

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223. FUNDAMENTALS OF STOCKMANSHIP. Whit S. Hibbard*¹, Bob Kinford², Guy Glosson³; ¹Stockmanship Journal, editor, Helena, MT, ²2lazy4U Livestock & Literary Co, Van Horn, TX, ³Manager at Mesquite Grove Ranch, Abilene, TX

ABSTRACT

This presentation will introduce fundamentals of stockmanship with a particular emphasis on "low-stress livestock handling." It will (a) start with definitions and set the context, then (b) contrast conventional livestock handling with low-stress livestock handling, (c) make the case for low-stress livestock handling, then (d) articulate its basic principles and techniques. Three primary questions will be answered: What is low-stress livestock handling? Why is it important? How do you do it? This presentation will lay the groundwork for the subsequent talks in the section, Stockmanship: Managing Rangelands with Effective Low-Stress Livestock Handling.

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224. HYDROLOGY IN ECOLOGICAL SITE DESCRIPTIONS. Curtis Talbot*, Joel R. Brown; USDA NRCS, Las Cruces, NM

ABSTRACT

Ecological Site Descriptions (ESDs) contain information essential to land management assessment and management. ESDs are composed of two distinct parts: inventory and interpretations. The Inventory section for each ESD contains relatively objective information about the abiotic and biotic settings defining the extent of the site concepts; soil and vegetation dynamics in response to changes in climate and disturbance in the form of a state and transition

model; and description of important ecological processes that drive change or impart resilience. The Interpretations section should contain information relevant to land management decisions about the array of ecosystem services that may be derived from the site and its associated landscapes and what conservation and management practices may be implemented to achieve objectives. Hydrological attributes have a place in both sections. Infiltration rates, runoff and erosion, and soil moisture dynamics are examples of quantitative information that should be included in ESD Inventory. The Interpretations section should discuss the socio-economic tradeoffs associated with managing plant communities for different hydrologic outcomes. Because hydrologic processes frequently transcend and integrate multiple ecological sites, both inventory and interpretation discussions should be multiscale and should include catena and watershed scale dynamics.

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225. OVERVIEW OF RANGELAND HYDROLOGY AND EROSION MODEL. Mariano Hernandez*¹, Mark A. Nearing², Frederick B. Pierson³, Osama Z. Al-hamdan⁴, C. Jason Williams³, Kenneth E. Spaeth⁵, Mark A. Weltz⁶, Haiyan Wei¹; ¹University of Arizona, Tucson, AZ, ²USDA-ARS, Tucson, AZ, ³USDA-ARS, Boise, ID, ⁴USDA-ARS-NWRC & University of Idaho, Boise, ID, ⁵USDA-NRCS, Weatherford, TX, ⁶USDA ARS, Reno, NV

ABSTRACT

The Rangeland Hydrology and Erosion Model (RHEM) is a newly conceptualized model that was adapted from relevant portions of the Water Erosion Prediction Project (WEPP) Model and modified to specifically address rangelands conditions. RHEM is an event-based model that estimates runoff, erosion, and sediment delivery rates and volumes at the spatial scale of the hillslope and the temporal scale of a single rainfall event. It represents erosion processes under normal and fire-impacted rangeland conditions. Moreover, it adopts a new splash erosion and thin sheet-flow transport equation developed from rangeland data, and it links the model hydrologic and erosion parameters with rangeland plant community by providing a new system of parameter estimation equations based on 204 plots at 49 rangeland sites distributed across 15 western U.S. states. Recent work on the model was focused on representing intra-storm dynamics, using stream-power as the driver for detachment by flow. RHEM simulations for multiple management practices can be run separately and then compared side-by-side within the model interface. The model produces graphical and tabulated output for annual precipitation, runoff, and erosion based on a CLIGEN-generated 300 year record of precipitation events. A new feature was developed that allows the user to configure a baseline scenario to represent conservation practices or a reference state of a state-and-transition model within an Ecological Site. Then, the user can run several scenarios and compare them against the soil loss baseline scenario and estimate the soil loss probabilities of occurrence of each scenario. Furthermore, a new approach was

*Presenter

developed for the parameterization of the splash and sheet flow erodibility parameter to enhance RHEM applications on disturbed rangelands. The improved splash and sheet flow erosion modelling and the probabilistic approach in RHEM creates a practical management tool for quantifying erosion and assessing erosion risk following rangeland disturbance.

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226. HYDROLOGIC FUNCTIONS IN ECOLOGICAL SITE DESCRIPTIONS. Kenneth E. Spaeth*; USDA-NRCS, Weatherford, TX

ABSTRACT

Rangeland landscapes are complex mosaics of geology, topography, soils, plants, and climate. Ecological understanding and land management is facilitated by forming homogeneous recognizable groups such as the ecological site. Ecological site concepts are based on stands of native plants with similar climate, soils, and hydrology requirements that occur in a relatively repeated fashion across a landscape. The USDA-NRCS organizes ecological sites within a Major Land Resource Area (MLRA)/Land Resource Unit (LRU). Ecological sites provide a basis for identifying and mapping community dynamics and ecosystem responses to management and disturbances [state-and-transition models (S & T), establishing ecologically based reference information for rangeland health, targeting conservation practices, and communicating regarding ecosystem responses to management]. Since water is the most limiting factor on rangelands; understanding and documenting hydrologic and erosion responses to ecological site changes, as described by the S&T model, are integral to the dynamics of the ecological site. The S&T model can be used to outline trends and changes in hydrology, erosion potentials, and the overall water budget for the respective states.

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227. ESTIMATING HYDROLOGIC AND EROSION RESPONSE FOR USE IN ECOLOGICAL SITE DESCRIPTIONS. C. Jason Williams*¹, Frederick B. Pierson¹, Kenneth E. Spaeth², Joel R. Brown³, Mark A. Weltz⁴, Mark A. Nearing⁵, Osama Z. Al-hamdan⁶; ¹USDA-ARS, Boise, ID, ²USDA-NRCS, Weatherford, TX, ³USDA NRCS, Las Cruces, NM, ⁴USDA ARS, Reno, NV, ⁵USDA-ARS, Tucson, AZ, ⁶USDA-ARS-NWRC & University of Idaho, Boise, ID

ABSTRACT

Ecological resilience of rangeland landscapes is strongly related to eco-hydrologic pattern-process feedbacks that regulate the retention or loss of water and soil resources. However, key ecohydrologic information is often lacking in Ecological Site Descriptions (ESDs) used to guide management of rangelands. In this study, we developed a framework and methodology for inclusion of key hydrologic information and eco-hydrologic feedbacks in ESDs. In our presentation, we identify the data required for inclusion of key ecohydrologic information into ESDs, demonstrate application of the Rangeland Hydrology and Erosion Model (RHEM) for popu-

lating hydrologic data in ESDs, and present a framework for eco-hydrologic data integration within the current ESD structure. The framework is presented as a broadly applicable methodology for integrating ecohydrologic relationships and feedbacks into ESDs and guiding resilience-based management strategies.

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228. USE OF RHEM TO ASSESS RUNOFF AND EROSION FOLLOWING DISTURBANCE ON RANGELANDS. Osama Z. Al-hamdan*¹, Frederick B. Pierson², Mark A. Nearing³, C. Jason Williams², Mariano Hernandez⁴, Kenneth E. Spaeth⁵, Jan Boll⁶, Mark A. Weltz⁷; ¹USDA-ARS-NWRC & University of Idaho, Boise, ID, ²USDA-ARS, Boise, ID, ³USDA-ARS, Tucson, AZ, ⁴University of Arizona, Tucson, AZ, ⁵USDA-NRCS, Weatherford, TX, ⁶University of Idaho, Moscow, ID, ⁷USDA ARS, Reno, NV

ABSTRACT

Landscape disturbance such as fire or woody plant encroachment on rangelands can have major impacts on the hydrological and erosion responses. As canopy and ground cover are reduced, soil sediments become available and can be detached by rain splash and overland flow. Disturbance can also increase the formation of concentrated flow paths that accelerate runoff velocity and the ability of water to transport rain splash and overland flow sediments downslope. These disturbance-related processes are represented in the Rangeland Hydrology and Erosion Model (RHEM) using readily available vegetation and soils data. RHEM can be used to assess erosion risk following disturbance and can be used to evaluate and predict the rate of hydrologic recovery following disturbance. RHEM can also be used for quantifying environmental impacts of disturbance associated with alternative conservation practices and can be integrated with Ecological Site Concepts to inform and evaluate overall management objectives.

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229. ESTIMATING SOIL LOSS FROM SALINE RANGELANDS. Sayjro K. Nouwakpo*¹, Mark A. Weltz², Cole H. Rossi³; ¹University of Nevada, Reno, Reno, NV, ²USDA ARS, Reno, NV, ³Bureau of Land Management, Salt Lake City, UT

ABSTRACT

Soil erosion prediction is an effective decision-support tool in rangeland where soil loss is considered a key indicator of ecosystem health. Most processed-based erosion prediction equations available for rangeland ecosystems have been developed from experimental data collected on soils with low salt content. On saline soils, detachment processes are often exacerbated due to the weakening effect of salts on soil cohesion, resulting in poor performance of existing erosion models in saline environments. Rangelands in the U.S. and in the world encompass considerable expanses of saline soils (e.g. rangelands in the Mancos shale geologic formation) which often pose off-site water quality concerns as a consequence of sediments and salt discharge to

*Presenter

surface waters. Accurate soil erosion estimation equations are therefore needed for saline rangelands. In this study, data collected from rainfall simulation experiments in saline rangelands of the western US were used to develop prediction equations for runoff and soil loss. These newly developed equations will be incorporated in the Rangeland Hydrology and Erosion Model (RHEM).

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230. ESTIMATING WATER QUALITY FROM SALINE RANGELANDS. Mark A. Weltz^{*1}, Sayjro K. Nouwakpo², Cole H. Rossi³; ¹USDA ARS, Reno, NV, ²University of Nevada, Reno, NV, ³Bureau of Land Management, Salt Lake City, UT

ABSTRACT

The Colorado River and its tributaries provide water to about 36 million people and irrigation water to nearly 4.5 million acres of land in the United States and Mexico. Damages within the United States as a result of dissolved solids in the Colorado River are estimated to be about \$383 million per year. About 55% of the salt loading is estimated to come from rangelands. Research on the topic of dissolved-solids loading to streams from rangelands is needed for identifying management practices that could reduce salt yields to the Colorado River. Specifically, there is a need to improve the understanding of sources and transport mechanisms of dissolved solids derived from rangelands. In this study, data collected from rainfall simulation experiments in saline rangelands of central Utah were used to develop prediction equations for runoff and water quality. These newly developed equations will be incorporated in the Rangeland Hydrology and Erosion Model (RHEM) and provide a means to rank ecological sites to determine relative contributions of salt loading to the upper Colorado River. A second goal is to evaluate the RHEM model for assessing hydrology, erosion, and salt mobilization and loading responses associated with management of vegetation within the upper Colorado River Basin.

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231. EFFECT OF AGGREGATION AT A WINTER FEEDING STATION ON INTESTINAL PARASITE LOAD IN ELK (CERVUS CANADENSIS). Morgan Hughes^{*1}, Johan DuToit²; ¹Wildlife Science, Logan, UT, ²Utah State University, Logan, UT

ABSTRACT

Elk feeding stations are used throughout the Western US as a means to prevent depredation on private lands (Smith,2001). Many of the unintended effects of such artificial congregation remain unexamined. In many species, increased densities result in increased parasite loads (Dietz, 1988) adding physiological stress to individual animals and reducing the economic value of the animal to sportsmen (Choquette, 1956). Through laboratory analysis of fecal float samples, I will monitor changes in the number of parasite eggs for elk at Hardware Ranch feeding station over the winter season to discover if there may be negative implica-

tions of feeding stations which should be further examined. Increased prevalence of parasites could also indicate an increased danger for transmission of other diseases which are a threat to domestic livestock (Williams, 2002).

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232. IDENTIFICATION OF DIET SUPPLEMENTS FOR ELK MANAGEMENT. Hope Braithwaite^{*}, Tim Bateman, Juan J. Villalba, Kari E. Veblen, Eric T. Thacker; Utah State University, Logan, UT

ABSTRACT

In the Intermountain West, Rocky Mountain Elk (*Cervus canadensis nelsoni*) habitat often overlaps with deer (*Odocoileus hemionus*) and Sage-Grouse (*Centrocercus urophasianus*). Elk can over-use certain areas potentially threatening these wildlife. One potential solution is to redistribute elk to less used areas, but tools to do this are limited. One approach is to feed elk a complete diet replacement, but then they no longer need to move to seek additional forage, leading to over-use. One approach to controlling livestock distributions is to provide appealing diet supplements that complement rather than replace livestock diets thereby allowing animals to move and consume existing forage. This approach has not yet been tested on elk. Thus, we tested elk preferences for 4 supplements, two high in energy (beet pulp and molasses) and two high in protein (soybean meal and canola) at a site in northern Utah. We also tested elk preference for two types of feeders, which differed in shape, size, and color. We used observational techniques (scan surveys) and measured the amounts of supplement consumed by elk to determine supplement and feeder preference. Our results suggest elk discriminated among supplements with greater preferences for high-energy supplements during periods of low ambient temperatures and preferences for high-protein supplements when temperatures increased. No significant differences regarding intake of supplement from the different feeder types was detected. Our results suggest that diet supplementation could potentially provide a way to relocate elk away from over-used areas, allowing other species to benefit from the absence of the large ungulates.

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233. VARIANCE IN STOMATAL SIZE AND DENSITY BETWEEN TRIPLOID AND DIPLOID QUAKING ASPEN (*POPULUS TREMULOIDES*) IN UTAH. Brianne Palmer^{*}; Utah State University, Logan, UT

ABSTRACT

Quaking aspen (*Populus tremuloides*) stands in Utah are triploid (three copies of each chromosome) or diploid (two copies of each chromosome). Their abundance in the intermountain west is declining and there may be differences in physiology between the two cyptypes. The purpose of this research is to determine whether there is a significant difference in stomatal sizes and densities between these cyto-types, which could relate to differences in drought tolerance, productivity, and effective management strategies. During

^{*}Presenter

the summer of 2013, we collected leaves from stands representing the two cytotypes from Swan Flats and Fish Lake in Utah. From the preliminary analyses, we deduced that the variation in stomatal size and density is primarily among clones but not among cytotypes. This is consistent with other aspects of aspen physiology found to vary by clone. This study will be expanded to include a larger sample size.

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234. RUSSIAN OLIVE (*ELAEAGNUS ANGUSTIFOLIA*) LEAF LITTER AS A FOOD SOURCE IN MONTANA'S PRAIRIE STREAM ECOSYSTEMS. Zachariah Conley, Drew Narduzzi, Smith L. Wells*; Montana State University, Bozeman, MT

ABSTRACT

The purpose of this study was to compare the effects of the invasive plant Russian olive (*Elaeagnus angustifolia*) and its native counterpart, plains cottonwood (*Populus deltoides*), on the primary food chain of Montana prairie streams. Russian olive is displacing plains cottonwood in riparian areas throughout eastern Montana and some expensive eradication efforts have been undergone to remove this invader. Research conducted to determine food web effects included: fat, protein, and energy content analysis of leaves both species; experiments on benthic macro-invertebrate utilization of the two species via leaf dry weight analysis; experiments on Fathead minnow (*Pimephales promelas*), a prairie stream fish, weight gain when fed diets of the two species; and scientific literature review. Russian olive leaves had higher concentrations of protein and energy than plains cottonwood and similar concentration of fat. However, the additional protein and energy from Russian olive leaf litter was found to provide no benefits to these ecosystems. One possible negative impact of Russian olive is the surplus of nitrogen released in stream corridors. Visual observations concluded that macro-invertebrates prefer larger leaves that form packs, such as cottonwood, for habitation but this showed no effect on disappearance rates; paired t-test data analysis indicated changes in leaf dry weight of both species were significant ($p < .05$). Data analysis on weight gains of Fathead minnows continues and preliminary results indicate that both species provide diets adequate enough to maintain fish weight and survival. This study shows there are minimal effects of Russian olive on the primary food chain of Montana prairie streams, which may have implications on future management and eradication efforts of this species.

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235. QUAKING ASPEN RESPONSE TO MECHANICAL TREATMENT IN SOUTHWEST MONTANA. Jarrett Payne*¹, Clayton Marlo²; ¹Montana State University, Twin Bridges, MT, ²Montana State University, Bozeman, MT

ABSTRACT

Land managers concerned with declining aspen cover at the Lutz Farm near Bozeman, Montana studied aspen stand response to mechanical treatment as an alternative to pre-

scribed fire. All aspen stands rated as "poor" with browsing dieback present in all monitored stands. Mature trees were clear-cut on one decadent aspen stand to evaluate if mechanical treatment stimulated sucker growth. A game camera and double electric fence measuring 45 feet by 90 feet was established on the clear-cut stand to evaluate livestock and wildlife browse use on aspen stems. A comparison of two means ($\alpha = .05$) was used to evaluate browse impacts on stem heights between the fenced and the unfenced portion of the clear-cut in 2013 and 2014. The clear-cut fenced portion had significantly higher stem heights than the unfenced clear-cut stems in both years ($\alpha = .027$ in 2013 and $\alpha < .01$ in 2014). A comparison of two means ($\alpha = .05$) was used to evaluate the total stem heights of the clear-cut's fenced and unfenced portion to each of the untreated aspen stands total stem heights. The protected clear-cut had significantly higher total stem heights both years than the two untreated aspen stands ($\alpha < .01$). Results suggest mechanical treatment may be a useful alternative to regenerate decadent aspen stands in southwest Montana. However, wildlife and livestock browsing must be deferred on newly regenerated aspen for successful recovery. Electric fencing can provide the necessary temporary protection for aspen suckers to reach a height of two meters to escape browsing.

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236. FACTORS AFFECTING PLANT PERSISTENCE FOLLOWING RANGELAND SEEDING TREATMENTS IN NORTHEASTERN UTAH. Benjamin Davis*, Todd Black; Brigham Young University, Rexburg, ID

ABSTRACT

Seeding treatments have been utilized to holistically manage rangelands dualistically for livestock and wildlife. Research documenting long-term plant persistence following treatments is limited. This study investigates the effects of treatment type, treatment timing, and seeding microsite characteristics on plant persistence. Imprinting, aeration, and drilling were more effective seeding techniques than broadcast seeding. In high-elevation Wyoming big sagebrush plant communities, forage kochia (*Kochia prostrata* [L.] A.J. Scott) and crested wheatgrass (*Agropyron cristatum* [L.] Gaertn) tended to persist in alkali soils whereas deeper soils favored the establishment of slender wheatgrass (*Agropyron trachycaulus* [Link] Gould ex Shinners), intermediate wheatgrass (*Thinopyrum intermedium* [Host] Barkworth & D.R. Dewey), alfalfa (*Medicago sativa* L.), sanfoin (*Onobrychis viciifolia* Scop.), crested wheatgrass, forage kochia, and basin wildrye (*Leymus cinereus* [Scribn. & Merr.] Å. Löve). Siberian wheatgrass (*Agropyron fragile* [Roth] Candargy) and slender wheatgrass were most persistent in the mountain sagebrush steppe.

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237. ENHANCED PHYTOREMEDIATION OF PB, CD AND CU USING BRASSICA JUNCEA AND CHELATORS EDTA AND EGTA. Kristin Cooper*, Crystal Welch, Angelina Lasko, Dylan Skinner-Rosenberg, Anna Gresham; Humboldt State University, Arcata, CA

ABSTRACT

An integrated greenhouse experiment was conducted to examine the level of Pb, Cd and Cu uptake into Brassica juncea. The chelators ethylene diamine tetraacetate (EDTA) and ethylene glycol tetraacetic acid (EGTA) were compared. A brief analysis of the role organic matter content plays in tying up Pb bioavailability was conducted. Contamination levels of Pb, Cd, and Cu in soil were investigated by nitric acid digestion and water extraction methods. Results showed that EGTA was most effective at enhancing uptake of Pb, Cd and Cu into shoots and roots ($p=0.005302$), ($p=1.72E-08$) and ($p=4.14E-06$). Organic matter had a significant difference in the bioavailability of Pb between soil type treatments ($p=1.55E-06$). Pb, Cd, and Cu amounts determined in soil varied significantly between nitric acid digestion and water extraction methods.

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238. EXAMINING THE COMPETITIVE EFFECTS OF VENTENATA DUBIA. Shawn McKay*¹, Lesley Morris², Christo Morris¹, Elizabeth A. Leger³; ¹Oregon State University, La Grande, OR, ²SRM, Bismark, SD, ³University of Nevada Reno, Reno, NV

ABSTRACT

Ventenata (*Ventenata dubia*) is a relatively new invasive annual grass to rangelands in the Pacific Northwest and the Great Basin. Although its spread has been rapid in the last decade, very little is actually known about this new invasive grass and how it will affect rangelands in either region. Some report that *V. dubia* is competitive enough to replace other invasive annual grasses as well as native perennial species. However, there are no published studies available to support this claim. In this study, we performed a greenhouse experiment to examine if *V. dubia* has a competitive effect on *Bromus tectorum*, *Taeniatherum caput-medusae*, or *Pseudoroegneria spicata*. Given that both *B. tectorum* and *T. caput-medusae* are also winter annuals, we expected that any competitive effects from *V. dubia* would be greater between annuals than for the native perennial grass. To test this, we compared the early seedling growth rates, final biomass, and competitive performance index for these species grown alone and in competition with *V. dubia*. Contrary to our expectations, our results showed that *P. spicata* grown in competition with *V. dubia* contained 20% less shoot biomass than when this species was grown alone and that the CPI for *V. dubia* grown in competition with *P. spicata* was greater than for either annual grass. Our results suggest that, at this stage of plant development and when grown in one on one competition, *V. dubia* has more of a competitive effect on the native grass than other invasive annuals. Even with the rapid increase in this species, its invasion may still

be within a lag phase of introduction, a time when control is more possible and less costly. More work needs to be done to understand how *V. dubia* interacts with other species and with increasing densities to understand how it will affect rangelands.

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239. LIVESTOCK GRAZING PREFERENCES ON YELLOW BLUESTEM. Craun Nolan*; Oklahoma State University, El Cerrito, CA

ABSTRACT

In the South Central United States, yellow bluestem (*Bothriochloa ischaemum*) has invaded rangelands and is known to mature earlier than native species, leading to decreased palatability and nutrition for livestock. As a result, livestock may exhibit unfavorable grazing distributions, water use, and overuse of native forage species in rangelands, thus promoting further invasion by *B. ischaemum*. To determine if the grazing pressure on *B. ischaemum* can be manipulated, thus reducing invasion, a study comparing native grasses and *B. ischaemum* was conducted in grazed tallgrass prairie west of Stillwater, OK on the Oklahoma State University Research Range. A total of 24 16m² plots were established and grazing exclosure zones were placed at 12 of the plots. During the first week of June, four native grass plots and four *B. ischaemum* plots were mowed. Four additional plots of both vegetation types were mowed in July. Forage nutrition, biomass, vegetation height, and soil samples were collected during the first week of August. Biomass and height results from the ungrazed plots suggest reduced grazing of *B. ischaemum* when it is mowed in July, however, mowing in June indicated increased grazing selection of *B. ischaemum*. Mowing native grasses and *B. ischaemum* in both June and July increased protein levels from 5% to 7% while also decreasing the number of *B. ischaemum* reproductive tillers. These results indicate mowing and grazing *B. ischaemum* in June might provide an option for range managers to control *B. ischaemum* invasion.

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240. RESPONSE OF REED CANARYGRASS TO TWO HERBICIDE APPLICATIONS. Kyle Schumacher*, Walter H. Schacht, Russel Hamer, Grant Weimer, Jeffrey Borchers; University of Nebraska-Lincoln, Lincoln, NE

ABSTRACT

Reed canarygrass (*Phalaris arundinacea*) is an aggressive grass species that can invade and dominate areas with moist soils. Dense stands of reed canarygrass are a particular concern in wildlife management areas managed by the Nebraska Game and Parks Commission (NGPC). Herbicides have become a commonly-used tool to control reed canarygrass by NGPC because other control practices have been largely ineffective. The objective of this study was to compare two common herbicides in the control of reed canarygrass. The study was conducted in open areas under mature stands of eastern cottonwood (*Populus deltoides*)

des) trees at the Powderhorn Wildlife Management Area in eastern Nebraska. Following a March wildfire in 2014, three herbicide treatments were applied in mid-May: glyphosate broadcast-sprayed at 0.56 kg ai ha⁻², clethodim broadcast-sprayed at 0.10 kg ai ha⁻², and a no spray control. At the end of the growing season in October, canopy cover of reed canarygrass, other grasses, sedges, forbs, and woody plants were estimated in 20 quadrats (20 x 50 cm) in each treatment area. Species richness increased in both herbicide treatments with 23 species in the glyphosate treatment, 12 species in the clethodim treatment, and 8 species occurring in the control area. Reed canarygrass decreased from 92% cover in the control area to 85% cover in the clethodim treatment and 12% cover in the glyphosate treatment. Percentage cover of grasses, forbs, and woody plants increased in both herbicide treatments. Percentage cover of sedges increased in the glyphosate treatment compared to the control plot and showed a decrease in cover in the clethodim treatment. Spring application of glyphosate following fire appears to be an effective tool in controlling reed canarygrass but follow-up management of the treated area is likely required to maintain longer-term control of this invasive species.

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241. USABLE SCIENCE FOR SUSTAINABLE RANGELANDS: A PRELIMINARY SUMMARY OF WORKSHOP OUTCOMES. Kristie Maczko*¹, Lori Hiding², Chad R. Ellis³, John A. Tanaka⁴; ¹Sustainable Rangelands Roundtable - University of Wyoming, Laramie, WY, ²Arizona State University, Tempe, AZ, ³Noble Foundation, Ardmore, OK, ⁴University of Wyoming, Laramie, WY

ABSTRACT

Rangeland research funding constraints are coupled with ever-expanding environmental, financial, and societal pressures. As obtaining support for rangeland research becomes more competitive, researchers and funders must ensure that land managers' needs are met. In response to these challenges, we must align on-the-ground knowledge needs with knowledge creation by rangeland researchers and research funding organizations. The Sustainable Rangelands Roundtable partnered with the Samuel Roberts Noble Foundation and the Consortium for Science Policy and Outcomes to convene an interdisciplinary workshop of researchers, land managers and producers, and representatives of funding agencies and organizations to develop a research agenda for Future Directions of Usable Science for Sustainable Rangelands. Grazing animals affect rangeland systems, as do human communities that manage these unique ecosystems. Rangelands provide ecosystem services including livestock forage, open space, clean air and water, carbon sequestration, recreation opportunities, wildlife habitat, food security, and scenic landscapes. Workshop outcomes reflect 20 hours of discussion and dialogue among over 40 contributors. Workshop participants' efforts focused on three main objectives. First, participants worked to develop a common understanding of the concept of "usable science," scoping the concept of usable science as it pertains to rangeland sustainability. Usable science considers the needs of its users

throughout the scientific enterprise, in this case to ensure that rangelands continue to provide a desired mix of economic, ecological, and social benefits to current and future generations. From that foundation, participants' shifted to their next objective, developing a portfolio of recommendations for future directions of usable science for rangeland sustainability. Areas of emphasis for the June 2014 workshop included soil health, water, plants, animals, and socio-economic aspects of rangeland sustainability. Lastly, participants were requested to consider current and emerging issues in sustainable rangeland management and potential geographic (regional) variations. The workshop concluded with an assessment of project/product components for decision-makers.

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242. PRESENTING RANGELAND ECOLOGY TO NATURAL RESOURCE STAKEHOLDERS. Kristen E. Gunther*¹, Ann L. Hild²; ¹University of Wyoming, Laramie, WY, ²Univ. of Wyoming, Laramie, WY

ABSTRACT

Ironically, in a time when society counts on science and technology to overcome the limitations inherent in natural resource extraction, American scientific literacy and scientific credibility are lagging. Science communication is a critical component of the interface between academic researchers and ecosystem stakeholders. However, scientists are trained primarily to communicate with one another and as a consequence, frequently frame their communications using highly specialized technical language. Often such communications are not readily accessible or particularly useful for resource managers and policy-makers. This communication gap hinders the translation of emerging science and creates lag times in the application of emerging science to real-world management. We ask how scientists might benefit from training that enhances the receptiveness of natural resource managers and policy decision-makers to newly refined scientific findings. We are conducting a series of studies to elicit feedback from scientists and individuals who drive natural resource policy or who apply scientific concepts to land management within the constraints of policy. We present preliminary results of our ongoing research to demonstrate the importance of communication techniques to scientific literacy.

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243. RANCHER DECISION-MAKING AND PERCEPTIONS OF SUCCESS: A CASE STUDY IN THE WESTERN GREAT PLAINS. Hailey Wilmer*¹, Maria Fernandez-Gimenez¹, Justin D. Derner², David D. Briske³, Kenneth W. Tate⁴, Leslie M. Roche⁵, David Augustine⁶; ¹Colorado State University, Fort Collins, CO, ²USDA-ARS, Cheyenne, WY, ³Texas A&M University, College Station, TX, ⁴University of California Davis, Davis, CA, ⁵University of California, Davis, Davis, CA, ⁶USDA-ARS, Fort Collins, CO

ABSTRACT

Ranchers in the semiarid, western Great Plains encounter highly variable inter- and intra-annual climatic conditions,

combined with markedly fluctuating market prices that are globally-influenced. However, both rancher decision-making processes and ranchers' perceptions of successful social, ecological and economic outcomes have been excluded from conventional grazing experiments, resulting in an incomplete assessment of both the process and outcomes of rancher decision-making. Using a case study approach, we examined how 17 ranching families in SE Wyoming and NE Colorado made grazing management decisions and documented the ecological conditions on their ranches. We paired qualitative interviews of ranchers with field-based ecological measurements of rangeland conditions on their ranches to explore 1) how ranchers made grazing decisions and what decisions they made, 2) how ranchers defined successful outcomes of these decisions, and 3) the relationships between rancher decision-making processes, the grazing decisions they made, their definitions of success, and measured ecological outcomes. Grazing decisions are influenced by a complex combination of human dimensions and ranch characteristics, both of which vary among ranches. By taking a holistic and rancher-centered approach to studying ranch decision-making processes and outcomes, the results of this exploratory analysis shed light on the human dimensions of adaptive grazing management. By doing so, this study addresses an identified gap in range science and may begin to explain the discord between past experimental research on grazing outcomes and the outcomes observed by managers.

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244. CALIFORNIA GRAZING REGULATORY ACTION PROJECT. Cindy M. Wise*¹, Jodi Pontureri²; ¹California State and Regional Water Boards, South Lake Tahoe, CA, ²California State and Regional Water Boards, Sacramento, CA

ABSTRACT

The California State Water Resources Control Board (State Water Board) is proposing a statewide action with goals to enhance environmental benefits from grazing, protect beneficial uses of surface and groundwater, and address water quality impacts related to livestock grazing in California. This Grazing Regulatory Action Project (GRAP) aims to facilitate efficiency and statewide consistency in developing and implementing requirements to meet these goals. Our challenge is to support well-managed grazing while still protecting water quality and its beneficial uses. Well-managed livestock grazing operations provide benefits to the environment, the economy, and California consumers. In some instances, however, grazing operations contribute to impairment of water quality and impact beneficial uses. Approximately 120 water quality impairments (including fecal bacteria, temperature, sediments or nutrients) identified on the 2010 Clean Water Act (CWA) List of Impaired Waters for California are on lands with active grazing operations. Under existing law, Total Maximum Daily Loads (TMDLs) are required for all waters and pollutants on the CWA list, including waters impacted by grazing operations. Developing a TMDL for each impaired water body is not a practical

solution. To date, the Water Boards have chosen to regulate livestock grazing through Water Board orders, grazing waivers, Water Quality Control Plan (Basin Plan) prohibitions, TMDLs and enforcement actions. These approaches have varied in their application and effectiveness, and have resulted in inconsistencies statewide. In addition to meeting the requirements of the CWA, the Water Boards must meet the requirements of the California Porter-Cologne Water Quality Control Act, which obligates the Water Boards to address all discharges of waste that could affect the quality of the waters of the State, including all nonpoint sources of pollution. Grazing in California is a nonpoint source of water pollution that is not currently regulated statewide. Examples of nonpoint source pollution that may be associated with grazing include discharges of sediment from the erosion of stream banks, discharges of bacteria from livestock feces that get into the surface water, and increased temperature of streams caused from trampling of riparian habitat. The participation of interested stakeholders in the development of a statewide grazing regulatory strategy is crucial to its success. Thus, the Water Boards engaged stakeholder groups by soliciting initial public comments in 2014 and early 2015. Water Board staff will compile all input from these outreach sessions and consider it in the development of the GRAP proposal during 2015.

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245. EFFECTS OF MOWING TREATMENT ON SMOOTH BROME BELOWGROUND BUD BANK. Denise N. Olson*¹, Lan Xu¹, Diane M. Narem², Nels Jr H. Troelstrup¹; ¹South Dakota State University, Brookings, SD, ²South Dakota State University, Brookings, SD

ABSTRACT

Smooth brome (*Bromus inermis*) is an invasive, perennial, cool-season grass that is outcompeting native grasses of the northern Great Plains of the United States, decreasing diversity, degrading habitats, and lowering nutrient value for grazing animals at later growing season. Management of smooth brome is a key to improve degraded native dominated grasslands. However, current practices have been met with minimal and/or short term success due to its fast-growing aboveground shoots and extensive rhizome structure. Even though vegetative reproduction via the belowground bud bank is the primary means for its local spread and persistence, the effect of management on its bud bank dynamics has not been evaluated until recently. Previous study indicated the mowing treatments at the boot stage over one growing season significantly reduced the total number of buds and percentage of dormant buds compared to control. However, these differences were not observed in the following year without treatment. The objective of this study was to examine the effects of simulated grazing (mowing) on smooth brome belowground bud bank over the course of the two consecutive growing seasons. The experiment was a Randomized Complete Block Design with 4 mowing treatments and 4 replications. Prior to each treatment, stem density was recorded within two 0.1 m² quadrats. Three tillers were randomly selected from each treatment plot and

*Presenter

excavated to determine the number of crown positions, total number of axillary buds, bud viability, and outgrowth tiller to bud ratio. Bud production, bud viability, bud density and tiller to bud ratio will be compared among frequency of mowing treatments within and between growing seasons.

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246. CATTLE AS A BIOLOGICAL CONTROL FOR NOXIOUS WEEDS IN NORTH DAKOTA. Melissa C. McCann*¹, Kevin K. Sedivec¹, Kent Belland², Jim Bennington³, Dennis L. Whitted¹; ¹North Dakota State University, Fargo, ND, ²North Dakota Army National Guard, Bismarck, ND, ³North Dakota Army National Guard, Devils Lake, ND

ABSTRACT

Feed and control of undesirable plants are two of the highest cost inputs for livestock producers. Continual grazing of desirable forages can inadvertently increase invasive plant species, causing the grazing area to become dominated by invasive plant populations. As undesirable plant compositions increase, animals use more energy than normal when searching for palatable, nutritional forage. Managers and producers employ targeted grazing to change animal behavior for the consumption of particular plants, allowing managers and producers to better utilize the land and natural resources. Cattle choose what to graze based on nutritional feedback and herd/maternal guidance. The purpose of this study was to manipulate cattle foraging behaviors by targeted grazing of leafy spurge (*Euphorbia esula*) which would lead to control of the weed. In 2013 and 2014, we encouraged cattle to consume leafy spurge by gradually introducing them to a mixture of hay and sweet feed concentrate; introduced first with 0%, 50%, and finally 100% freshly cut leafy spurge. We placed the hay and sweet feed in six feed bunks on a pasture at Camp Grafton South, a National Guard Training Area near McHenry North Dakota. We collected both qualitative and quantitative data to determine the total consumption of leafy spurge from the field and feed bunks. The quantitative data shows a trending increase in the total amount of leafy spurge that was consumed from the feed bunks. With the observational data, we noted that cattle seemed to be willing to graze leafy spurge from the feed bunks. Historically, the idea of cattle consuming leafy spurge was nothing but a divergent idea. This research indicates targeted grazing by cattle on leafy spurge may be possible. More research is needed to discover if cattle grazing behaviors can be manipulated for targeted grazing of noxious weeds.

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247. USING EARLY GRAZING TO CONTROL KENTUCKY BLUEGRASS. Bob D. Patton*, Bryan Neville, Anne C. Nyren; North Dakota State University, Streeter, ND

ABSTRACT

Early season intensive grazing is being tested as a means to control Kentucky bluegrass (*Poa pratensis* L.), an invasive grass species. Kentucky bluegrass is a perennial cool-season grass that begins growth in the spring earlier than

our native species. Its forage quality is high in the spring but decreases through the season, resulting in reduced overall forage quality during the summer. Heavy grazing while Kentucky bluegrass is growing actively may shift the balance in the plant community to favor the native species. Each of six pastures was assigned to one of two treatments: early intensive and season-long grazing. On the early intensive grazing treatment the pastures were stocked as early as possible after Kentucky bluegrass greened up, around April 27th prior to the three-leaf stage and cattle were removed when 30 percent of the native species had received some grazing, around June 2nd. On the season-long treatment cattle were placed on pasture mid-May and removed mid-September. Frequency of occurrence, density and aerial cover of plant species were monitored using nested frames with 50 frames per pasture. Forage production and utilization were determined using the cage comparison method. While clipping plots at peak production, an estimate was made of species percentage by weight. Forage production was not significantly different between the early intensive and the season-long grazing treatments in 2011, 2012 or 2013 ($P > 0.05$). Kentucky bluegrass aerial cover ($P = 0.001$) and frequency of occurrence ($P = 0.003$) declined on the early intensive treatment during this project, while aerial cover of Kentucky bluegrass increased ($P = 0.001$) on the season-long treatment in 2012 and 2013. After three years, initial results indicate that early grazing can reduce Kentucky bluegrass aerial cover and frequency. Removing cattle before the native grasses and forbs have received significant grazing pressure should allow these species to increase in the community.

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248. IMPACT OF KENTUCKY BLUEGRASS INVASION ON SPECIES DIVERSITY AND NITROGEN. John R. Hendrickson*¹, Mark A. Liebig¹, Allison Haider²; ¹USDA-ARS, Mandan, ND, ²North Dakota State University, Fargo, ND

ABSTRACT

Kentucky bluegrass (*Poa pratensis* L.) has been increasing rapidly on rangelands in the northern Great Plains. Despite the rapid increase, relatively little is known about the impact of Kentucky bluegrass (POPR) invasion on ecosystem services. A study was initiated at the Northern Great Plains Research Laboratory (USDA-ARS) near Mandan, ND to investigate POPR invasion effects on plant species diversity and aboveground biomass nitrogen (N). Four sites (4.9 x 4.9m) within a long-term moderately grazed pasture were selected with half the area being dominated by POPR and half dominated by other species (Control). Two 1/8 m² quadrats were clipped by species to ground level on each half in July 2013. All standing dead and detached litter was also removed and placed in a litter category. Nitrogen and carbon were determined on the green biomass and litter components. Species richness was similar in POPR and control areas. However, Simpson's Diversity index was greater on the Control ($D = 0.379$ and 0.666 for POPR and Control, respectively; $P = 0.0005$). Percent N in all the aboveground biomass components was similar between

POPR and Control areas, but total g N m⁻² was greater in the POPR area (9.2 vs. 4.0 g m⁻² for POPR vs Control, respectively; $P = 0.0011$) because of greater biomass in POPR. The increased N in the POPR dominated area may drive the POPR increase. However, while species diversity was greater in the Control, the lack of differences between the two areas may suggest potential for re-establishing dominance of native grasses afflicted by POPR invasion.

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249. DOES ANNUAL PRECIPITATION REGULATE THE PROPORTION OF SPECIES DIVERSITY THAT COMPRIS-ES INVASIVE SPECIES? Mark P. Lyseng^{*1}, Edward W. Bork², Cameron N. Carlyle², Daniel B. Hewins², Barry Adams³, Mike Alexander⁴, Jennifer Richman³, Darlene Moisey⁵, Mike Willoughby⁶, Craig DeMaere³; ¹Grad student, Edmonton, AB, ²University of Alberta, Edmonton, AB, ³Government of Alberta, Lethbridge, AB, ⁴Government of Alberta, Pincher Creek, AB, ⁵Government of Alberta, St. Paul, AB, ⁶Government of Alberta, Edmonton, AB

ABSTRACT

Plant species invasions are problematic due to their ability to alter rangeland function, including biodiversity and the provision of environmental goods and services such as forage production. A grassland's susceptibility to invasion may also vary as a function of climate and disturbance. In this study, detailed species composition data were used from approximately 120 long-term grassland study sites across southern and central Alberta to evaluate the relative abundance of introduced species in relation to 1) agro-climatic gradients, including rainfall (272 – 437 mm) and soil conditions, and 2) the presence or absence of livestock grazing (inside and outside of long-term exclosures). Preliminary data has shown that species diversity increased along the precipitation gradient for both grazed and ungrazed plots. In high precipitation areas invasive species cover was higher in grazed plots but in low precipitation areas it was higher in ungrazed plots. We will further assess plant community composition, including the proportion of diversity comprised of invasive species, and related to the fore-mentioned factors. Results of this study will have implications for the ongoing management and conservation of native grasslands across the region.

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250. PLANT DIVERSITY AFFECTS SUCCESS OF INVASIVE THISTLES IN RESTORED NEBRASKA GRASSLAND. Katilyn J. Price^{*1}, David A. Wedin¹, Stephen Young², Chris Helzer³; ¹University of Nebraska-Lincoln, Lincoln, NE, ²Cornell University, Ithaca, NY, ³The Nature Conservancy, Aurora, NE

ABSTRACT

Invasive plant species threaten native grasslands, affecting nutrient cycling, biodiversity, wildlife habitat, and usable land for production. Consequently, preventing establishment of invasive species is critical before removal becomes difficult and expensive. The purpose of this study was to examine

the effects of grassland plant diversity on musk thistle (*Cardus nutans*) and Canada thistle (*Cirsium arvense*) establishment and determine which environmental factors (light penetration, soil moisture, plant diversity, and soil nitrogen) account for resistance to invasions. In a field experiment at The Nature Conservancy's Wood River site (Nebraska), the two invasive thistle species were planted into replicated grassland diversity plots. The ¾ acre grassland plots were seeded as monoculture (*Andropogon gerardi*), low diversity, and high diversity treatments in 2010. The experiment also included plots maintained as bare soil. Actual plant diversity was measured in 2013. Environmental factors were measured during the growing seasons (April-October) of 2013 and 2014. After two years, both thistle species flourished in bare soil plots, maintained populations in monoculture and low diversity plots, while thistles in the high diversity grassland plots emerged and the rapidly died prior to completing their normal life cycle. Analyses of the environmental factors show strong declines in resource availability (light, water, nitrogen) associated with both plant biomass and diversity across the experimental diversity gradient.

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251. EVALUATING PERENNIAL GRASS COMPETITION AS A MANAGEMENT TOOL. Dan Harmon^{*1}, Charlie D. Clements²; ¹USDA ARS, Reno, NV, ²USDA, Reno, NV

ABSTRACT

Evaluation of plant competition is highly dependent on life stage and cycle. One of the largest problems the Great Basin faces is the competitive ability of the invasive Cheatgrass (*Bromus tectorum*). Advantages of cheatgrass are often attributed to large seed production (seed banks), Fall germination, and plasticity. However the measurement of a "successful" competitor is often biomass. Biomass represents the negative effect of competitor A on competitor B through resource limitations and thus judging competitor A as the winner. This relationship in the authors opinion is too often termed "suppression". We limit the term "suppression" for use only at the population level for densities not individual plant biomass. The target goal for cheatgrass suppression is absence (zero seed production) not smaller plants. While biomass is related to seed production, annuals exist at high densities producing an excess abundance of seed. It is unfounded that decreased biomass would have significant effects on cheatgrass dominance. For a perennial grass we hypothesized that competing with cheatgrass at the seedling phase is best evaluated by survival (drought tolerance) not biomass or seed production. This research examines which indices of competitiveness relate to survival. We conducted a 3 year study measuring biomass, germination, emergence, drought tolerance, and seed production of cheatgrass, squirreltail, bluebunch and crested wheatgrass. Plants were seeded at high intra and inter specific competition densities in replicated soil boxes (9m³). Biomass was a poor indicator of cheatgrass dominance and determined crested wheatgrass as the dominant. Seedling drought survival and germination corresponded to cheatgrass dominance and the largest dis-

crepancy between cheatgrass and perennials. Emergence did not differ between species. While all indices contribute to perennial failures, seedling drought survival was fundamental for evaluating success. Seeding perennials with the highest seedling drought tolerance should be paramount for management activities.

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252. BOTANICAL COMPOSITION OF CATTLE DIET IN AN AREA INVADDED WITH NATAL GRASS (*MELINIS REPENS*) IN THE STATE OF CHIHUAHUA. Obed Gutierrez-Gutierrez^{*1}, Carlos R. Morales-Nieto², Velez-Sanchez-Verin Cristina³, Palacios-Nunez Jorge³; ¹Facultad de Zootecnia y Ecología, Chihuahua, Mexico, ²Universidad Autónoma de Chihuahua, Chihuahua, Mexico, ³Universidad Autónoma de Chihuahua, Chihuahua, Mexico

ABSTRACT

In the south-central region of the State of Chihuahua, the invasion of African grasses has changed the composition and dynamics of rangelands. The objectives of this study was to determine the botanical composition of the cattle diet and estimate a preference index in an invaded area with natal grass (*Melinis repens*) area. This research was conducted in the ranch 'Salinas', located in the municipality of Satevó, state of Chihuahua, Mexico. Samples were taken from animals with an esophageal fistula. The collected samples were analyzed by the microhistological technique. The diet selected by the cattle consisted of 58% grasses and 42% forbs and shrubs (growth stage); however on later sampling dates, grasses represented up to 80% of the diet. During the four sampling dates of this study, cattle diet consisted mainly of natal grass on the following stages: growing 26.67%, 29.27% developing, and 28.86% and 35.53% at maturity and latency stages, respectively. Native species such as sideoats grama (*Bouteloua curtipendula*) and blue grama (*Bouteloua gracilis*), accounted from 18 to 23% of the diet during all the sample dates. The highest preference index (12.63) was for the poverty threeawn (*Aristida divaricate*) and leather weed (*Croton pottsii*) with 12.95, during the growth stage. In contrast the lowest preference index was for natal grass with a range of 0.50 to 0.61. The botanical composition of the cattle diet consisted mainly of natal grass.

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253. UNDERSTORY FORAGE PRODUCTION AND HERBICIDE MORTALITY OF HUISACHE (*ACACIA FARNESIANA*). Kyle Brunson^{*}, Robert D. Cox; Texas Tech University, Lubbock, TX

ABSTRACT

Huisache (*Acacia farnesiana*) is a thorny brush species that has become a problem on millions of acres across south Texas due to its rapid and aggressive growth that allows it to readily infest rangelands and outcompete profitable forages. In order to understand how huisache control might influence understory plant growth, we assessed differences in herbaceous production in areas under huisache canopy and in in-

terspace areas unaffected by huisache shading. We utilized a paired-plot design and clipped five pairs of 0.25m plots. Plot pairs included one plot directly underneath a mature huisache canopy, and one plot away from (and unshaded by) huisache. Differences between under-canopy and interspace vegetative production were analyzed to understand how huisache removal might influence herbaceous production. We found that vegetative production appears to be influenced by shading from huisache canopy, with under canopy plots producing 94.1 g/m² and interspace plots producing 103.9 g/m². Huisache removal, though difficult due to huisache's ability to resprout, may provide improved herbaceous production of forage for livestock and wildlife.

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254. REGIONAL CHEATGRASS DYNAMICS ACROSS 14 YEARS AND FUTURE CHEATGRASS COVER TO AID RANGELAND AND SAGE GROUSE CONSERVATION. Stephen P. Boyte^{*1}, Bruce K. Wylie², Donald J. Major³; ¹SGT, Inc. @ USGS Earth Resources Observation and Science, Sioux Falls, SD, ²USGS Earth Resources Observation and Science, Sioux Falls, SD, ³U.S. BLM Idaho, Boise, ID

ABSTRACT

Species invasions can cause substantial and permanent changes to ecosystems, compromising their ability to support wildlife habitat and economic activities. Cheatgrass (*Bromus tectorum*) invasion in the Northern Great Basin (NGB) has dramatically changed the region's fire regime, leading to native species extirpation and causing rangeland degradation over tens of thousands of hectares. Future spatial dynamics of cheatgrass likely will be affected by climate change and could include movement of the species into previously uninvaded areas. Monitoring the cheatgrass invasion on NGB rangelands using remote sensing, biogeophysical, and climate data integrated into regression-tree models provides several benefits: 1) Land managers, policy makers, and scientists have access to historical and relatively current rangeland conditions over a broad geographical area; 2) mapping cheatgrass models can be relatively easily updated; and 3) future scenarios can be input into models to project estimates of future dynamics. This study presents data from 14 years of cheatgrass percent cover monitoring, provides estimates of future cheatgrass percent cover using future climate data, and provides maps and data analysis regarding cheatgrass percent cover and greater sage grouse priority areas of concern. The preliminary cheatgrass percent cover model training data R² value = 0.84; the test data R² = 0.83.

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255. THE EFFECT OF ANNUAL PRECIPITATION ON AGROPYRON CRISTATUM SUPPRESSION OF BROMUS TECTORUM. Dan Harmon^{*1}, Charlie D. Clements²; ¹USDA ARS, Reno, NV, ²USDA, Reno, NV

ABSTRACT

The ability of established crested wheatgrass (*Agropyron cristatum*) to suppress cheatgrass (*Bromus tectorum*) is

well documented. Many studies examining the competition between these two species, usually do so at the seedling phase. We do not consider decreased performance between two seedlings as an appropriate use of the term "suppression" as it relates to weed management. We define cheatgrass suppression as an established perennial grass having a negative effect on the density of cheatgrass. This is seen with the familiar bare rings around a mature crested wheatgrass plant. We have also observed that in years of high precipitation, these rings of suppression reduce in diameter with cheatgrass growing proximate to crested wheatgrass plants with no apparent signs of "suppression". We designed an experiment adding artificial precipitation at bi-monthly intervals (March-May) to replicated (9m2) crested wheatgrass stands (4.26 plants/m2) in order to measure suppression effects. We hypothesized that increased precipitation would decrease suppression. We measured the cheatgrass seed bank prior to the study and added seeds so that all treatments were equal. Treatments included adding additional 4.57cm precipitation (Treatment 1) and 1.52cm precipitation (Treatment 2). The natural precipitation (control plots) for that time period was 2.36cm. We also eliminated crested wheatgrass (Glyphosate) from treatment 2 plots (Treatment 3). Treatment 1 had on average 101 cheatgrass plants/m2 compared to 8 cheatgrass/m2 in control plots. Treatment 2 plots had 23 cheatgrass/m2. Cheatgrass plants in treatment 3 (Crested removal) were significantly larger than others likely due to increased available soil nitrogen (14ppm vs. 5ppm). Overall we find the results support our hypothesis but acknowledge there are many other interacting factors. Suppression is seldom "complete" with cheatgrass seed banks ever present and awaiting a disturbance to gain dominance. Management to preserve perennial grass stands is critical as this research demonstrates the fragility of cheatgrass suppression.

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256. POLLEN ABSCISSION IN WIND-POLLINATED WEEDS. david greene*¹, David Timerman²; ¹humboldt state university, arcata, CA, ²University of Toronto, Toronto, ON

ABSTRACT

Wind pollination remains little studied, especially the mechanism by which grains are abscised from anthers. Using the cosmopolitan weed *Plantago lanceolata*, we show via a shaker table in the laboratory and by field observations that grains are emitted through resonant vibration of the stamen. Abscission occurs in discrete bursts, each successive burst containing fewer grains and requiring a higher frequency as the anther mass is reduced. The accelerations are quite large and permit the grains to escape the boundary layer around the anther. We relate this result to the morphological traits typical of wind-pollinated plants, arguing that resonance-induced dispersal of grains is likely the main mechanism by which anemophilous species disperse pollen.

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*Presenter

257. EVALUATING ECOSYSTEMS SERVICES PROVIDED BY RANGELANDS WITH MANAGED AND UNMANAGED CONSERVATION EASEMENTS. Stephanie R. Larson-Praplan*¹, Van Butsic²; ¹UC Cooperative Extension, Santa Rosa, CA, ²UC Berkeley, Berkeley, CA

ABSTRACT

Conservation easements are voluntary agreements between landowners and government or non-profit organizations which restrict landowner actions in return for financial and lifestyle benefits to the landowner. While easements are often used to purchase the development rights of a property, conservation easements can also be used as part of a payment for an ecosystem services scheme. Typically, those who supply ecosystem services are not rewarded for all of the benefits they provide to others because markets for their services have not been developed. Arguably, the most prominent reasons why markets for ecosystem services rarely exist are the uncertainty about ecosystem processes, an inability to define market and non-market services, and a lack of funds with which to compensate ecosystem service providers. In order to assess the potential for payments for ecosystem services to be included in the price of future conservation easements, we evaluated the current value of ecosystem services provided by rangeland properties with conservation easements in Sonoma County, CA. A basic evaluation of the multiple benefits of current conservation easements was conducted, qualifying the economic return on investments of these purchased easements. We developed an assessment tool, using InVEST®, to map and value the goods and services from rangelands. The generated information will be used to support the structuring of future conservation easements such that they take into account measurable increases in ecosystem services provided by rangeland owners. This tool can be used by both private and public lands owners to apply the incremental value received by conservation easements.

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258. LAND HEALTH ASSESSMENTS: AN IMPLEMENTATION OF THE AIM STRATEGY THROUGHOUT NEVADA. Todd Granberry*, Wade Lieurance; Great Basin Institute, Reno, NV

ABSTRACT

Managing diversity is essential to maintaining the functionality of vegetative, soil, and hydrologic processes of rangeland ecosystems. Since 2011, the Great Basin Institute (GBI), in partnership with the Bureau of Land Management, has implemented the Assessment, Inventory, and Monitoring (AIM) strategy to conduct land health assessments on public lands in Nevada. State-wide application of the AIM strategy produces consistent, comparable, and scalable rangeland data to characterize and monitor ecological trends. AIM indicators include bare ground coverage, vegetation composition and height, canopy gaps, and plant species of management concern. Data resulting from this monitoring program have been used to inform management decisions regarding renewable

energy development, livestock grazing, sage-grouse habitat conservation, wild horse and burro management, and post-fire restoration. Field crews have established over 1250 AIM plots throughout the state that will be resampled periodically to collect trend data over time. Data sets such as these allow land managers the ability to identify areas of resource concern and make data driven management decisions. Managing diversity and vegetation composition is a vital component for increasing ecological resistance and resilience with respect to disturbance events.



259. DEVELOPING THE 18TH INDICATOR FOR INTERPRETING INDICATORS OF RANGELAND HEALTH ON NORTHERN GREAT PLAINS RANGELANDS. David Toledo¹, Chadley Prosser^{*2}, Jeff Printz³, John R. Hendrickson⁴, Pat L. Shaver⁵; ¹USDA-ARS, Bismarck, ND, ²Forest Service, Bismarck, ND, ³USDA-NRCS, Bismarck, ND, ⁴USDA-ARS, Mandan, ND, ⁵none, WOODBURN, OR

ABSTRACT

National Resources Inventory (NRI) resource assessment report shows little to no departure on Rangeland Health for most Northern Great Plains Rangelands. This information is supported by Interpreting Indicators of Rangeland Health (IIRH) data collected at local to regional scales. There is however a mismatch between what these data are showing and what resource professionals are seeing on the ground. Despite evident ecosystem changes, IIRH assessments show little to no departure from reference condition for soil stability and hydrologic function, and slight to moderate departure from reference condition for biotic integrity. These differences are mainly attributable to invasion of Kentucky bluegrass, smooth brome and other exotic grasses. According to NRI data, Kentucky bluegrass is now present in over 55% of the areas sampled in the Northern Great Plains. This non-native, perennial, cool season grass can serve to stabilize soils and increase site stability; it affects nutrient flows, soil structure, and plant community composition affecting biotic integrity; and it affects the hydrologic function of an area by changing root structure and the way in which water flows, is captured and then safely released back into the ecosystem. Based on our assessments, we believe that the current 17 indicators for Interpreting Indicators of Rangeland Health do not fully capture the current condition of these rangelands. An additional indicator, an 18th indicator, based on presence and thickness of both a root mat and a thatch layer would address the changes in hydrologic function and biotic integrity that are currently being seen on the ground. Through field observation, literature review and professional knowledge, we present a protocol for creating and describing an ecologically based indicator. We provide a description for this 18th indicator and a method for qualitatively assessing this indicator based on on-site quantitative data.



**Presenter*

260. RECORDING VARIABILITY IN PRECIPITATION DURING AN ARIZONA MONSOON. Christopher R. Bernau^{*1}, Mike Crimmins², Dave Schafer³, Doug Tolleson¹, Andy Groseta⁴, Enoch Malouff⁵; ¹University of Arizona, Camp Verde, AZ, ²University of Arizona, Tucson, AZ, ³University of Arizona, Cottonwood, AZ, ⁴W Dart Ranch, Cottonwood, AZ, ⁵Orme Ranch, Orme, AZ

ABSTRACT

Rainfall in Arizona's summer monsoon season is characterized by temporally and spatially variable high intensity events. To record these events Arizona state agencies have erected a network of weather stations that monitor regional precipitation averages. Each station in this network can record specific precipitation at a single location; however, the density of the weather station network is insufficient for recording the variable rainfall experienced locally, and the cost of the weather station is prohibitive when considering expanding the network to be pertinent at the local scale. For land managers, knowing the local precipitation is critical for predicting vegetation response and planning future management. The purpose of this study was to provide more accurate local precipitation data, and to collect variability in regional precipitation data, by supplementing the existing weather stations with inexpensive low maintenance rain gauges. Ten 2" diameter PVC pipe rain gauges and four tipping bucket rain gauges were spread on three ranches in Yavapai County in association with four county weather stations. Rain gauges were checked weekly and the site specific data were presented to local land managers as weekly rain totals and cumulative rain totals for the monsoon season. Between May 16 and September 15th the average precipitation totals of the weather stations recorded 7.4" while the additional rain gauges increased the recorded average to 8.0". Site specific data varied widely between sites, with several sites fluctuating between above and below expected average precipitation as the monsoon progressed and with a September 15th low of 6.2" and a high of 10.6". The results demonstrate that site specific data, rather than regional averages, is needed for informed management decisions.



261. IMPACTS OF DROUGHT ON BIOMASS PRODUCTION AND SPECIES COMPOSITION IN THE NORTHERN MIXED GRASS PRAIRIE. Joe R. Bennett^{*}, Alexander Smart, Lora Perkins, Todd Trooien, Sharon Clay, David Clay; South Dakota State University, Brookings, SD

ABSTRACT

Drought by definition is any annual reduction of rainfall greater than 25%. Historically, drought occurred in the Northern Mixed Grass Prairie, in one out of five years. Spring and summer drought occurs at the same frequency, but is more sporadic. The objective of this study was to simulate a 50% spring or summer drought using 3.3 x 2.2 m stationary rain-out shelters to examine vegetation resistance and resilience. In South Dakota's Mixed Grass Prairie, rainout shelters were placed in high-diversity/high-productivity and low-diversity/

low-productivity areas on three separate ranches. Treatments within each study area include a 1-yr spring drought, 1-yr summer drought, 2-yr spring drought, 2-yr summer drought, ambient precipitation, and 100% of the 30 year average precipitation (“control”). During the first year (2014), rainout shelters were placed on the 2-yr spring and summer treatments. Supplemental water was added, based on the 30-year average, to the 1-yr spring and summer treatments and “control”. In the second year of the study (2015), rainout shelters will be placed on all the replicates of both the 1-yr and 2-yr spring and summer droughts while “control” will continue to be the reference point. Spring drought was implemented from April 1st to June 30th and summer drought was from June 1st to August 31st. Biomass clippings (by species) and species composition were measured after the first frost event for all replicates and treatments. We hypothesize that sites with high-productivity/high-diversity will be more resistant and resilient than low/diversity/low productivity sites to the effects of drought due to species diversity. In addition, spring drought should have a greater impact than summer drought due to higher proportion of C3 species in the Northern Mixed Grass Prairie. These data can serve as baseline data for ranchers preparing drought management plans.

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262. LOWER JOSEPH CREEK WATERSHED ASSESSMENT. John Williams^{*1}, Nils Christoffersen², Bruce Dunn³, Cynthia Warnock⁴, Rod Childer⁴, Jamie McCormack⁵, Kelly Birkmaier⁴; ¹Oregon State University Extension Service, Enterprise, OR, ²Wallowa Resources, Enterprise, OR, ³Wallowa County Natural Resources Advisory Committee, Enterprise, OR, ⁴Rancher, Enterprise, OR, ⁵United States Forest Service, Enterprise, OR

ABSTRACT

In 2006 the Wallowa County Natural Resource Advisory Committee (NRAC) began its second watershed assessment, focusing on the Lower Joseph Creek Watershed (LJCW). This assessment is the latest effort by Wallowa County to implement the Wallowa County-Nez Perce Tribe Salmon Habitat Recovery Plan, written in response to the listing of the Snake River Chinook salmon in 1992. The LJCW is a comprehensive watershed evaluation prepared through a collaborative process including the US Forest Service, Wallowa Resources, several state agencies, and tribal and environmental group representatives. The LJCW assessment objectively examines conditions on the ground, and identifies opportunities to restore and improve healthy watershed function. The process covers 177,929 acres of public and private lands, at a cost of \$350,000. It includes a review of the forest, range, riparian, wildlife, cultural, economic, roads and recreation resources. In 2013, the Wallowa Whitman Forest Collaborative selected LJCW as one of two priority projects. The five eastern Oregon collaboratives supported it as the first project under the USFS Eastside Restoration Strategy. A dedicated interdisciplinary team was appointed by the USFS to develop forest restoration projects

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with increased size and in a timely manner. Scheduled completion is January 2015. The assessment identified over \$80 million of forest restoration, range improvement and road and recreation maintenance over the next five years. These activities include commercial harvest over 16,000 acres that could produce over 100 million board feet of timber. The current federal land harvest level is approximately 4 million board feet per year in Wallowa County. Implementation of the watershed restoration activities will give a boost to the local economy, by reducing the fire risk, opening up stands for improved range conditions and grazing opportunities with fencing and water developments.

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263. EFFECTS OF WESTERN JUNIPER REMOVAL ON SOIL MOISTURE AND VEGETATION PRODUCTIVITY IN WET MEADOW HABITATS. Timothy C. Keeseey^{*1}, David Lile²; ¹Honey Lake Valley Resource Conservation District, Chico, CA, ²U.C. Cooperative Extension, Susanville, CA

ABSTRACT

Little research has been conducted on how western juniper directly influences specific components of the water budget for a given watershed. Yet juniper control projects often cite increased water availability as an objective, and there is a significant amount of anecdotal evidence indicating that removal of western juniper results in increased water availability, expansion of riparian/meadow habitats, and increased vegetative productivity. For this pilot study soil moisture probes and 1 meter exclusion cages were set up in 2010 in six wet meadow/seeps (< 1 ha in size) surrounded by western juniper (*Juniperus occidentalis*) in Lassen County, CA. Western juniper was removed from upland areas surrounding three of the wet meadow/seep monitoring sites, while the upland juniper stands surrounding the other three monitoring sites were left intact. Data loggers continually monitored soil volumetric water content (m³/m³ VWC) and soil temperature (° C). Vegetation from exclusion cages was clipped and weighed annually. While seasonal soil moisture curves vary by site and by year, effects on soil moisture and vegetative yield due to juniper removal could not be clearly established over the current monitoring period, and may be over-shadowed at least partially due to drought.

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264. UTILIZING FECAL PROFILING VIA NIRS TO COMPARE LEUCAENA LEUCOCEPHALLA AND UROCHLOA MAXIMA PASTURES. Stephanie J. Ficke-Beaton^{*1}, Preston Irwin², Carolyn Wong²; ¹USDA Natural Resources Conservation Service, Hilo, HI, ²USDA Natural Resources Conservation Service, Kamuela, HI

ABSTRACT

In the interest of contributing to the food security, sustainability, and local economics of Hawaii, Kamehameha Schools initiated a forage trial that would compare the addition of *Leucaena leucocephalla*, known in Hawaii as Haole koa, to pastures of *Urochloa maxima*, commonly

called Guineagrass. Ten, five acre paddocks of Urochloa maxima as the dominant forage were constructed and ten, five acre paddocks of Urochloa maxima with Leucaena leucocephala rows were constructed. Each system was stocked with 25 commercial cross bred steers. Once a month and three days after the weekly rotation, composite fecal samples were collected from each group. A total of 24 samples were obtained over a 12 month period. The samples were submitted to Texas A & M Grazing Animal Nutrition Laboratory at the Blackland Research Center in Temple, Texas. The samples were scanned using a near infrared reflectance spectroscopy (NIRS) machine to capture the spectra of the fecal chemistry. The fecal spectra were used to generate dietary crude protein (%CP), digestible organic matter (%DOM), fecal phosphorous and fecal nitrogen. The NIRS/NUTBAL (nutritional balance profile) was used to monitor the nutritional status and the nutrient concentration in the animal's diet. The results from the 24 samples were compared to determine the nutritional difference and/or benefits between the two pasture systems. Other monitoring efforts focused on collecting forage samples, individual weights on each group of steers at the completion of every 10 paddock or 70 day rotation. Individual carcasses were evaluated at harvest using standard USDA beef quality and yield grades.

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265. AN ANALYSIS OF BEAKED SEDGE (CAREX UTRICULATA) STUBBLE HEIGHT AND RECOVERY FOLLOWING HERBIVORY IN NORTHEASTERN ARIZONA. Sarah Noelle*¹, George B. Ruyle¹, Wink Crigler²; ¹University of Arizona, Tucson, AZ, ²XDiamond Ranch, Greer, AZ

ABSTRACT

Beaked sedge (Carex utriculata) is a dominant species within montane riparian meadow communities in northern Arizona and is utilized by both livestock and wild ungulates throughout the growing season. In order to determine the effects of grazing on beaked sedge, we examined grazed and ungrazed stubble height data of beaked sedge from 2 riparian meadow pastures in northeastern Arizona between 2009 and 2014. Measurements were taken prior to, during, and following livestock grazing and throughout the growing season (in ungrazed sites) during years of complete rest. Average stubble heights in both grazed pastures remained greater than the minimum residual heights often suggested in riparian grazing management guidelines. However, both grazed and ungrazed sedge heights were below those now being required for the newly endangered New Mexico meadow jumping mouse. Average stubble heights in non-use years were also at or below recommended average heights, indicating use of riparian areas by wild ungulates. However, percent of plants grazed in all years was generally below 50% indicating utilization levels within those recommended for streamside vegetation. Our data highlight 3 major findings: 1. It is important when, where and how sedge heights are measured in terms of meeting suggested guidelines; 2. Sedges grazed early to mid-growing season will significantly

recover height; and 3. Wild ungulate use may impact meeting any stubble height guidelines in these riparian areas. If stubble heights are used in the grazing management of riparian meadows, we recommend establishing permanent sampling locations, consistent timing of measurement, and identification of key species. We show that managed live-stock grazing in riparian meadows can meet reasonable average stubble height guidelines when grazed by mid-growing season.

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266. APPLICATION OF BLM'S ASSESSMENT, INVENTORY AND MONITORING STRATEGY AT GRAND STAIRCASE-ESCALANTE NATIONAL MONUMENT, UTAH. Kevin H. Miller*¹, Sarah E. McCord², Emily Kachergis³, Brett G. Dickson⁴, Rob DAndrea⁴; ¹BLM, Kanab, UT, ²USDA-ARS, Las Cruces, NM, ³BLM, Denver, CO, ⁴Northern Arizona University, Flagstaff, AZ

ABSTRACT

Grand Staircase-Escalante National Monument (GSENM), a unit of BLM's National Conservation Lands, has been implementing the Bureau's Assessment, Inventory and Monitoring (AIM) strategy over the past two years. The purpose of the strategy is to provide scientifically sound and technically defensible multi-scale monitoring of multiple resource conditions to support management and decision-making. This is done partly through improved probabilistic sampling design and standardized inventory, assessment and monitoring methods. Initially, the strategy has been applied to assess and monitor land health for both land use planning (large scale) and grazing administration (smaller, allotment scale). Applications include determining plant community composition to allow spatially-explicit estimates of forage availability using ecological site descriptions (ESDs), and evaluating options for integrating the existing key area-based monitoring framework with AIM's probabilistic sampling design while preserving the utility of historic data to establish trends in vegetation condition and plant community structure. Results compare forage production estimates from ESDs based on determination of state and community phase from AIM data with those determined from rangeland health monitoring. Results from resampling and simulation modeling of existing non-probabilistic data provide estimates of the temporal and spatial representativeness of those data and allow comparison with those from AIM sampling. Evaluations of allotment condition for grazing management based on existing, key area-based data can be supplemented with AIM data. Future improvements include incorporating remote sensing into sampling design to allow variation in sampling density based on heterogeneity of vegetation condition and plant community composition, and adding indicators of aquatic resource condition. AIM applications on GSENM will eventually extend to support management of other resources such as cultural (archaeological), wildlife and recreational.

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267. LONG-TERM TREND MONITORING METHODS FOR ARID ENVIRONMENTS . Del W. Despain¹, Ashley L. Hall^{*2}; ¹University of Arizona, St. George, UT, ²University of Arizona, yuma, AZ

ABSTRACT

Many vegetation monitoring techniques are often not applicable in extremely dry environments due to low vegetation cover. Typical quadrat and point sampling methods for plant frequency and cover can be problematic in areas with low vegetative cover as they require large quadrat sizes and/or large sample sizes. In arid regions of western Arizona, belt-density and line-intercept cover transects are being used to collect long term trend data for grazing allotments. Belt transects are well suited for sampling density of woody species which dominate these dry environments. Line-intercept transects work well for sampling cover in ecosystems with 5-40% canopy cover which is representative of southwestern Arizona. For trend monitoring, 300ft by 100ft macroplots are established throughout grazing allotments. Sampling of each macroplot is conducted along ten randomly positioned transects. In general, these methods can be applicable to ecosystems with widely scattered vegetation or disturbed areas with low canopy cover.

268. CHALLENGES AND OPPORTUNITIES OF USING SAMPLEPOINT TO SUPPORT RANGE INVENTORY AND MONITORING. Gene A. Fults^{*}; USDA NRCS, Vancouver, WA

ABSTRACT

SamplePoint is software developed by the ARS which grids a range of points for density onto a photograph image, generally a .jpg. The crosshair points can zoom to pixel size so file sizes of at least 3 megabytes are needed. Percent plant, litter, and bare ground cover are easily determined in about 5 minutes per image. Overhead canopy along riparian areas can be captured rapidly for later analysis. Some aspects of functional groups can be interpreted. Rough forage quality green to yellow to brown ratios can be determined. Knowledge of species and expertise in plant identification are helpful but do not fully achieve a reliable frequency assessments from the photos. Especially in taller vegetation. The value of this tools helps support professional judgements when care in sample collection of photos, scale consistency, and lens angles are observed.

269. INTEGRATING RANGELAND AND PASTURELAND ASSESSMENT METHODS INTO A NATIONAL GRAZINGLAND ASSESSMENT APPROACH. David Toledo^{*1}, Matt A. Sanderson², Sarah Goslee³, Jeffrey Herrick⁴; ¹USDA-ARS, Bismarck, ND, ²USDA-ARS, Mandan, ND, ³USDA-ARS, University Park, PA, ⁴USDA-ARS, Las Cruces, NM

ABSTRACT

Grazingland resource allocation and decision making at the national scale need to be based on comparable metrics.

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However, in the USA, rangelands and pasturelands have traditionally been assessed using different methods and indicators. These differences in assessment methods limit the ability to consistently apply land evaluations to land management across geographic boundaries and in areas undergoing land use/land cover change. Our work shows an almost complete consensus among a group of method users that (1) an improved pastureland assessment tool is needed, and (2) both Interpreting Indicators of Rangeland Health and the Pasture Condition Scoring methods play different and yet important roles in grazingland assessments. The Interpreting Indicators for Rangeland Health protocol provides a way to assess and interpret soil and site stability, biotic integrity, and hydrologic function attributes based on ecological potential. The Pasture Condition Scoring protocol provides a framework that could be used to formalize management interpretations based on ecological potential and land use practices that could allow the ecological potential to be exceeded for some indicators. We present a Grazingland Assessment Approach that uses the Interpreting Indicators of Rangeland Health protocol for ecological assessments relative to site potential and a management interpretation protocol that can be used to target management inputs to where they will have the greatest impact. This improved approach will provide consistent assessments at the national scale while allowing the information to also be used to guide management at pasture to watershed scales.

270. CREATING A SIMPLE WEB INTERFACE TO BLM'S NATIONAL RIPARIAN DATABASE USING GEOCORTEX. Melissa D. Dickard^{*1}, Richard Bowen², Sarah Burnett³, Heather Fonda¹, Paul Summers¹; ¹BLM, Denver, CO, ²Nex-Gen Technologies, Denver, CO, ³Sanborn, Denver, CO

ABSTRACT

The Bureau of Land Management (BLM) uses the Proper Functioning Condition assessment (PFC) to determine and report on the condition of riparian areas. This method has been in use since the mid-1990's and consequently data is stored in formats ranging from file cabinets to customized local databases. After creation of a corporate database, the BLM needed a tool to help field users enter and query the data. Direct access through the Arc platform did not prove feasible because of limited ArcGIS technical skills and time to learn and use a customized Arc entry form. Geocortex provides a web-based interface for ArcGIS. It is used to bridge any technical gaps and provides an intuitive and relatively inexpensive user interface, allowing users to interact directly with the data. It is a "widget-builder" approach, which allows relatively easy creation of personalized workflows and look and feel. Once one interface is created, the subsequent projects go quicker because the widgets created for one project can then be modified for another project. For example, once a PFC database interface was created, the BLM used many of the same workflows to create databases for well logs and springs. Because the three databases use similar concepts and tools, users can easily navigate in both web applications

because the environment is similar. The HTML 5 viewer allows for use on all platforms, including mobile devices. Data still can be made available in Arc using map services, so complex queries or data analysis can be completed there.

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271. THE IMPORTANCE OF COLLABORATIVE DATA SHARING: A LOOK AT THE BLM'S NEW NATIONAL MONITORING DATABASE. Sarah F. Lamagna^{*1}, Emily Kacherigis², Matthew R. Bobo²; ¹Bureau of Land Management, Denver, CO, ²BLM, Denver, CO

ABSTRACT

As the Nation's largest land manager, the Bureau of Land Management (BLM) administers almost 260 million acres of public land, nearly 80% of all land in the United States. It is inherently clear that managing these lands for many ecosystem benefits can prove to be very difficult, and sometimes, responsibility is given to only a few natural resource managers to manage several hundred thousand acres of land. In order to more efficiently and effectively meet local, regional, and national needs and to understand the health of the nation's public lands, the Assessment, Inventory, and Monitoring (AIM) Program was created. The AIM strategy gives the BLM an opportunity to collect quantitative information on the status and trend of resources on public lands and addresses different management objectives at multiple scales. Reporting at multiple scales will help inform land managers of the effectiveness of their management actions and provide opportunities for adaptive management. One of the five primary elements of the BLM's AIM Strategy is electronic on-site data capture and centralized data management through BLM's national geospatial infrastructure. As science becomes more data intensive and collaborative, data sharing becomes even more important, especially well-managed, long-term preservation of data. The BLM's AIM Strategy has enabled collaborative use of national monitoring data on rangelands by developing a national database called TerrADat (Terrestrial AIM Database) so that information is readily accessed, aggregated, and shared. Research has found that a large majority of scientists would use other researchers' datasets if they were easily accessible and that the lack of access to data generated by other researchers or institutions is a major impediment to progress in science. TerrADat can provide statistically valid ecosystem monitoring data to a range of land managers and researchers to aid in their adaptive management decisions.

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272. MULTI-SCALE ECOSYSTEM MONITORING: AN APPLICATION OF SCALING DATA TO ANSWER MULTIPLE ECOLOGICAL QUESTIONS. Sarah E. McCord^{*1}, Darren James¹, Dereck Wilson², Jason W. Karl³, Emily Kacherigis⁴; ¹USDA-ARS, Las Cruces, NM, ²Bureau of Land Management, Redding, CA, ³USDA ARS Jornada Experimental Range, Las Cruces, NM, ⁴BLM, Denver, CO

ABSTRACT

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Standardized monitoring data collection efforts using a probabilistic sample design, such as in the Bureau of Land Management's (BLM) Assessment, Inventory, and Monitoring (AIM) Strategy, provide a core suite of ecological indicators, maximize data collection efficiency, and promote reuse of monitoring datasets to address multiple ecosystem concerns at multiple scales. Our objective is to apply multi-scale monitoring data to answer questions related to overall landscape health, post-fire grazing closures, and emergency stabilization and rehabilitation (ES&R) treatment effectiveness in northern California and northwestern Nevada. To meet this multi-scale objective, we deployed the AIM strategy at three spatial scales and intensities: low-intensity landscape sampling across the study area, medium-intensity sampling of the nine livestock grazing allotments which intersected the Rush Fire of 2012 (610,345 acres), and high-intensity sampling of ES&R treatments within the fire boundary (2,558 acres). Terrestrial plots were established within a probabilistic sampling framework, and the BLM core indicators were measured at each plot (n=205) in 2013. At the landscape scale, indicator estimates varied with ecological potential, disturbance history, and land use. The sample points were then subset to answer management questions at local scales. ES&R treatment effectiveness plots (n=28) were found to have high bare ground, low foliar cover, and low perennial plant density. When we applied the data (n=106) to answer post-fire livestock grazing monitoring questions, low perennial grass cover and high bare ground indicate insufficient recovery 1 year after the fire to support extensive livestock grazing. We also found that uncertainty increased with increased scale and decreased sampling density. This multi-scale monitoring approach maximizes efficiency in data collection, analysis, and reporting by acquiring the same ecological information at each scale and reusing data at each scale. This will enable land managers to efficiently and effectively collect monitoring data to inform decision making.

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273. GEOSPATIAL ASSESSMENT OF FIRE, CHEATGRASS, AND CLIMATE CONDITIONS IN THE GREAT BASIN ECOREGION. Esther Essoudry^{*1}, Oliwia Baney², Cheryl Cary³, Juan Torres-Perez⁴; ¹NASA DEVELOP Program, Alameda, CA, ²NASA DEVELOP Program, Los Altos, CA, ³NASA DEVELOP Program, Oakland, CA, ⁴Bay Area Environmental Research Institute, Mountain View, CA

ABSTRACT

The Great Basin of the western United States represents one of the last large expanses of wildlands in the nation. This ecoregion is home to a variety of native endemic species, and supports some of the oldest organisms alive today. Sagebrush shrub-steppe is home to the Greater Sage-Grouse, which is under consideration for federal protection. However, this desert biome is currently facing significant ecological change. Of particular concern is the spread of the invasive species *Bromus tectorum*, or cheatgrass, which has the ability to displace ecologically crucial native plants such as sagebrush. Extreme precipitation

events, coupled with increases in frequency, duration, and magnitude of fire events, may lead to significant increases of cheatgrass, triggering both ecological and economic impacts in the region over time. This project provided a set of analytical tools and methods for researchers and land managers to quantify and mitigate these changes in the Great Basin ecoregion. The northern section of the Great Basin, accounting for 30% of the ecoregion, was analyzed using remotely-sensed imagery, modeled geospatial data, and in-situ data. This project created a set of maps and values correlating annual cheatgrass spread to fire activity. Correlations were also performed with historical precipitation, temperature, and soil water storage provided by the Basin Characterization Model (BCM). These correlation maps and results provide a low-cost means for land managers to assess landscape condition, and a repeatable methodology for monitoring landscape changes and consider more focused conservation efforts.

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274. USING RANDOM FOREST TO ESTIMATE POTENTIAL CHEATGRASS AND PERENNIAL HERBACEOUS COVER FROM SITE ENVIRONMENTAL CHARACTERISTICS. Nathan L. Cline*¹, Bruce A. Roundy¹, Chris Bolzotti²; ¹Brigham Young University, Provo, UT, ²University of Utah, Provo, UT

ABSTRACT

Developing geospatial estimates of potential cheatgrass (*Bromus tectorum* L.) and perennial herbaceous cover following fire and fire surrogate treatments has been challenging due to high variability in climate and site environmental characteristics. The advancement of geospatial climate models and analysis tools, such as BIOCLIM and Random Forest, may provide opportunities for applicability to this problem. We conducted a Random Forest analysis to spatially estimate cheatgrass and perennial herbaceous cover using 43 site environmental characteristics as explanatory variables. Site environmental characteristics were derived from 5 m digital elevation models (DEM), BIOCLIM, and ClimateWNA geospatial data sets. Cheatgrass and perennial herbaceous cover were previously collected at 45 wooded (*Juniperus* spp.) shrublands (*Artemisia* spp.) in Utah. We used Random Forest and ModelMap for R statistical software to conduct the analysis. Preliminary analysis indicates a hierarchy of influential site environmental characteristics that included elevation, mean precipitation and mean temperature of the wettest quarter of the year. These site environmental characteristics and a geospatial map of potential cheatgrass and perennial herbaceous cover may aid managers in determining which sites are more or less resilient to woodland reduction treatments or which sites may require the addition of plant materials for successful restoration.

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275. MONITORING INVASIVE WEEDS USING AERIAL AND GROUND LEVEL VERY HIGH RESOLUTION IMAGERY ACROSS EXTENSIVE RANGELAND. Stephen K. Ndzeidze*; Oregon State University, Corvallis, OR

ABSTRACT

Using very high resolution remote sensing to monitor invasive weeds is an increasingly high priority for rangeland researchers across the United States. In the western United States, invasive weeds such as medusahead (*Taeniatherum caput-medusae* (L.) Nevski) are transforming vegetation communities by establishing small localized infestations. Monitoring through detection and mapping of infestation is very important to understand the rate of infestation and spread. Recent developments in digital imaging, GPS technology, and computer technology have provided new opportunities to speed the collection, processing and storage of field data. This study focuses on how the rate of infestation across extensive rangelands can be accurately estimated using data collected within a strict protocol from GPS-positioned, digital color aerial and ground level photography. Images were collected using Nikon 200, 16 megapixel fitted with a 24mm lens. This study employs a continuously recording GPS device, digital camera, and a computer to acquire and manage information. Photographs were taken at 5-second intervals while the aircraft flew a grid over the study area approximately 1500m above ground level. For ground level imagery, photographs were taken on transects where infestations were identified. The position of the aircraft was monitored at one-second intervals via two recording GPS units. Aerial and ground level images had a ground pixel resolution of 0.35 m and 0.0004717 m respectively. Ground photo locations were also used as training sites to assign spectral values (red, green and blue) for use in image classification. Images were classified using VegMeasure 2 software and analysis was supported by ArcGIS and GlobalMapper

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276. USING REMOTE SENSING TO MAP AND ESTIMATE DEGRADATION IN SAVANNA GRASSLANDS IN CAMEROON . Stephen K. Ndzeidze*¹, Richard A. Mbih², Gilbert F. Bamboye³, Harry M. Wirngo³, Carine S. Bongadzeem³; ¹Oregon State University, Corvallis, OR, ²University of Missouri-Kansas City, Kansas City, MO, ³University of Yaoundé 1, Yaounde, Cameroon

ABSTRACT

The use of remote sensing to monitor and estimate the rate of savanna degradation is becoming an increasingly high priority for rangeland researchers across Sub-Saharan Africa. Over the past three decades, remote sensing, geographic information system (GIS), and landscape ecology methods have been gradually integrated to estimate degradation in savanna grasslands. It is important to have quantitative data demonstrating the magnitude of change so that rational land use strategies can be formulated and implemented and root causes of degradation addressed. To extract mapping

features, this study utilizes Landsat multispectral scenes change-detection and Google images. Landsat scenes between 1973 and 2013 were used for targeted vegetation detection with the Spectral Angle Mapper (SAM) algorithm in Exelis Visual Information Solutions (ENVI) software. Locations with the greatest loss of vegetative cover were identified and mapped as zones experiencing extreme rangeland change. These zones occur particularly above 1,500m elevation, where abundant precipitation and multiple anthropogenic agropastoral influences have significantly transformed the agrarian landscape. Camaroon's Western High Plateau is covered by "prairie" grass savanna vegetation that constitutes very rich pasture for grazing. However, with expanding human and animal populations, land use conflicts between resident farmers and grazers have occurred due to overgrazing, expansion of invasive weeds, conversion of rangelands to farmland, and deforestation.

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277. THE IMPACT OF LAND USE ON THE 3D STRUCTURE OF VEGETATION AND SOILS IN A COLD DESERT ECOSYSTEM IN JORDAN. Robert A. Washington-Allen^{*1}, Mounir Louhaichi², Kathryn Clifton Ramirez², Motasem Elkayed³, Zeyad Makhamreh³, S. "Iris" Hassan²; ¹University of Tennessee, Knoxville, TN, ²International Center for Agricultural Research in Dry Areas, Amman, Jordan, ³University of Jordan, Amman, Jordan

ABSTRACT

Drylands cover 41% of the world's terrestrial land surface and provide \$1 trillion in ecosystem goods and services to 36% of the global human population, yet the degree of degradation in this ecosystem is unknown. We conducted a paired plot study during peak summer temperatures (mean of 32° C) in July of 2014 in the cold salt desert shrub steppe ecosystem of the East Bank Plateau of Amman, Jordan. We used a FARO Focus 3D 905-nm terrestrial laser scanner (TLS) at approximately 7-cm spacing between scan lines and a range accuracy of ±2 mm in a paired plot design to compare the impact of restoration/conservation management to open access land-use on the 3D structure of vegetation and soils. The restored site was planted with native shrubs and the terrain was treated with slope contouring. The open access site is subject to both subsistence cropping and livestock grazing. Both sites are on saline Inceptisols and Aridisols that derive from salt playa/basin landforms at elevations ranging between 860-m to 890-m above sea level. Analysis of a 10-cm pixel TLS generated digital canopy height model indicated less vegetation cover on the open access site, compared to the restored site. Topographic analysis of a TLS generated 10-cm ground digital elevation model for both sites indicated greater surface roughness for the restored site, suggesting the open access site was more susceptible to wind and water driven sediment loss as confirmed by water catchment sediment traps at both sites.

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*Presenter

278. USING DUAL-WAVELENGTH TERRESTRIAL LASER SCANNING TO DETECT MICRO-CHANNELS OR RILLS CREATED BY CATTLE USE. Zachariah T. Seiden, EL, Robert A. Washington-Allen*, John J. McNelis, Kyle L. Landolt, John S. Schwartz; University of Tennessee, Knoxville, TN

ABSTRACT

Cattle trailing and trampling can create rilling in areas of concentrated cattle movement. These rills can convey runoff and pollutants to streams, leading to impacts on water quality and public health. The number of rills at a site has been suggested as an indicator of water erosion and loss of site quality. Thus it is helpful to identify cattle paths in drylands to evaluate the amount of sediment loss from each site. Identification of erosion rills from remote sensing products has proven difficult because these features typically occur at resolutions finer than publicly available aerial or satellite imagery. Additionally, the 10- to 30-meter pixel resolution of digital elevation models (DEMs) is too coarse to discern impacts from rills, which scale at between 5 to 30 cm. We addressed this problem by surveying a commercial livestock grazing site in the Oostanaula watershed in Sweetwater, TN, with both a 532-nm Leica Scanstation C-10 and a 905-nm FARO Focus 3D 330X Terrestrial Laser Scanner (TLS). We established both control and impacted catchment sites to collect Total Suspended and Dissolved Solids (TSS & TDS). We scanned at 5 locations, registered these scans, and generated a 1-cm resolution digital terrain model (DTM). We used the ratio of the 905-nm to 532-nm intensity scans, a simple ratio vegetation index to discriminate and remove vegetation from bare ground in rills. We delineated the flow paths and flow directions of water in cattle rills and thus detected the preferential flow path of erosion to the catchments, as well as a count of the number of rills in the field. We used freely available aerial photography from the USDA Farm Services in Google Earth to successfully verify the number and location of cattle rills.

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279. LOW-COST WIRELESS SALINITY SENSORS FOR RUNOFF CHARACTERIZATION AND WATER QUALITY MONITORING. Sandra Y. Li^{*1}, Todd R. Adams², Sayjro K. Nouwakpo³, Mark A. Weltz⁴; ¹USDA-ARS-GBRRU, Reno, NV, ²University of Nevada Reno, Reno, NV, ³University of Nevada, Reno, Reno, NV, ⁴USDA ARS, Reno, NV

ABSTRACT

The ability to dynamically measure the electrical conductivity of runoff is key to many hydrologic applications including hydraulic property characterization and solute transport quantification. In applications requiring a large number of wireless conductivity sensors, the limited availability and high cost of commercial options can make deployment prohibitive. Here, a low-cost, rugged, and precise wireless sensor network system has been developed to measure runoff electrical conductivity in the field and laboratory. The sensing module is designed around an inexpensive microcontroller generating an alternating voltage to excite the two measurement

electrodes. Each microcontroller is coupled with a Radio Frequency (RF) module which sends the measured data to a data collection RF module connected to a commercial datalogger. Laboratory tests in static salt solution columns showed that changes in salt concentration of 0.01 mg/ml were detected by the devices. The system has been successfully used to trace a pulse input of salt for runoff flow velocity measurement, and is routinely used to monitor native salt detachment and transport from saline rangeland erosion plots during rainfall simulation experiments.

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280. USING JOURNALMAP TO IMPROVE DISCOVERY AND VISUALIZATION OF RANGELAND SCIENTIFIC KNOWLEDGE. Jeffrey K. Gillan¹, Jason W. Karl^{*2}, Ashley Galera¹; ¹Jornada Experimental Range, Las Cruces, NM, ²USDA ARS Jornada Experimental Range, Las Cruces, NM

ABSTRACT

Most of the ecological research conducted around the world is tied to specific places; however, that location information is locked up in the text and figures of scientific articles in myriad forms that are not easily searchable. While access to ecological literature has improved dramatically in the digital age, the ability to find out what is known about a specific place is hindered by current search technologies that still rely primarily on key word, topic, text, and author searching. Tools for discovering and evaluating ecological studies have largely focused on the what of research while downplaying the where. This is somewhat surprising given the strong spatial focus of ecology and the growing number of powerful map-based search and analysis tools that are readily available. To address these needs we created JournalMap (<http://www.journalmap.org>), a map-based scientific literature database and search engine. With JournalMap we use study area descriptions from the article to map where the research was actually conducted. We demonstrate the value of map-based knowledge discovery with three examples: a time-series visualization of sage-grouse (*Centrocercus urophasianus*) knowledge from over 300 articles, an assessment of the omission and commission errors associated with topical searching for articles within the Chihuahuan Desert, and mapping patterns and biases of rangeland research knowledge from over 1,500 articles from Rangeland Ecology and Management and the Journal of Arid Environments. These three examples illustrate how map-based search engines can improve knowledge discovery and reveal gaps in ecological knowledge. JournalMap's goal is to encourage the science community to improve location reporting in peer-reviewed literature and increase the discoverability of relevant scientific knowledge through web mapping interfaces.

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*Presenter

281. NEW LOOK, TRENDING TOPICS, MORE CONTENT, MOBILE RESPONSIVE: RE-LAUNCHING THE RANGELANDS PARTNERSHIP PORTALS. Barbara S. Hutchinson^{*1}, Amber Dalke¹, Sarah Noelle¹, Beth Burritt², Jeanne Pfander¹; ¹University of Arizona, Tucson, AZ, ²Utah State University, Logan, UT

ABSTRACT

An "optimization" grant from eXtension allowed The Rangelands Partnership and the eXtension Rangeland Stewardship and Health (RSH) Community of Practice to gain user feedback on how to improve and better integrate their web portals. Through discussions and surveys of Partnership members as well as through a series of stakeholder focus group sessions, information was gained to initiate an extensive redesign effort. Following months of meetings and fine-tuning, Global Rangelands (<http://globalrangelands.org>), Rangelands West (<http://rangelandswest.org>), and eXtension Rangelands (<http://www.extension.org/rangelands>) will officially launch their new looks, improved navigation, expanded content, and mobile responsive design in early 2015. While retaining easy access to more than 15,000 resources to serve multiple audience's research, education, and Extension information needs, new features will include (1) content from SRM (meeting abstract archive), GSSA (journal article abstracts), FAO full-text documents, a Teaching Curriculum Clearinghouse, and many more fact sheets and videos (<https://www.youtube.com/user/GlobalRangelands/playlists>); (2) comprehensive pages on "Trending Topics" such as wolf reintroduction, wild horses and burros, and sage grouse; (3) higher visibility for educational resources including "Careers and Education", "Distance Course Catalog" and teaching tools for all ages; and (4) mobile responsive design for Global Rangelands and Rangelands West. News on the re-launching of the portals and their new capabilities will be announced through the Partnership's social media outlets including Facebook page <https://www.facebook.com/RangelandsWest> and Twitter <https://twitter.com/RangelandsPartn>.

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282. CHARACTERIZATION AND COMPARISON OF VEGETATION ON DAKOTA SKIPPER INHABITED AND EXTIRPATED SITES IN SOUTH DAKOTA . Diane M. Narem^{*1}, Lan Xu², Gary Larson², Dave Ode³; ¹South Dakota State University, Brookings, SD, ²South Dakota State University, Brookings, SD, ³South Dakota Game Fish and Parks, Pierre, SD

ABSTRACT

Native prairie continues to disappear due to conversion and degradation, putting pressure on endemic prairie species such as the Dakota skipper (*Hesperia dacotae*). In South Dakota, the Dakota skipper, proposed to be listed as a federally threatened species, is relegated to small remnants of high quality dry-mesic native prairie. Populations have been found to decrease or disappear in response to changes in vegetation composition and management practices. To bet-

ter understand the components of suitable Dakota skipper habitat, the vegetation, land management and size of eight occupied and six extirpated sites were characterized and compared. Vegetation sampling consisted of 50-m transects subjectively placed on or near former Dakota skipper survey points or tracks. Six 1-m² quadrats were placed along transects on alternate sides at every 10 m. Within each quadrat, litter depth was recorded and bare ground and species cover were estimated using Braun-Blanquet cover classes. Management history for each site was obtained. Site size was determined using a combination of aerial imagery and ground-truthing. Roads, water bodies, wetlands, crop fields, woodlands, and non-native prairie were used to define edges of sites. NMS ordination of transects showed a difference in vegetation composition between extirpated and inhabited sites with the exception of two extirpated sites. Small site size and early haying were identified as major factors possibly contributing to decline at these two extirpated sites. Consequently, vegetation degradation is apparently not the only factor in Dakota skipper population decline, but critical minimum habitat size combined with timing of management practices probably play a role as well.

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283. THE EFFECTS OF GRAZING ON BREEDING POPULATIONS OF SPRAGUE'S PIPITS IN WESTERN NORTH DAKOTA. Brian J. Chepulis^{*1}, Edward S. DeKeyser¹, Lawrence D. Igl²; ¹North Dakota State University, Fargo, ND, ²United States Geological Survey, Jamestown, ND

ABSTRACT

Trend analysis from the North American Breeding Bird Survey indicates that the Sprague's Pipit (*Anthus spragueii*) is experiencing a severe population decline (4.1% annually). This drastic population decline has led to the listing of the Sprague's Pipit as a candidate species under the Endangered Species Act in 2010. The Little Missouri National Grasslands in North Dakota are listed as an important breeding area for the Sprague's Pipit and other sensitive grassland birds. With a major reduction in fire frequency in this region, livestock grazing has increasingly played a larger role in the structuring of grassland communities. The timing and intensity of grazing by livestock influence vegetation structure, composition, primary productivity, and ultimately Sprague's Pipit occurrence and abundance. Our objectives were to evaluate effects of livestock grazing on vegetation structure and composition, grassland bird density, and grassland bird diversity and community composition. Sixty study sites (i.e., legal quarter-sections) were selected using random stratified sampling. Sites were surveyed twice during the summer of 2014 using a modified transect survey to evaluate grassland bird presence and abundance. To capture the vegetation structure at the time of the bird surveys, we also collected data on vegetation structure (e.g., VORs, maximum vegetation height, and litter depth) and biomass at each study site on or near the day of each bird survey. Sprague's Pipits also have been found to closely associate with native vegetation throughout their breeding range. To

test this we sampled site plant communities using modified Whittaker plots to detect species richness and diversity as well as using ocular estimation to determine percent cover. Preliminary results show that livestock grazing does influence vegetation structure, thus affecting grassland breeding bird density and community composition. Our data also suggest that vegetation structure, and not composition, influences the occurrence of Sprague's Pipits.

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284. GREATER SAGE-GROUSE HABITAT SUITABILITY ASSESSMENT ON HISTORICAL CRESTED WHEATGRASS SEEDINGS IN SOUTHEASTERN OREGON. Eytchison Michael^{*1}, Lesley Morris², Thomas A. Monaco³, Elizabeth A. Leger⁴, Shawn McKay¹; ¹Oregon State University, La Grande, OR, ²SRM, Bismark, SD, ³USDA, Agricultural Research Service, Logan, UT, ⁴University of Nevada Reno, Reno, NV

ABSTRACT

In 1962, Congress allocated \$16.2 million for range rehabilitation to the Vale Oregon District of the Bureau of Land Management (BLM). The Vale Rangeland Rehabilitation Program (VRRP) was offered as a solution to deteriorating public rangelands. Over the next 15 years the VRRP conducted brush control by plowing or spraying (primarily 2-4, D) and seeding of 773,000 acres to crested wheatgrass (*Agropyron cristatum*). Even though wildlife experts contributed to the program, the focus was on traditional land use, stock-raising. Since that time, attention has shifted to conservation of the greater sage-grouse (*Centrocercus urophasianus*). Sage-grouse have large ranges with different habitats for different times of the year, requiring a mosaic of ecological sites. Unfortunately, 50 years later, little is known about how these historical seedings will serve as habitat. We conducted a study of sage grouse late brood-rearing/summer habitat on 15 sites in 7 seedings from the VRRP ranging in size from 1,800 - 4,500 acres and spanning 5 different ecological sites. All of the seedings were classified as preliminary priority habitat by the BLM and surrounded about 17 mapped lekking locations. We measured sagebrush canopy cover, height, and shape and perennial and annual grass, forb, and crested wheatgrass cover. Habitat potential was ranked as suitable, marginal, or unsuitable according to the BLM's Sage-grouse Habitat Assessment Framework. Suitability varied within an ecological site and within the same seeding that crossed different ecological sites, regardless of sprayed or plowed treatment. Of the sites evaluated 6 were suitable, 4 marginal and 5 unsuitable. Our findings suggest that managers will need to account for land-use history and ecological site classification when developing sage-grouse habitat conservation plans.

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**Presenter*

285. SAGE GROUSE CONSERVATION THROUGH PRIORITIZATION AND COLLABORATION IN NORTHEAST CALIFORNIA. Tiffany M. Russell*¹, Andrew Johnson², Susan Abele³, Heidi Ramsey⁴; ¹Point Blue Conservation Science, Susanville, CA, ²Bureau of Land Management, Susanville, CA, ³U.S. Fish and Wildlife Service, Reno, NV, ⁴Natural Resources Conservation Service, Susanville, CA

ABSTRACT

The Greater Sage-Grouse's decline and potential listing under the Endangered Species Act has created a flurry of conservation activity across western rangelands. However, with such large areas in need for restoration, and with multiple threats affecting the habitat, it can be difficult to know how to prioritize these conservation actions. In Northeast California, the Buffalo Skedaddle Population Management Unit Working Group is attempting to sort through the cacophony and develop specific conservation projects that will provide real on the ground benefit for the Greater Sage-Grouse and the sagebrush ecosystem. With the recently published General Technical Report 326, Using Resistance and Resilience Concepts to Reduce Impacts of Invasive Annual Grasses and Altered Fire Regimes on the Sagebrush Ecosystem and Greater Sage-Grouse: A Strategic Multi-Scale Approach and the BLM's Wildfire and Invasives Annual Assessment process, the working group is analyzing their region of interest at multiple scales with soil moisture and temperature, existing sagebrush, threat of juniper encroachment, and existing sage grouse breeding bird densities. Once priority areas and probable actions have been developed through this model, groups of landowners, natural resource professionals, and other interested community members will use local knowledge to analyze the limiting factors for each population in these priority areas. Some practices the group plans to use include fire breaks, green stripping, juniper removal, and grazing management. Funding will be sought for restoration actions through NRCS's Sage Grouse Initiative, the BLM, USFWS Partners for Wildlife program, and other private and public sources. Monitoring of projects after implementation will occur to adaptively manage the plans and ensure success criteria is met. Through this approach, the Buffalo Skedaddle Group believes they will cooperatively improve habitat in key areas that will produce Sage-Grouse population effects across public and private lands.

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286. NON-INVASIVE ASSESSMENT OF MULE DEER DIET QUALITY ON THE KAIBAB PLATEAU IN NORTHERN ARIZONA. Doug Tolleson*¹, Matt Williamson², Steve Rosenstock³, Christopher R. Bernau¹, Stephen Prince⁴, Jay Angerer⁵; ¹University of Arizona, Camp Verde, AZ, ²Grand Canyon Trust, Flagstaff, AZ, ³Arizona Game and Fish Department, Flagstaff, AZ, ⁴Texas A&M University, Temple, TX, ⁵Texas A&M University, College Station, TX

ABSTRACT

We applied near infrared spectroscopy (NIRS) to feces collected from free-ranging mule deer (*Odocoileus hemi-*

onus) on the western Kaibab Plateau, north of the Grand Canyon, to evaluate its applicability as a management tool. This historically and ecologically significant deer herd annually moves along an elevational gradient; wintering in the Western North Kaibab Woodland at ~1800m asl and spending summers in the Kaibab Plateau Forestland at ~2400m asl. Predominant woodland species include Utah juniper (*Juniperus osteosperma*), Gambel oak (*Quercus gambelii*), cliffrose (*Purshia mexicana*) and big sagebrush (*Artemisia tridentata*). Ponderosa pine (*Pinus ponderosa*), Aspen (*Populus tremuloides*), and mixed conifer dominate the higher elevation forest with an understory that includes grasses such as blue grama (*Bouteloua gracilis*) and squirreltail (*Elymus elymoides*) with forbs such as yarrow (*Achillea millefolium*) and cinquefoil (*Potentilla* spp.). Winter diet is considered to be the limiting factor for this herd. Many techniques to acquire nutritional information on herbivores require invasive techniques or close observation. Fecal pellet groups contain information about deer diets. We collected fecal pellets during March to September in 2012 and January to September in 2013. Diet crude protein (CP) and digestible organic matter (DOM) as well as fecal nitrogen (N) and phosphorus (P) were predicted with NIRS calibrations developed using white-tailed deer (*Odocoileus virginianus*), elk (*Cervus elaphus*), domestic sheep (*Ovis aries*) and domestic goats (*Capra hircus*). Year and month affected diet quality ($P < 0.05$). NIRS-predicted diet CP and DOM varied greatly between calibrations. Mahalanobis distance (H) values indicated that these mule deer samples were not closely related to the existing elk, deer or domestic animal calibrations (i.e. all > 10.0). Samples from this herd should be added, however, H values from multi-species fecal N calibrations were 4.5 ± 0.5 , indicating that this calibration can be used to evaluate fecal N in west Kaibab mule deer.

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287. MERGING WILDLIFE HABITAT AND RANGELAND MONITORING TECHNIQUES FOR RESOURCE EFFICIENCY. Glenn C. Owings*¹, Joshua Hemenway², Loren Racich¹, Daren Many¹; ¹Sublette County Conservation District, Pinedale, WY, ²BLM, Pinedale, WY

ABSTRACT

Agency personnel are tasked with monitoring thousands of acres each field season. Due to constraints on time and finances, using efficient and informative monitoring techniques is paramount. In an effort to streamline data collection efforts, the authors sought to determine if a simple addition to the Daubenmire vegetative cover technique could be used to adequately monitor forb density for the Bureau of Land Management Sage-Grouse Habitat Assessment Framework. The study area was located in eastern Sublette County, WY, USA. The landscape is characterized by sagebrush steppe and associated ecosystem components. In order to minimize the influence of differing soil and precipitation regimes on study results, all sampling was restricted to a 230 acre area represented by a single ecological site. Within that area, ten sites were randomly selected (n=10).

At each site, one 150' line was established. One team of two observers recorded the total forbs by species in each of 30, 20x50cm Daubenmire frames. Concurrently, another team of two observers recorded total forbs by species using the currently applied belt method (50' x 1m). Diversity and evenness estimates were calculated for each method using the Shannon-Weiner diversity index. Because observations were dependent, a paired-t test was used to determine if there were differences in forb density and diversity index values between sampling methods. Differences were considered significant when $p < 0.05$. The modified Daubenmire method yielded higher forb density (32/m²) and diversity estimates (0.73) compared to the belt method (9/m², 0.64). Differences for both comparisons were statistically significant. Based on these results, it is recommended that the BLM adopt the modified Daubenmire method as a way to seamlessly incorporate a required sage grouse habitat metric into range monitoring protocol.

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288. GRAZEKEEPER - PLANNING AND RECORD-KEEPING SYSTEM FOR ALL LIVESTOCK GRAZING. Tyrrell Hibbard*; Montana GLCI, Helena, MT

ABSTRACT

The Montana Grazing Lands Conservation Initiative (GLCI) spearheaded the development of GrazeKeeper to address the cumbersome nature of keeping and reviewing grazing records. GrazeKeeper allows ranchers to plan, record, and organize grazing activities in a manner that allows reports to be created and pulled at will. GrazeKeeper is a web-based software program that helps ranchers inventory pastures and livestock, measure degree of grazing on plants, track livestock movements, and most importantly to query reports for livestock movements by pasture or management group, while providing a visual and actual record of available forage. Ultimately, GrazeKeeper organizes grazing data to help ranchers determine if planned livestock movements are sustaining, impeding, or stimulating the grazing resource on the ranch. The program acts as a planning tool for livestock movements, and allows users to provide as much additional detail as desired. GrazeKeeper's planning feature can be adjusted in real-time to allow for any changes in planned management as they occur on the ground, such as drought, fire, or pasture quality. The feature interfaces with a tracking tool to record actual dates, movements, and grazing severity. The program also harnesses the National Oceanic Atmospheric Administration's (NOAA) National Weather Service to provide automatic weather capture for locations identified with a Google Earth mapping feature. When the plans are in place, the program allows the user to query the input data/information to generate reports by specific pasture and/or management groups. GrazeKeeper will help determine the effectiveness/feasibility of managing grazing lands, allowing managers to make sound decisions and maximize economic returns for managing their ranch. Additional information on GrazeKeeper can be found at <https://www.grazekeeper.com/>.

*Presenter

289. UCCE LIVESTOCK & RANGE SHEEP INFORMATION WEB PAGE. John M. Harper*¹, Ryan F. Keiffer¹, Melvin R. George²; ¹University of California, Ukiah, CA, ²University of California, Davis, Sacramento, CA

ABSTRACT

University of California Cooperative Extension (UCCE) and UC Agriculture Natural Resources (UC ANR) information on rangelands and grazing animals has centered on practical applied research to solve past and current issues associated with management of California's vast range natural resources. In a continuing effort to make this information available in a digital form that is easily searched by livestock species and topics we have created a third web page focusing on range sheep production, management, health and nutrition. This poster describes and provides an overview of this valuable extension web page effort. It is part of the larger UCCE Livestock & Natural Resources Web site that is further linked to California Rangelands, Rangeland Partnership and Global Rangelands.

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290. FORAGE QUALITY AND WEANING WEIGHT INFLUENCES GRASS-FINISHED CATTLE PERFORMANCE AND MEAT QUALITY. Mark Thorne*¹, Glen Fukumoto², Yong-Soo Kim³, Chin N. Lee³, Matthew Stevenson⁴, Melelani Abran⁵; ¹University of Hawaii - Manoa, Kamuela, HI, ²University of Hawaii at Manoa, Kealahou, HI, ³University of Hawaii-Manoa, Honolulu, HI, ⁴University of Hawaii at Manoa, Lihue, HI, ⁵University of Hawaii-Manoa, Kamuela, HI

ABSTRACT

For over twenty-five years, Hawaii has exported its annual calf crop to mainland stocker-finisher programs. The increasing cost of shipping calves has sparked interest in grass-finished beef production. However, successful grass-finished beef production requires different management tactics than conventional stocker-feeder programs. Grass-finish beef quality is a function of genetics, forage quantity and quality over the production cycle, age of animal at slaughter, and climatic conditions that affect forage production and animal performance. University of Hawaii research indicates that the ideal Live Weight-Age ratio of grass-finished beef cattle is 27.2; corresponding to a 544 kg animal slaughtered at 20 months with a frame score of 5. This translates into an average daily gain of 0.91 kg/day. To achieve this rate of gain grazing animals must have access to adequate high-quality forage throughout their production cycle. However seasonal variation in forage productivity makes this very difficult. Alternatively, delaying weaning until calves reach a heavier weight allows continued growth at a higher rate of gain than on grass alone thus reducing the overall length of time grass-finish animals need access to high-quality forage. In 2011 a research project was initiated to evaluate the effect of weaning weight on animal performance and carcass quality. Yearly, 12 steers and 12 heifers were randomly selected from the University of Hawaii production herd and assigned to one of three weaning weight groups of 272, 227,

or 181 kg. Post weaning the animals were grazed together in low-intensity short-duration grazing system with a stocking rate ranging between 10 (beginning) and 24 AUD/ha (ending). Forage samples were collected monthly and analyzed for quality. Animals were weighed monthly and slaughtered at approximately 20 months of age. Carcass quality of each animal was scored and meat tenderness assessed. Results suggested that heavier weaning weights positively influenced ADG and carcass quality traits.

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291. ASSESSING DUNG BEETLE COLONIZATION IN THE DECOMPOSITION OF A DUNG PAT. Matt J. Judkins*¹, Martha Mamo², Ana B. Wingeyer², Kenneth S. Evans²; ¹University of Nebraska-Lincoln, Ankeny, IA, ²University of Nebraska-Lincoln, Lincoln, NE

ABSTRACT

Dung beetle activity has been associated with decreased time of dung pat decomposition, higher forage yield, and increased nutrient incorporation in soil. The objectives of the experiment were to test methods of assessing dung beetle colonization and evaluate the quantity and type dung beetles colonizing dung pat. This experiment is part of a larger project at the University of Nebraska-Lincoln Barta Brothers ranch, evaluating how dung beetles influence dung rate of dung pat decomposition, greenhouse gas flux, and soil nutrient dynamics. Dung pat, 20-cm in diameter, were placed in the field with or without screen to exclude dung beetles in Harvest time 1-6(days 1 through 56) replications. Dung pat were harvested after 4 days harvest time 2 days and tested for dung beetle presence using several methods. The methods were manual search, flotation, manual search before flotation, flotation followed by search in supernatant, and manual search plus flotation plus search in supernatant. The results showed that flotation followed by search of supernatant to be fastest and most effective method to quantify dung beetle number and type. Funds for this project were provided by the USDA National Institute of Food and Agriculture (USDA-NIFA).

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292. USING WET DISTILLERS GRAINS AS A LATE SEASON PROTEIN SUPPLEMENT FOR GRAZING STEERS. Keith Harmony*¹, John R. Jaeger²; ¹Kansas State University, Hays, KS, ²Kansas St. University, Hays, KS

ABSTRACT

Steers grazing on Kansas shortgrass rangelands achieve 55% of their total season gain during the first half of the grazing season and 45% during the last half. To attain a higher rate of gain during the last half of the season, protein supplementation was implemented to improve the digestibility of late season forage. It was hypothesized that wet distillers grains plus solubles (WDGS) could be used as a replacement for a mixture of finely rolled milo and soybean meal supplement as a late season crude protein (CP) source. Steers were stocked continuously season-long at a rate of

3.5 ac/steer, or 0.95 animal unit months (AUM)/ac, from May through October. During the last half of the grazing season, animals were supplemented at 1.0 lb dry matter/hd/day with a finely rolled milo and soybean meal mix in a 1:1 ratio, with WDGS, or were fed no supplement. The milo:soybean meal mixture was fed in a bunk, while the WDGS was fed in two treatments, either in a bunk or on the ground on shortgrass vegetation. Gains during the early season in were similar among treatments before being fed supplement. During the last half of the grazing season, animal gains were greater for the WDGS supplemented groups fed in the bunk compared to the no supplement groups. All supplemented animals had similar gain. For the whole grazing season, steers fed a late season supplement gained 17-30 lb/hd more than the unsupplemented group. Animals unsupplemented on pasture had similar gain in the feedlot compared to animals supplemented on pasture. Supplement treatment did not affect available forage dry matter in pastures. Wet distillers grains plus solubles can be fed as a late season protein supplement to replace a 1:1 mix of milo:soybean meal.

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293. CHUTE EXIT RATING IMPROVES SEASONALLY AND IS NOT RELATED TO WEIGHT GAIN FOR GRAZING STEERS. Justin Reeves, Justin D. Derner*; USDA-ARS, Cheyenne, WY

ABSTRACT

Between 2011 and 2013, a five category chute exit rating (1 =walk; 2 =trot; 3=bolt; 4=jump; and 5=fall) was assigned to 1643 yearling steers of mixed breeds following release from a hydraulic chute at the USDA-ARS Central Plains Experimental Range (CPER) near Nunn, CO, USA. Ratings were conducted at the beginning (mid-May) and ending (early-October) of each grazing season. Steers were grazed season-long at moderate stocking densities (6.5 ha/steer) on semiarid rangeland, with minimal handling throughout the season. Low-stress cattle handling principles were used for the design of the cattle handling facility, as well as for treatment of steers by handlers. No weight gain differences were observed between different chute exit ratings at the beginning or end of the grazing season, counter to many feedlot studies in which cattle with poor temperaments gain less weight. When comparing chute exit ratings between the beginning and ending of the grazing season, steers were over seven times more likely to be calmer than more agitated. Across all years, 66.3% of steers ended the season with a rating of 1, and only 4.6% of steers finished the grazing season above a rating of 2.

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294. BODY TEMPERATURE IN EWES WITH DIFFERENT COLORED LAYERS UNDER TWO PASTORAL SYSTEMS. Roberto Pineros-Varon¹, Jairo R. Mora-Delgado*², Gisou D'Áz³; ¹researcher, Ibagué, Colombia, ²Universidad del Tolima, Ibagué, Colombia, ³Author- researcher, Ibagué, Colombia

ABSTRACT

In the dry tropics, yields ruminants generally are affected by heat stress, which can be mitigated in wooded rangelands. The purpose of this was to evaluate the behavior of ewes with different colored layers (white and red). Both, under grazing on two fields -a silvopastoral system with citrus trees (SSPC) and a conventional paddock (SPC)- in the dry tropics of the warm valley of Tolima. The thermal response of 12 ewes Katahdin F1 (six white layer and six red layer) was evaluated. Body temperatures at 6,00, 12.00 and 16.00 hours were recorded using an implanted data logger Subcue®, into the perianal area of the animal. The temperature and humidity were recorded by environmental data loggers HOBO®, located in each system evaluated. A completely randomized 2x2x3 factorial design was performed, where the factors were production system (SSPC and SPC); color of layers (white and red) and time (6,00, 12.00 and 16.00). The data were analyzed under a general linear mixed model. Relevant results indicate significant differences in the perianal temperature of white ewes, during midday hours, between SSPC and SPC. On the afternoon (16.00 h) significant differences were found between the experimental fields in white ewes on SSPC, while in SPC they reached a higher temperature. It can be concluded that the shady of citrus offer more comfort to ewes of white layers, which could generate better growth performance. Besides offer additional products for the producer, such as citrus.

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295. ANIMAL ACTIVITY INFLUENCE BY GRAZING STRATEGY. Torie W. Lindsey*¹, Miles D. Redden¹, Jerry Volesky², Walter H. Schacht¹; ¹University of Nebraska-Lincoln, Lincoln, NE,²University of Nebraska-Lincoln, North Platte, NE

ABSTRACT

Grazing strategy is reported to affect animal movement and energy expenditure. Activity (steps taken) of yearling steers was studied using three different grazing strategies on Sandhills subirrigated meadow at the University of Nebraska Barta Brothers Ranch 11 km northwest of Rose, Nebraska. The grazing strategies were a 4-pasture rotation with a single occupation, a 120-pasture rotation with a single occupation (ultrahigh stocking density), and continuous grazing. The research was conducted during a 60-day grazing season from mid-June to mid-August in 2013 and 2014. Each pasture in the 4-pasture rotation was 0.42 ha and grazed by 10 steers for 15 days and each pasture in the 120-pasture rotation was 0.14 ha and grazed by 36 steers for 0.5 day. The continuously grazed pastures were each 0.75 ha and were grazed by 4 steers for the entire 60 days. Two steers from each grazing strategy were randomly selected and fit-

ted with IceCube pedometers, and the pedometers were on the same steers for the entire 60-day grazing season. We hypothesized that animal activity would increase as pasture size increased and as the length of grazing time in a pasture increased, thus continuously grazed pastures will have the greatest activity while ultrahigh density grazing will have the least number of steps per day. However, the 2013 data showed a significantly greater number of steps taken in the ultrahigh stocking density pastures (5,551 steps day⁻¹) than in the continuously grazed pastures (3,751 steps day⁻¹) and pastures in the 4-pasture rotation (3,959 steps day⁻¹). Steer activity in the ultrahigh stocking density pastures peaked shortly after each half-day move as the steers grazed and moved rapidly back and forth through the pasture. A leapfrog style of movement was observed after each move. The 2014 data will be presented and results of the 2-year study will be discussed.

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296. APPROACHES TO REDUCE CATTLE USE OF RIPARIAN AREAS THROUGH HERDING AND STRATEGIC SUPPLEMENT. Dave Stricklan*¹, Derek W. Bailey¹, James B. Lamb², Michael F. Millward²; ¹New Mexico State University, Las Cruces, NM, ²Brigham Young University - Idaho, Rexburg, ID

ABSTRACT

Livestock use of uplands and riparian areas has long been a concern of range managers and livestock producers. Strategies to prevent overuse of riparian habitats by livestock have evolved and over time, including development of upland water sites, strategic salt and supplement placement, construction of artificial shade sources, and herding. Our objective was to evaluate the effectiveness of differing levels of low stress livestock herding (i.e. stockmanship) combined with strategic placement of low moisture block (LMB) supplements. We provided cattle with LMB and water in upslope areas away from streams. We applied three treatments, traditional herding once a week – no LMB available, low stress herding twice a week – and strategic placement of LMB, and low stress herding five days a week - plus strategic LMB placement. The three treatments were replicated twice over the second grazing season and two of the treatments (traditional herding and low stress herding five days a week with strategic LMB placement) were replicated the previous year. Cattle that were herded using low-stress techniques were attracted to LMB and spent more time away from riparian areas than the traditionally herded cows, particularly during warmer weather. Frequency of low stress herding affected the time cattle spent away from riparian areas. With increased frequency of low-stress herding, cows spent more time in upland areas and away from riparian areas.

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*Presenter

297. EVALUATION OF FOUR GRAZING STRATEGIES AND THEIR EFFECT ON WILDLIFE POPULATIONS AND HABITAT. Alfonso Ortega*¹, Tyler A. Campbell¹, Gilly Riojas², Fritz Linney², Humberto Martinez², Chris Huff², Neal Wilkins¹; ¹East Wildlife Foundation, San Antonio, TX, ²East Wildlife Foundation, Hebronville, TX

ABSTRACT

The East Wildlife Foundation has a mission of supporting wildlife conservation and the other public benefits of ranching and private land stewardship. This mission is achieved through research, education, and outreach. We have begun a research project that will evaluate continuous versus rotational grazing at 2 different stocking rates. This project will be conducted on approximately 18,000 acres. The area designated has been grazed with cattle for over a century. After the droughts of 2011, 2012, and 2013 this property presented available forage values as low as 5 lbs/ac. The property was destocked in March of 2014 and after the first growing season, in late June 2014, forage availability values ranged from 250-400 lbs/ac. This project will evaluate the changes in vegetation by conducting 230 permanent transects that evaluate vegetation diversity and structure. Grazing intensity will be evaluated by placing 10 5x5'-exclosures along with a paired point per pasture (a total of 80). Furthermore, 6 2-acre grazing exclosures will be placed to evaluate the response of vegetation with the removal of grazing. We have established a grid of 19 double rain gauges in order to collect information uniformly throughout the research area. The initial phase of this project has been completed. The area was destocked in order to allow for recovery of the vegetation, pretreatment data has been collected, and the monitoring methodology has been established. Because of the low forage availability values, grazing on this project will not commence until the spring of 2016.

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298. GRAZING MANAGEMENT AS A CLIMATE CHANGE MITIGATION AND ADAPTATION STRATEGY. Dan R. Denesiuk*, Lauch Fraser; Thompson Rivers University, Kamloops, Canada

ABSTRACT

The purpose of my study is to test whether Management-intensive Grazing (MiG) can help ranchers in BC's Interior optimize carbon sequestration in their pastures. Carbon sequestration helps to reduce greenhouse gases (CO₂) and is proposed as a means of offsetting carbon dioxide emissions. Grasses allocate much of their annual growth into belowground biomass production, which is conducive to the storage (sequestration) of carbon. Improved grazing practices are recognized as a strategy to increase rates of carbon sequestration and are therefore a viable option for climate change mitigation. Increasing soil carbon levels may also improve the adaptability of a ranch to climatic changes, through greater moisture retention, nutrient cycling and other associated benefits. Soil carbon is said to increase in pastures that are converted from extensive management to

intensive management (MiG). For this study, seven working ranches in the BC Interior are being observed, and soil samples taken from pastures that are managed intensively, as well as those being managed extensively (traditionally) –for comparison. Preliminary results suggest that carbon density is positively correlated with depth in intensively managed pastures, and negatively correlated in extensively managed ones. This could indicate that intensive management practices are more likely to store carbon deeper in the soil, and might sequestering it more effectively than extensively managed pastures. If MiG is shown to optimize carbon sequestration, subsequent benefits of climate change mitigation and adaptation can be supported and communicated to ranchers in the interior of BC. Improvements in soil carbon storage, hydrological functions, and other ecological services can significantly benefit the environment, as well as result in tangible economic benefits from increased land productivity and adaptability to climate change.

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299. STOCKING RATE CONSTRAINS THE ESTABLISHMENT OF THE POSITIVE FEEDBACK AND STRUCTURAL HETEROGENEITY WITH PATCH-BURN GRAZING. John D. Scasta*¹, Courtney Duchardt², David M. Engle³, James R. Miller⁴, Diane Debinski⁵, Ryan Harr⁶; ¹University of Wyoming, Laramie, WY, ²University of Illinois, Urbana-Champaign, IL, ³Oklahoma State University, Stillwater, OK, ⁴University of Illinois, Urbana, IL, ⁵Iowa State University, Ames, IA, ⁶Iowa Department of Natural Resources, Des Moines, IA

ABSTRACT

Management for heterogeneity with interactive fire and grazing has been effective in many ecosystems, but its efficacy has been variable in fragmented and invaded mesic grasslands. We assessed factors constraining the fire-grazing interaction in Iowa, USA from 2007 - 2013. Specifically, we modeled how livestock management, fire management, and biotic and abiotic landscape features influenced the establishment and maintenance of low vegetative structure in burned patches, the positive feedback driving the fire-grazing interaction. The most informative model included stocking rate, burn completion and precipitation. The lightest stocking rate did not establish low vegetative structure in the burn patch and the heaviest stocking rate did not maintain low vegetative structure in the burn patch. The intermediate stocking rate resulted in the lowest vegetative structure in the burn patch and the greatest heterogeneity. Appropriate stocking rates can overcome the fire behavior constraint associated with exotic species invasion and render fire as the effective driver of grazing patterns and vegetation structure in mesic grasslands.

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*Presenter

300. RATE OF DEGRADATION OF CATTLE DIET SAMPLES COLLECTED ON AND OFF PRAIRIE DOG COLONIES. Janna J. Kincheloe^{*1}, Kenneth C. Olson¹, Jameson R. Brennan²; ¹South Dakota State University, Rapid City, SD, ²South Dakota State University, Rapid City, SD

ABSTRACT

Prairie dogs alter vegetation structure and composition on their colonies by continuously clipping it to short stature. Alteration of structure and composition likely influences diet selection and therefore nutrition of grazing cattle, but this relationship is poorly understood. Our objective was to compare rate of digestion of diets of cattle grazing either on- or off-colonies of prairie dogs. In 2013, 6 ruminally cannulated steers grazed 4 pastures that were partially colonized by prairie dogs. Steers were used to collect diet samples for nutrient analysis from temporary enclosures in 3 locations in the pastures: annual-plant-species dominated core of PD colonies, grass-dominated portion of PD colonies, and off-PD colony. Diet samples were collected monthly in June, July, and August. Diet samples were lyophilized, ground to pass a 2-mm screen, and composited across pasture and steers to create location by month composites. In 2014, the composite diet samples were subjected to in-situ incubation in 2 of the same steers grazing the same pastures. A first-order disappearance model was used to determine rate of degradation. Influence of advancing plant maturity as the grazing season progressed on differences in rate of degradation among on- and off-prairie dog colony locations will be discussed. Rangelands with a mosaic of on- and off-prairie dog colony locations appear to provide the opportunity for grazing cattle to select diets that optimize nutrient intake.

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301. PRAIRIE DOG AND CATTLE UTILIZATION OF WESTERN WHEATGRASS IN A MIXED-GRASS PRAIRIE. Jameson R. Brennan^{*1}, Patricia S. Johnson¹, Lan Xu²; ¹South Dakota State University, Rapid City, SD, ²South Dakota State University, Brookings, SD

ABSTRACT

Prairie dogs are a controversial rangeland species due to their importance as ecosystem builders and as direct competitors with livestock for resources. Consumption and clipping of vegetation by prairie dogs can substantially reduce available forage for cattle throughout a growing season and alter plant communities on mixed-grass prairie ecosystems. Research has demonstrated the effect of prairie dog colonies on forage quality and quantity for livestock, however, comparisons of use patterns by cattle and prairie dogs are lacking. A study was initiated in 2014 near McLaughlin, SD to compare defoliation patterns of western wheatgrass tillers by prairie dogs and cattle over a growing season. The study site has four 500 acre pastures with varying levels of prairie dog occupation that are grazed from June to October by yearling cattle at stocking rates calculated to achieve 50% utilization. Two hundred western wheatgrass tillers, accessible only to prairie dogs on active prairie dog colonies, were

randomly chosen and permanently marked with small, colored wire rings at the base of tillers. Two hundred western wheatgrass tillers were similarly marked in off-town sites that were only accessible to cattle. Height, number of leaves, and grazing status of each tiller were recorded weekly. Preliminary results showed average pre-graze and post-graze heights of western wheatgrass tillers were greater off-town than on-town. Both probability of grazing and frequency of grazing were higher on-town compared to off-town. The two herbivore species appear to utilize vegetation differently throughout the growing season which may cause a shift in how plants respond to grazing pressure.

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302. CONTRIBUTIONS OF SEED BANK AND BUD BANK TO VEGETATION COMPOSITION UNDER PRAIRIE DOG AND LIVESTOCK HERBIVORY. Lan Xu^{*1}, Patricia S. Johnson², John R. Hendrickson³, Kevin K. Sedivec⁴, Jameson R. Brennan²; ¹South Dakota State University, Brookings, SD, ²South Dakota State University, Rapid City, SD, ³US-DA-ARS, Mandan, ND, ⁴North Dakota State University, Fargo, ND

ABSTRACT

Characterizing the contribution of the seed bank and bud bank to vegetation composition will enhance our understanding of vegetation dynamics and grassland ecosystem resiliency associated with wildlife and livestock herbivory. Vegetation regeneration and resiliency following disturbance comes from seeds (seed bank) and/or vegetative propagules (bud bank). The objective of this study was to determine the effects of ecological site (Clayey vs. Loamy), intensity of disturbance, and types of grazing (prairie dogs vs. cattle) on the presence, size, types, and viability of seed and vegetative propagule reserves. Within each ecological site, locations were selected in areas with no grazing, grazing by prairie dog only, and grazing by cattle only. At each location, two prairie dog burrows (on-town) or sampling points (off-town) at least 2m apart were randomly selected. Two soil cores were taken at 0.5m, 1.0m, and 2.0m from the center of each burrow or sampling point. One core was used to evaluate the seed bank while the other was examined for vegetative propagules. Vegetative reproductive structures were sifted out of the cores used to evaluate the seed bank and the remaining seed bank core sample was spread onto standard seed flats on top of potting soil. Each soil core used to determine vegetative propagules was placed intact into a 15cm X 15cm square plastic pot. The soil cores and seed flats were maintained in a greenhouse with ambient photoperiod during the 2014 growing season. Samples were misted daily and emergence was recorded weekly. Plants were identified as they emerged, counted and then removed. Species richness, abundance, and viability of seed bank and bud bank were determined. Similarity indices were calculated based on abundance to assess similarity of potential contribution of seed and bud bank to current and future plant community composition for each ecological site, type of herbivory and intensity of disturbance.

303. EFFECTS OF WARMING AND SEASON OF DEFOLIATION ON THE SPECIES COMPOSITION OF A MANITOBA PRAIRIE. Donald Thompson¹, Mae Elsingner², Michael P. Schellenberg^{*3}; ¹Agriculture and Agri-Food Canada, Lethbridge, AB, ²Agriculture and AgriFood Canada, Brandon, MB, ³Agriculture and Agri-Food Canada, Swift Current, SK

ABSTRACT

Global warming is expected to affect competitive interactions of grassland species. Early season grazing can allow warm season grasses to predominate in mixed prairie, speeding plant community adaptation to climate change. From 2010 to 2013, a southwest Manitoba prairie dominated by big bluestem (12% cover) and Kentucky bluegrass (4% cover) was subjected to warming using open top chambers (OTC) combined with three clipping treatments including; early July clip, early August clip, and no clip. Cover estimation was done twice each year, in early July and August, to take into account phenological differences among species. Species covers after two years of the treatments were compared using Proc Mixed of SAS. OTC's did not affect species composition or diversity components. Also there were no significant interactions between OTC's and clipping time. The clipping treatments, however had significant effects on species composition and diversity components. Compared to the non-clipped controls, August clipping approximately halved the cover of big bluestem and doubled the cover of Kentucky bluegrass. August clipping also increased the cover of thistles and smooth aster. August clipped plots had greater species number, evenness and Shannon diversity than the two other treatments. With July clipping species covers were similar to no clip. With these two treatments big bluestem cover was greater than August clip but covers of the subordinate species were less. In the short term we found warming with OTC's had no effect on big bluestem cover, but over the long term climate change could favour warm season grasses. Earlier grazing could enhance this trend.

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304. COMPARISON OF WESTERN WHEATGRASS IN WINDROWS VERSUS STOCKPILING. Casey A. Matney*; Colorado State University, Sterling, CO

ABSTRACT

Many ranchers and livestock producers utilize western wheatgrass (*Pascopyrum smithii*) pasture during winter in the mixed grass prairie and shortgrass prairie regions. A high proportion of these ranchers defer grazing on these pastures until the dormant season, commonly known as stockpiling grass pasture. However, few of these ranchers know what the forage value of the stockpiled pasture is during the winter or how this method of forage management compares to a low input alternative such as putting forage in windrows. In this study, we compared putting grass in windrows (treatment) to stockpiling pasture (control). Our objective was to determine if cutting western wheatgrass in late summer and putting the grass in windrows would provide superior forage value than leaving the forage to remain

standing in the pasture. The study was conducted from 2011 to 2012 in northeast Colorado. Two large western wheatgrass pastures were each divided into two study plots, each receiving a windrow treatment and a control of 8 ha in size. Pastures were excluded from grazing during the study, and pastures had not been grazed since the winter of 2010. Forage samples of the stockpiled vegetation and the windrows were taken from each study plot during October, December, and early March. Crude protein, acid detergent fiber, and total digestible nutrient values were determined. Treatment comparisons of forage values will be presented.

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305. DETECTION OF HONEY MESQUITE LEAVES IN CATTLE DIETS USING FECAL NEAR INFRARED REFLECTANCE SPECTROSCOPY. Piedad E. Mayagoitia¹, John W. Walker², Marco Pittarello³, Rick E. Estell⁴, Derek W. Bailey^{*1}; ¹New Mexico State University, Las Cruces, NM, ²Texas A&M University, San Angelo, TX, ³University of Torino, Grugliasco, Italy, ⁴USDA-ARS, Las Cruces, NM

ABSTRACT

Honey mesquite (*Prosopis glandulosa* Torr.) is a common invasive shrub whose leaves contain secondary compounds that limit consumption by cattle. However, crude protein and fiber levels of mesquite leaves are similar to alfalfa hay. The ability to consume small quantities of mesquite leaves might make cattle more adaptable to southwestern rangelands. The objective of this study was to determine if consumption of mesquite leaves by cattle could be detected using fecal near infrared reflectance spectroscopy (NIRS). Six cannulated cows were fed either a cool season, warm season or cool and warm season mix grass hay ad libitum. Dry ground mesquite leaves were placed directly in the cannula to achieve 0, 1, 3 and 5% of the diet. Each level of mesquite was fed for 7 days and then increased to the next concentration. Fecal samples were collected on day 6 and 7, dried, ground, and analyzed using NIRS. Samples were separated into calibration (warm and cool season grass) and validation data sets (mix). Hay intake dropped dramatically for 3 of the 6 cows at the 5% mesquite level. No problems with intake or behavior were evident when mesquite comprised 3% or less of the diet. Fecal NIRS under-predicted mesquite in diet at 0 and 1% levels when two 0% mesquite samples from the validation data set were included in the calibration and over-predicted mesquite at all levels without validation samples in the calibration. Including the 0% mesquite fecal samples reduced the bias at higher mesquite levels (3 and 5%) by about 1 percentage unit compared to calibrations without fecal samples from the 0% diet. Simple coefficient of determinations did not differ ($P > 0.50$) between the two calibrations and were about 0.70. Fecal NIRS may have the ability to estimate the amount of mesquite leaves consumed by cattle grazing rangelands.

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*Presenter

306. DECOMPOSITION OF DUNG EXCRETED FROM CATTLE GRAZING SMOOTH BROMEGRASS PASTURES. Bradley D. Schick*, John A. Guretzky, Walter H. Schacht, Martha Mamo; University of Nebraska-Lincoln, Lincoln, NE

ABSTRACT

Rapid nutrient cycling improves forage quality and livestock productivity in pastures. Interseeding legumes may be a strategy to enhance N cycling, but effects of dung excreted from cattle grazing pastures with legumes on dung decomposition rates and soil N cycling have not been studied. Our objective was to evaluate how dung excreted from cattle grazing legume-interseeded, N-fertilized, and unfertilized smooth brome (Bromus inermis Leyss.) pastures affects dung chemical composition, dry matter decomposition, CO₂ flux, and N availability in soil. Freshly deposited dung was collected by hand from the legume-interseeded, N-fertilized, and unfertilized treatments, refrigerated, separately homogenized, and placed as pats in a neighboring unfertilized pasture. Each treatment was collected 3, 7, and 30 days after placing the pats in two experimental periods (June and August) in 2014. CO₂ flux from dung was measured for each treatment, as well as a non-dung influenced control. Dung collections coincided with vegetation and diet samples from ruminally-fistulated cattle to examine effects of the pasture treatments on N cycling through the plant-animal-dung-soil complex. CO₂ flux did not differ among treatments in June but tended to be greater from dung excreted in legume-interseeded pastures in August. Forage quality in all diets was high and comparable in June, but was relatively higher in legume-interseeded pastures in August.

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307. EVALUATING POTENTIAL FORAGES FOR SUPPRESSING FOXTAIL BARLEY AND DOWNY BROME IN WESTERN CANADA SALINE FIELDS. Alan D. Iwaasa*, Harold Steppuhn, Ken Wall; Agriculture and Agri-Food Canada, Swift Current, SK

ABSTRACT

Agricultural producers across Canada and the United States consider foxtail barley (*Hordeum jubatum* L.) and downy brome (*Bromus tectorum* L.) major weeds that are detrimental to both field crop and livestock production. Study objective was to evaluate the ability of potential pure and mix forage treatments to suppress foxtail barley and downy brome on two different salinity ranges. Two Alberta Canada sites were selected: Site1 was slightly to moderately saline (2 to 8 dS/m ECe) and Site2 was slightly to severely saline (2 to 16 dS/m ECe). Ten forage treatments were compared to unseeded control and were: Saltmaster mixture (20% each of tall fescue, tall wheatgrass, slender wheatgrass, smooth brome and alfalfa), AC-Rocket smooth brome, Spredor 4 alfalfa, AC-Saltlander green wheatgrass seeded at 15 or 30 cm row spacing, Nuttall's salt-meadow grass, Polar northern wheatgrass, Green wheatgrass/slender wheatgrass mixture, Poole western

wheatgrass and Orbit tall wheatgrass. Each site was evaluated for salinity, pre-seed treated with glyphosate, cultivated and harrow-packed and most forage treatments were seeded at 30 cm row spacing. Site1 and 2 were seeded May 16 and June 29, 2006, respectively. After three growing seasons at site1, AC-Saltlander green wheatgrass 15 and 30 cm, green wheatgrass/slender wheatgrass mixture, smooth brome and tall wheatgrass reduced average foxtail barley and downy brome populations to less than 5% and 4% of the total biomass ($P < 0.0001$), respectively. At Site 2, five growing seasons were needed and only AC-Saltlander green wheatgrass 15 and 30 cm and the green wheatgrass/slender wheatgrass mixture lowered foxtail barley plant populations significantly ($P < 0.0001$). These reductions were to 8%, 8% and 19% of the total biomass, respectively. Downy brome was not present at this site. Results show that as the salinity increases, forage options become more limited, and green wheatgrass becomes the best choice to compete with foxtail barley and downy brome.

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308. MEASUREMENT OF CAMPOS RANGELANDS HERBAGE MASS BY SIMPLE METHODS. Martin Do Carmo^{*1}, Geronimo Cardozo², Pablo M. Soca³; ¹Instituto Nacional de Investigación Agropecuaria, Tacuarembó, Uruguay, ²Instituto Nacional de Investigación Agropecuaria, Treinta y Tres, Uruguay, ³Facultad de Agronomía, Paysandú, Uruguay

ABSTRACT

Accurate and precise estimation of herbage mass is essential for livestock management, because herbage allowance depends on its estimation. Difficulties in estimation arise because of great variability in herbage mass in grassland and rangeland situations. Measuring yield directly by cutting is costly and destructive; but herbage height is highly correlated with herbage mass, thus could be a substitute of the cutting. Based on measurement of herbage mass in a large experiment (EEBR) and in four farms across Uruguay (MICN), we analyzed the relationship between herbage height and dry weight of the quadrat in kg/ha. Analysis was performed with PROC MIXED and PROC CORR of SAS. On the other hand, the sample size to be taken in each paddock is of great importance and was estimated from the data population described above by resampling and estimating the coefficient of variation (CV) between means. A CV of 10% was defined as the limit to consider the estimation precise enough. The general relationship was $y = 224 (\pm 36) + x * 339 (\pm 4)$, $R^2 = 0.84$. Sample size to maintain the average with a CV error below 10% varied with mean, because it changes the variance, however as a general rule, with a sample size between 60 to 100 only one estimation from 198, was above 10% error of the mean. We conclude that estimations based on herbage height are accurate enough ($R^2 = 0.84$) to estimate the herbage mass and a sample size from 60 to 100, give as confidence to estimate herbage mass with precision in paddocks from 5 to 190 ha. That methodology should be extended to Campos rangeland manager for decision making to control grazing intensity.

309. KEYNOTE: THE FUTURE OF STUDENT LEARNING. Jillian Kinzie*; Indiana University Bloomington, Bloomington, IN

ABSTRACT

The quality and value of an undergraduate education continues to receive scrutiny by various stakeholders associated with higher education. Concern about stagnant graduation rates and limited gains in essential student learning outcomes has motivated greater action to enhance undergraduate education on many college campuses. Considerable attention has been placed on increasing student engagement in effective educational practices, and in particular, increasing students' participation in high-impact practices, such as undergraduate research, service-learning and capstones, that hold promise for increasing learning gains. This plenary will provide an overview of the critical emphases in student learning and review what matters to improved undergraduate education.

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310. EFFECTIVE STRATEGIES TO TEACH INTERDISCIPLINARY SCIENCE EDUCATION. Meena M. Balgopal*; Colorado State University, Fort Collins, CO

ABSTRACT

Because undergraduate capstone experiences are associated with increased overall performance as students, it is important to design these courses so they meet your students' needs. Capstone courses vary across disciplines, institutions, and geographic regions. Program faculty may or may not adhere to an agreed upon course framework. Regardless of design, these courses are often opportunities for students to draw from all of their undergraduate experiences (course work, research experiences, internships, etc.) as they prepare for either graduate studies or employment. Students often synthesize their own knowledge and evaluate how they can contribute to their profession. Rangeland and natural resource students typically represent diverse stakeholder interests and perspectives. What unifies these diverse perspectives, though, is the desire to address problems associated with socio-scientific issues (SSIs). SSIs are issues for which there may be no clear-cut right or wrong answer but for which a clear understanding of both social-cultural and bio-physical systems is needed. Many natural resource management graduates will be directly or indirectly involved in addressing SSIs and perhaps helping community members resolve problems associated with SSIs. In this regard, graduates will benefit from being fluent in different disciplines so they can communicate with different stakeholders. Designing an interdisciplinary capstone course, therefore, requires that curriculum developers and instructors are able to identify the necessary skills as their profession grows and changes. I will present a few models of how interdisciplinary courses can be designed, as well as, issues that instructors should consider as they implement such courses. In addition, I will discuss strategies for assessing interdisciplinary capstone courses.

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311. ASSESSING THE QUALITY OF STUDENT EXPERIENCES WITH CAPSTONE COURSES. Jillian Kinzie*; Indiana University Bloomington, Bloomington, IN

ABSTRACT

Believing that the undergraduate experience is fragmented and not preparing students for the world's complexities, educators across campuses are assessing and investing in improving culminating or capstone experiences to help students put the pieces together. Culminating experiences take many forms, including senior seminars, capstone courses, field-based experiences and internships, senior projects, and comprehensive exams. Participation in a culminating experience is positively associated with the extent to which students interact with faculty, collaborate with peers on academic matters, and experience higher-order learning and perceive their environment as supportive of their learning. What else do we know about levels of participation, quality of students' experiences in capstone courses, and outcomes?

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312. INVENTORY AND CHARACTERIZATION OF THE APPROACHES, SCOPE, AND VARIATIONS OF CURRENTLY OFFERED SENIOR CAPSTONES. Karen R. Hickman*; Oklahoma State University, Stillwater, OK

ABSTRACT

A primary objective of the currently funded USDA Higher Education Challenge Grant "Building a Better Capstone for Multidisciplinary Education" is to inventory and characterize senior capstones. This presentation will provide an overview of at least a dozen range education senior capstone courses offered in the US. Faculty responsible for teaching these capstones were contacted and asked a series of questions concerning their specific course. These questions were designed to inventory the student body make-up of the courses (e.g. student from multiple disciplines), use of on-line technology, and participation of multiple institutions in the class. Challenges faced in offering meaningful capstone experiences, how the instructor and the students would like to see the capstone improved for a more meaningful experience, and the ability of the course to influence the student's transition into the workforce was also assessed. Additionally, while there are several very good case studies of capstones in a broad array of disciplines, also inventoried and characterized were capstones in the following disciplinary areas: forestry, soil science, wildlife, fisheries, geosciences, natural resources conservation, water science, and agricultural social sciences. These inventories will be completed during the fall 2014 semester and results will be presented during this symposium.

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313. BUILDING A BETTER CAPSTONE: WORKFORCE RELEVANCE FOR MUTABLE NATURAL RESOURCE PROFESSIONALS. Melanie Murphy*¹, Ann L. Hild²; ¹University of Wyoming, Laramie, WY, ²Univ. of Wyoming, Laramie, WY

ABSTRACT

Preparing students for tackling real-world questions in science is a national goal in meeting the challenges of the 21st Century. Beginning with Next Generation Science Standards early in education (K-12), increasing national attention to the scientific process and inquiry-driven learning can strengthen our ability to generate graduates who are poised to meet the rapidly changing needs of the global workforce. Starting with these NGSS guidelines, we link them to skills developed in capstone courses and compare current goals to anticipated workforce trajectories. Using published assessments of employer needs combine with additional capstone-specific surveys, we will assess how attributes of capstones articulate with desired skills needed to meet the rapidly changing venues in which our graduates are employed. We identify current workforce expectations for students matriculating from range programs and discuss how current capstone approaches build needed skills. We will consider training in teamwork, critical assessment of available information, policy awareness, development of alternative scenarios, and tools for informed decision-making. We will describe how capstone courses can prepare students for careers in natural resource agencies (local, state, federal), non-governmental organizations, private industry and as landowners. In addition, as many career-level positions now require post-bachelor training, we evaluate how well the capstone experience can also prepare students for continued education in certificate, MS and PhD programs. We assess how workforce needs are addressed by current capstone examples and how the capstone experience can become increasingly relevant to the broad array of potential employment opportunities in the future.

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314. PROGRAM EFFECTIVENESS: EVALUATING THE IMPACT OF YOUR CAPSTONE COURSE. Meena M. Balgopal*; Colorado State University, Fort Collins, CO

ABSTRACT

Curriculum and instructional design is a dynamic process. Only after instructors are able to implement their courses, does it become clear what innovative strategies are working and which are not. Evaluating a course involves considering “what’s working” at different levels: the student, the instructor, the curriculum, and the overall program. In this session I will discuss some considerations for capstone instructors as they construct their student learning objectives, gather instructional materials, design learning activities for students, and determine how best to assess student learning outcomes. Moreover, I will describe how instructors can gather evidence during and after a course to determine whether it met their intended goals (i.e., was it effective or not).

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315. CAN CAPSTONES ADDRESS ISSUES RAISED IN RECENT REPORTS OF TRENDS IN UNDERGRADUATE EDUCATION? Susan Edinger-Marshall*; Humboldt State University, Arcata, CA

ABSTRACT

Capstones are intended as culminating experiences that encourage collaboration, critical thinking, and integrative learning. This presentation will probe the connections between capstone experiences and recent studies of trends in undergraduate education. What criticisms do recent graduates and employers convey that might be addressed by capstone experiences offered locally and/or regionally? For example, a study among soil scientists identifies the lack of field, communication, and problem solving skills as the most critical areas of concern. Recent research in rangeland ecology and management points to weaknesses in geospatial technology and land management policy and law. More generally, an employer survey commissioned by the American Association of Colleges and Universities reveals innovation and problem solving as a high priority. Further, it gives a high ranking to educational practices that emphasize “application of skills over acquisition of discrete bodies of knowledge.”

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316. SUCCESSFUL APPROACHES TO EXPANDING DIVERSITY IN A RANGELAND/NATURAL RESOURCES CAPSTONE. Maria Fernandez-Gimenez*; Colorado State University, Fort Collins, CO

ABSTRACT

In a capstone course, students synthesize and apply the diverse knowledge and skills they have developed during their education, and thereby demonstrate their learning. Frequently the context for synthesis and application is a problem- or project-based learning challenge such as development of a management plan. In rangeland and natural resource management, diversity encompasses multiple disciplines (e.g. soils, hydrology, rangeland ecology, wildlife, forestry, economics, policy and sociology of natural resources) and skills sets (e.g. critical thinking, research, oral and written communication, and teamwork). However, appreciation of and competence in working with other types of diversity (e.g. class, race, ethnicity, culture, gender, sexual orientation, ability/disability) is underemphasized in NR capstones, and indeed, throughout NR curricula. Further, facilitating student understanding of and cultivating skills in diverse ways of knowing and thinking is seldom an explicit goal. Yet, cultural and communication competence is an essential ingredient to success in a global workforce, as are systems thinking and logical analytical thought. This presentation draws on personal and professional experiences, coupled with scholarship on successful approaches to enhancing diversity and integrating multiculturalism across the curriculum, to reflect on the what, why and how of expanding diversity in rangeland/NR capstones. I argue that incorporating multiple dimensions of diversity into a capstone class not only creates a more supportive and equitable learning en-

vironment for students from traditionally underrepresented groups, but also improves the communication and cultural competence of all students. A successful capstone would help all students to recognize and confront the discrimination and social structures that reinforce existing inequalities in natural resource professions and in management of natural resources more broadly. However, relying on a capstone alone to develop these competencies is unlikely to succeed. Rather, these themes need to be woven throughout the curriculum and understood as an integral part of a range/NR education.

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317. DEVELOPMENT OF THE RENEWAL ON THE STANDING ROCK SIOUX RESERVATION PROJECT. Timothy Faller*¹, Linda S. Black Elk², John R. Hendrickson³; ¹North Dakota State University, Mandan, ND, ²Sitting Bull College, Fort Yates, ND, ³USDA-ARS, Mandan, ND

ABSTRACT

The Standing Rock Sioux Reservation covers approximately 2.3 million acres and straddles the North Dakota and South Dakota border. The reservation has a population of 6,171 people and an unemployment rate of 71%. Farming and ranching are the major economic activities on the reservation and management of natural resources has great importance both economically and culturally. Discussions with community members indicated that unemployment, diet and natural resource management were major concerns for the Standing Rock community but state and federal research institutions did not have a strong background in working with Native American communities. To address these issues, Sitting Bull Tribal College, North Dakota State University, South Dakota State University and the Northern Great Plains Research Laboratory, USDA-ARS, collaborated on a funded project to investigate the potential to develop a natural meat project on the Standing Rock reservation. The collaborative institutions received a \$5 million AFRI grant to develop the concept of a natural meat project on the reservation. A multi-disciplinary team of soil, range, wildlife and animal scientists along with communication scientists, extension experts in food safety and preparation and Native American change agents was assembled. The natural resource management emphasis on this phase has focused on understanding the interactions between prairie dog and livestock herbivory on different ecological sites and developing insights into prairie dog colony dynamics and colony impacts on grassland birds. Other team members have worked to enhance communication between Standing Rock community members and the project team and to provide food preparation and safety information to the Standing Rock community. While challenges remain the team approach provides opportunities for research in collaboration with Native American communities.

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318. NATIVE SCIENCE: UNDERSTANDING AND RESPECTING OTHER WAYS OF KNOWING. Linda S. Black Elk*; Sitting Bull College, Fort Yates, ND

ABSTRACT

Partnerships that cross cultural lines can be rewarding and enlightening, but they can also present challenges and complications. Issues of trust, respect and reliable consultation are critical, but many researchers struggle in finding common ground with co-investigators. This is especially the case in partnerships involving Native communities and state or federal agencies. One excellent way of finding common ground when working with Native Americans, is to familiarize oneself with the scientific methodologies and histories that have been a part of oral traditions for generations. Native Science or “Native Ways of Knowing” can provide new methods and novel ways of knowing and understanding the environment. This talk will provide background on Native Science and examples of the ways in which this knowledge continues to contribute to our understanding of the world.

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319. PARTICIPATORY ASSESSMENTS AND ACTION RESEARCH FOR PROBLEM-SOLVING WITH UNDERSERVED COMMUNITIES: LESSONS FROM ETHIOPIA AND NEPAL. David L. Coppock*; Utah State University, Logan, UT

ABSTRACT

As US researchers we are steeped in traditions of observational or experimental science. Such approaches, however, can be woefully inadequate for diagnosing and solving real-world problems. This is especially true when the researchers and members of a target population of project beneficiaries are from different cultures. Participatory Rural Appraisal (PRA) and Participatory Action Research (PAR) are approaches that have existed for over 20 years. PRA was developed to assist foreign change-agents in developing countries where extension capacity was nil. The PAR approach, in contrast, was incubated in the US to address inefficiencies in business or educational environments. Both approaches have evolved over time and some terminology has changed, but the core principles remain the same. Both are dedicated to putting the project beneficiaries on center stage and the researchers or change agents in support roles. And while both embrace a series of steps, neither is a cookbook—users are free to adapt the process to each situation. My colleagues and I have combined PRA and PAR in Ethiopia and Nepal where the target populations are poor, disempowered, and disillusioned. The topics have included poverty mitigation, rangeland management, and climate-change adaptation. PRA is initially used to obtain a rank-ordering of solvable problems, while PAR is employed as an iterative tool to refine solution-oriented pathways. Success is easier to achieve when development of human or social capital becomes the goal; success can be more elusive for topics such as natural-resource management because high costs or local politics can constrain the solution set. Both PRA and

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PAR are invigorating to use, especially when positive outcomes are observed. My colleagues and I would find it hard to return to conventional research. The downside, however, is that PRA and PAR involve stakeholders and high transaction costs; this can be troublesome for researchers needing quick publications.

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320. IMPLEMENTING A CULTURE-CENTERED INFRASTRUCTURE FOR WORK WITH AMERICAN INDIAN COMMUNITIES. Robert S. Littlefield, Kimberly Beauchamp*; North Dakota State University, Fargo, ND

ABSTRACT

The presentation is based upon the well-established need for a culture-centered approach when building communication infrastructures with American Indian communities. The culture-neutral, culturally sensitive, and culture-centered approaches are highlighted, with culture-centered approaches identified as the essential element for building a longterm relationship between external entities and local tribal communities. The longitudinal development of the communication infrastructure enacted on the Standing Rock Sioux Reservation in conjunction with the Renewal of the Land Project supported by the USDA is detailed in the presentation, including: initial talking circles with tribal elders, oral surveys with local ranchers, interaction with extension agents, and surveys involving members of the eight districts on the reservation. The results of current research efforts including focus groups of young adults at Sitting Bull College, along with follow up surveys from district residents will be shared, identifying perceptions of the project, project personnel, and preferred communication channels and ethical approaches.

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321. THE ROLE OF A 1994 LAND GRANT COLLEGE. Gary A. Halvorson*; Sitting Bull College, Ft. Yates, ND

ABSTRACT

In 1994 Congress authorized the formation of the 1994 Land Grant Colleges. These colleges are also known as Tribal Colleges. Sitting Bull College (SBC) is located in Ft. Yates, North Dakota on the Standing Rock Sioux Reservation. SBC has an Environmental Science program that offers an AS, BS and MS degree. Six science faculty are at the PhD level and mentor undergraduate and graduate research programs. SBC has engaged in numerous collaborative projects in the past with 1862 Land Grant Universities and other research institutions. The current collaboration entitled 'Renewal on the Standing Rock Sioux Reservation: Land, Cattle, Beef, and People', includes scientists from North Dakota State University, South Dakota State University and USDA-ARS. The collaboration started with a grant to SBC to begin some initial soils research at the proposed study site and to survey Standing Rock Community members about a larger research project. The results of the survey were used to develop a research program that included the interests of the people. The goals of the research now include providing

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a healthy source of meat from the cattle raised on the site and to do so in harmony with the wildlife, including the prairie dogs. The roles of SBC in this research include making sure the research is carried out in a culturally sensitive way, helping to seek continued input from Community members, providing students with jobs related to the research, giving training to our students in the research areas and making sure the people of Standing Rock benefit from the research. The research is an example of how collaborations with Tribal Colleges should work.

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322. MEANINGFUL PARTNERSHIPS WITH 1994 TRIBAL LAND-GRANT COLLEGES AND UNIVERSITIES. Lisa J. Yellow Luger*; United States Dept. of Agriculture 1994 Program, Fort Yates, ND

ABSTRACT

The mission of the USDA 1994 Tribal Land-Grant Colleges and Universities Program is to develop with Tribal Colleges and Universities their land-grant capacities to benefit rural tribal economies. The USDA's TLGCU Program was established to develop policy guidelines and procedures; coordinate and oversee further participation in the Department's programs and activities; and, monitors, evaluates, and reports on agency compliance with policy and Executive Orders designed to increase participation between the 1994 Tribal Land-Grant Colleges and Universities and USDA agencies. The Tribal Land-Grant Liaison Program functions to support the schools and USDA in collaboration to build and/or strengthen the 1994s land-grant curricula, improve USDA compliance with Executive Orders and legislation to assure that the Department's programs and services are accessible to 1994 land-grant institutions, support 1994s with their land-grant development through the promotion of USDA programs and services, engage tribal producers and farmers in USDA programs, and to improve agencies' recruitment of students from 1994 schools.

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323. THE ROLE OF EXTENSION IN THE NATIVE AMERICAN COMMUNITY. Shawn Burke*; South Dakota State University Extension, Rapid City, SD

ABSTRACT

The 100th anniversary of the Smith Lever Act provides an excellent backdrop to a review of the history and current status of Extension in Indian Country. On the whole, American Indian tribes are still significantly underserved in funding and staffing for Extension programs. Significant institutional challenges exist, both in the USDA funding mechanisms and in the oversight and support of programs amongst tribes, state and tribal colleges, and other partners. New opportunities will include expanded partnerships with shared programmatic objectives that leverage the community trust provided by reservation-based Extension offices.

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324. SOIL RESPONSES TO PRAIRIE DOG ACTIVITY: OBSERVATIONS ACROSS THREE ECOLOGICAL SITES. Mark A. Liebig*¹, Cory J. Barth², John R. Hendrickson¹, Kevin K. Sedivec², Gary A. Halvorson³; ¹USDA-ARS, Mandan, ND, ²North Dakota State University, Fargo, ND, ³Sitting Bull College, Ft. Yates, ND

ABSTRACT

Prairie dogs induce changes in soil properties that can potentially affect vegetation composition and structure as well as landscape hydrology. Geographical application of these outcomes across rangeland landscapes, however, is compromised by a lack of studies addressing soil responses to prairie dog activity on multiple soil types. Furthermore, there is limited information on this topic within the eastern edge of the black-tailed prairie dog (*Cynomys ludovicianus*) domain. To address these information gaps, we sought to quantify prairie dog effects on soil properties for three unique ecological sites differing in soil and landscape attributes. The study was conducted approximately 10 km southeast of McLaughlin, SD, USA on a 1400 ha ranch including both private and leased tribal land. Over a period of two years, soil properties and infiltration rate were evaluated on the ranch within thin claypan, loamy, and shallow loamy ecological sites corresponding to footslope, backslope, and summit/shoulder landscape positions, respectively. Across ecological sites, surface depths (0-20 cm) were most responsive to prairie dog activity, and prairie dog-induced changes to soil properties tended to subside with increased distance from mounds. Prairie dog activity contributed to changes in soil pH, nutrient status, and soil physical condition. Specifically, soil within prairie dog mounds was often acidified, high in available nutrients and soil organic carbon, and possessed greater infiltration rates compared to surrounding soil, thereby creating significant soil heterogeneity within an ecological site. Both landscape-associated and mound-specific soil heterogeneity induced by prairie dogs may complicate rangeland restoration efforts, which are generally applied at large spatial scales. In instances where prairie dogs are extirpated (e.g., epizootic plague), we suggest restoration efforts explicitly consider soil heterogeneity within and across ecological sites.

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325. VEGETATION DYNAMICS UNDER PRAIRIE DOG AND LIVESTOCK HERBIVORY. Patricia S. Johnson*¹, John R. Hendrickson², Lan Xu³, Kevin K. Sedivec⁴, Jameson R. Brennan¹; ¹South Dakota State University, Rapid City, SD, ²USDA-ARS, Mandan, ND, ³South Dakota State University, Brookings, SD, ⁴North Dakota State University, Fargo, ND

ABSTRACT

Our understanding of the impact of herbivory on vegetation dynamics is primarily based on livestock grazing, while herbivory by native wildlife, such as prairie dogs, is not well understood. Extensive prairie dog populations on the Standing Rock Indian Reservation limit forage availability for live-

stock; however, control measures may be limited because of 1) the cultural importance of prairie dogs to the Lakota society, 2) concerns about impacts to associated species such as black-footed ferrets, and 3) potential losses to plague. Therefore it is critical to understand vegetation dynamics of mixed-grass prairie systems grazed by both cattle and prairie dogs to predict herbivory impacts on important plant species and develop management strategies for co-existence of livestock and wildlife. A key initial variable was selection of stocking rate strategy to account for both cattle and prairie dog grazing. We based initial stocking rates on previous research indicating each prairie dog-occupied acre provides 50% of the forage of each non-occupied acre. Utilization data determined that our stocking rate strategy was effective in producing predicted utilization levels. Other efforts are focused on evaluating differences in cattle and prairie dog grazing and the consequences of that grazing to facilitate improved prediction of outcomes of grazing for important plant species. These efforts include 1) determining the probability, frequency, and severity of grazing of western wheatgrass tillers by cattle and by prairie dogs; 2) western wheatgrass plant responses to those defoliation patterns, including tiller initiation and survival, bud banks and bud survival, and tiller reproduction strategies; and 3) the presence, size and viability of seed reserves.

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326. PLANT COMMUNITY COMPOSITION AND CHANGE UNDER PRAIRIE DOG AND LIVESTOCK HERBIVORY ON DIFFERENT ECOLOGICAL SITES. Aaron Field¹, Kevin K. Sedivec*¹, John R. Hendrickson², Patricia S. Johnson³, Lan Xu⁴; ¹North Dakota State University, Fargo, ND, ²USDA-ARS, Mandan, ND, ³South Dakota State University, Rapid City, SD, ⁴South Dakota State University, Brookings, SD

ABSTRACT

State and transition models in the northern Great Plains often contain a community phase based on prairie dog occupation of a site. However, our understanding of the impact of herbivory on plant community change and composition is limited by herbivory of native wildlife, such as Black-Tailed Prairie Dogs (*Cynomys ludovicianus*) and whether these impacts are affected by ecological site. In addition, plague events have decimated prairie dog colonies especially in the western portions of the Northern Great Plains. Extensive prairie dog populations on the Standing Rock Indian Reservation limit forage availability for livestock; however, control measures may be limited. Plant community shifts can be attributed to many types of disturbance, and also to the removal of disturbance. Our objective was to quantify changes in a northern mixed-grass system with the removal of prairie dogs and/or cattle disturbance on the Standing Rock Indian Reservation near McLaughlin, SD. Baseline data was collected in traditionally grazed pastures and community shifts were measured after 2 years of cattle and prairie dog exclusion, with paired-grazed plots as controls. Methods included modified Daubenmire frames, 10-point pin frames, and quadrat frequency frames. These methods allowed us

to gather canopy cover, basal cover, and species frequency data. Data analysis is in progress, with final results to be presented at the SRM 2015 annual meeting.

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327. EFFECT OF GRAZING ON RANGELAND WITH PRAIRIE DOG COLONIES ON CATTLE NUTRITION AND PERFORMANCE. Kenneth C. Olson*¹, Janna J. Kincheloe¹, Jameson R. Brennan², Benjamin Hauptman³; ¹South Dakota State University, Rapid City, SD, ²South Dakota State University, Rapid City, SD, ³Montana State University, Chinook, MT

ABSTRACT

One objective of the Renewal on Standing Rock Reservation project is to evaluate grazing steer response to level of prairie dog (PD) colonization on Northern Mixed Prairie. Four pastures (200 ± 10 ha) were fenced to create an increasing gradient of proportion of the pasture area occupied by PD colonies (0, 18, 40, and 75%). Pastures are stocked with yearling steers to create equal grazing pressure in each pasture by reducing stocking rate in proportion to increasing PD colonization. Steers are weighed at initiation, mid-point, and end of each summer grazing season. Proportion of steer time spent on- or off-PD colony is being determined by placing GPS collars on 5 steers in each pasture. Two GPS collars in each pasture have activity switches to determine amount of time spent grazing on- or off-colony. Ruminally cannulated steers are used to collect diet samples for nutrient analysis in temporary enclosures in 3 locations: annual-plant-species dominated core of PD colonies, grass-dominated portion of PD colonies, and off-PD colony. Ingestion rate is calculated as the weight of forage collected during diet sampling divided by grazing time during sampling periods. Ingestion rate in each sampling location multiplied by grazing time per day in that location is used to calculate daily forage intake from PD colonies vs. off-colony. Forage intake is multiplied by nutrient content to calculate effect of grazing location on nutrient consumption. Comparing these at each proportion of PD colony per pasture allows prediction of the optimum proportion of PD colony to allow cattle to select the most balanced diet to meet performance goals. Additionally, it will allow recommendation of management options for any given level of PD colonization to optimize cattle nutrient intake. Extension programming will utilize this information to assist Native American ranchers to optimize land resource utilization in beef enterprises.

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328. UNDERSTANDING THE INTERACTION OF PRAIRIE DOGS AND LIVESTOCK HERBIVORY ON PASSERINE BIRD POPULATIONS. Ben A. Geaumont*¹, Amanda Lipinski², Wyatt Mack³, Ryan F. Limb³, Kevin K. Sedivec³; ¹North Dakota State University, Hettinger, ND, ²University of Nebraska, Lincoln, NE, ³North Dakota State University, Fargo, ND

ABSTRACT

The mixed-grass prairie is a dynamic ecosystem that evolved under periodic disturbance. Prairie dogs and livestock are

two disturbance agents that continue to influence areas of the mixed-grass prairie in North America. Black-tailed Prairie Dogs (*Cynomys ludovicianus*), once abundant in both the short and mixed-grass prairie, influence the environment with their soil excavation and herbivory of both above- and below-ground plant material. Livestock herbivory, a common use of mixed-grass prairie, has the ability to alter the local plant community over time. Grassland birds, like the mixed-grass prairie, evolved under similar disturbance pressures. However, since European settlement, millions of hectares of prairie habitat are lost to crop production and urbanization, while much of the remaining prairie is fragmented and colonized by exotic plants. Much like native prairie, prairie dogs and grassland birds experienced declines in recent years. As part of a larger study designed to evaluate the environmental consequences of beef production on mixed-grass prairie occupied by prairie dogs, we examined the effect of livestock and prairie dog herbivory on local grassland bird populations. Bird surveys both on and off prairie dog colonies indicated that some birds are negatively correlated with on-town sites such as grasshopper sparrow (*Ammodramus savannarum*) $r = -0.90$, and dickcissel (*Spiza americana*) $r = -0.51$, while others, including the horned lark (*Eremophila alpestris*) and vesper sparrow (*Poocetes gramineus*), are positively correlated with on-town sites $r = 0.73$ and $r = 0.61$, respectively. In addition to bird surveys, we monitored 121 nests belonging to grassland birds from 2012 – 2014. Similar to bird survey results, grasshopper sparrows were found nesting in off-town sites while horned larks tended to select prairie dog colonies as nest sites.

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329. BEEF CATTLE MANAGEMENT ON PRAIRIE DOG COLONIES. Christopher S. Schauer*¹, Clint Clark¹, Kenneth C. Olson²; ¹North Dakota State University, Hettinger, ND, ²South Dakota State University, Rapid City, SD

ABSTRACT

One hundred eighty six Angus-cross yearling steers (approximately 307 kg) annually are allocated to one of four treatments. Treatments consist of different levels of prairie dog occurrence and include: 1) 0%, 2) 18%, 3) 40%, and 4) 75% colonization of the pasture by prairie dog colonies. Each pasture is approximately 200 ha in size, with both natural and well water provided ad libitum. Stocking rates were calculated in year 1 to achieve approximately 50% utilization of the available forage, therefore pastures are not stocked with equal quantities of steers (treatments 0, 18, 40, and 75% stocked with 75, 55, 45, and 17 steers, respectively). The grazing period begins approximately June 1, ending by October 15. Steers are weighed (2-day weights) at the beginning and end of the grazing period, and once mid-period to evaluate health and livestock performance. Following the end of the grazing period, approximately 50% of the yearling steers are transported to the NDSU Carrington Research Extension Center and placed in a finishing feedlot for additional research. Research activities in the finishing phase have focused on increasing the forage inclusion in finishing

rations and the evaluation of particle size in forage based rations. Additionally, a May calving Angus-based cow herd is being developed on the project's pastures that have prairie dog colonization. Following calving, cow/calf pairs graze the native mixed-grass prairie until weaning in October. After weaning cows return to the native prairie and graze until winter weather prevents grazing. Cows are fed during the winter months via bale grazing of alfalfa/grass round bales until spring turnout on native prairie. The long-term goal of the cow/calf and yearling system is to provide an example of a "birth-to-plate" cattle operation that results in a beef product for local consumption, aiding economic development as well as human health.

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330. FUTURE VISION: A SUSTAINABLE AND HEALTHY FOOD PRODUCTION SYSTEM. James J. Garrett*; Sitting Bull College, Ft. Yates, ND

ABSTRACT

Sitting Bull College, a land-grant college is collaborating with the USDA Agriculture Research Service and two land-grant universities to create more sustainable methods of raising cattle on the Standing Rock Lakota Reservation in the mid-grass lands of north-central South Dakota. The four collaborating institutions and agencies are partnering in the development of secure concepts of a safe and healthy food production system for the local reservation community. The project is located in Mahto, SD consisting of an 1800-hectare ranch. It is currently in the baseline data collection and analysis phase of the operation. Methods are being developed that will enable local ranchers to raise calves from birth to butcher weight on the ranch. Finishing will be completed on the ranch with high protein forages. Butchering will take place in a local slaughter unit manned by local community people. The meat then will be sold and consumed locally. This presentation elaborates on benefits that will accrue to the current economically-depressed reservation community in terms of both economic and food security, food quality and quantity, enhanced marketing and employment opportunities for local ranchers and community members. It provides a vision of what tomorrow's grassland community food systems may look like in the context of the grassroots reservation community.

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331. RANGELAND LITERACY, IT TAKES A VILLAGE! Seth Pratt*; University of Idaho, Moscow, ID

ABSTRACT

As we face the complex challenge of a growing world population, we will undoubtedly see changes to land use across the globe. Those of us who care for and have experience managing rangelands should collectively endeavor to impart knowledge to young people who will guide land management toward sustainability in the future. Gain insights into the profound influence of youth education programs and how you can play a role in helping young people have impactful

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experiences that shape their vision for a changing society.

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332. AMERICAN SOCIETY OF ANIMAL SCIENCE, JUNIOR ANIMAL SCIENTIST PROGRAM. Meghan Wulster-Radcliffe*¹, Doug Tolleson²; ¹American Society of Animal Science, Champaign, IL, ²University of Arizona, Camp Verde, AZ

ABSTRACT

The Junior Animal Scientist Program was started by the American Society of Animal Science to provide students an opportunity to learn not only about the science behind livestock production and management, but that associated with zoo and companion animals as well. Animal scientists felt the need to respond to what they felt were misleading sources of information about animal agriculture and research. Their website states: "Animal science is a STEM discipline that helps prepare students for high level science and math courses." The program is geared for ages 5 to 12. Club membership includes a subscription to the Jr. Animal Scientist magazine which covers such topics as careers, activities, and science concepts. There are also materials for older students. Example subject areas include: 1) Livestock and the environment; e.g. "Sustainable farmers are very aware of the impact of their farming practices on the environment. For this reason, they try to limit their use of non-renewable resources. Not only does this help the environment stay healthy, but it also keeps the farmer from depending too much on resources that could run out, leaving her without necessary inputs for her farm.", 2) Animal health and welfare; "It is important for pets, zoo animals and farm animals to stay healthy. Animal scientists study how animal housing and feed can affect health.", and 3) What are species; "The definition of species is a difficult concept to define; these are two commonly agreed upon definitions, but the exact separations are still debated. Species classification isn't a natural phenomenon, but rather one used by biologists to help them talk about the plants and animals that they study." This program may provide either a model for the range profession to adapt for a similar program, a collaborative partner for such a range-oriented program, or both.

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333. AN EDUCATOR'S PERSPECTIVE ON RANGELANDS CURRICULUM. S L. Johnson*; Welder Wildlife Foundation, Austin, TX

ABSTRACT

Providing rangelands curriculum for teachers means looking at more than the ideas that range management professionals wish to communicate to students. It must also meet the needs of these teachers and students. This means that the curriculum must provide activities that address the content and skills required by the state to be taught and tested in their jurisdiction. In this presentation you will learn how to make rangelands curriculum appropriate, useable, and teacher friendly. You will also learn the basic concepts in-

cluded in state and national science standards that are related to important rangelands conceptual themes and why these basic concepts are important. In addition, you will explore the appropriate age to begin teaching these concepts and how to meet the needs of students by using multiple learning modes to create lessons that are interesting, fun, and memorable to help students internalize the concepts and make them a part of their value systems. Finally, we will look at how these techniques encourage students' interests in careers in range management.

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334. THE PRAIRIE PROJECT. Blayr B. Gourley*, Dwayne Elmore; Oklahoma State University, Stillwater, OK

ABSTRACT

The Prairie Project provides students, K-12, information about the prairie ecosystem via text, pictures, and videos through an educational website. The project was created in 2011 and funded by Oklahoma Gas and Electric and Oklahoma State University. The goal of the project is to get educational information about the prairie ecosystem into the classrooms to educate students about the ecosystems around them. The program provides information in three separate age groups, K-4, 5-8, and 9-12. Each group provides age-specific information about the topics: plants, animals, fire, grazing, and energy. Each group is broken down and explains specific plant species, wildlife species, types of fire, types of grazing animals and energy on the prairie, and how they all work together to create the prairie ecosystem. The website can be used in the classroom as a teaching tool, or at home as an informational resource. The website provides lesson plans for each topic as well as links to relevant lesson plans found elsewhere, relieving teachers of creating lesson plans. The Prairie Project is advertised on Facebook, Twitter, trade shows and professional meetings. Please visit theprairieproject.okstate.edu to find more information about the prairie ecosystem.

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335. 4-H AND HIGH SCHOOL RANGE EDUCATION PROGRAMS IN ARIZONA. Doug Tolleson*¹, Kirk Astroth²; ¹University of Arizona, Camp Verde, AZ, ²University of Arizona, Tucson, AZ

ABSTRACT

4-H is the youth education program of each state's land grant university. As of the early 2000's most western US states had, at one time or another, a 4-H range, forestry, wildlife or other natural resources project. At that juncture, however, most of the curriculum was outdated and did not incorporate the current state of knowledge and technology. Unfortunately, most state Extension Services were not willing to invest in revising 4-H range materials. In 2004, a multi-state, multi-partner collaborative group consisting of county and tribal extension and 4-H agents, The Nature Conservancy, Society for Range Management, Idaho Rangeland Resources Commission, Boone & Crockett Club, USDA, and univer-

sity range management faculty received funding to revise these materials. The specific charge to this collaborative group was to develop a new land resources curriculum that could be used in 4-H as well as other educational environments such as camps, home schools, public schools, and after-school programs to educate youth about rangeland ecology and management. The curriculum is intentionally designed to inform and educate non-traditional extension audiences and non-agricultural audiences so that they gain an appreciation for the importance of our natural resources to supporting a modern lifestyle. The initial target audience is youth in grades 4-6. All curriculum components are posted on the "Rangelands West" family of web sites. The National FFA organization provides agriculture education for high school students. FFA has activities geared toward such subjects as soil, range and pasture judging, plant identification, and wildlife. Envirothon is a national environmental education competition, the 2014 subject matter was sustainable rangelands. Range Rocks! is the youth outdoor experiential learning effort of the V Bar V Range Program. Over 200 high school students have participated in hands-on range management activities at the ranch. Arizona Cooperative Extension is involved in each of the described programs.

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336. RANGELANDS CURRICULUM FROM WELDER WILDLIFE FOUNDATION IN TEXAS. S L. Johnson*; Welder Wildlife Foundation, Austin, TX

ABSTRACT

Rangelands: A Conservation Guide is a teacher guide for kindergarten through fifth grade. The curriculum provides hands-on, active learning for students with 27 student-centered lessons using real world science investigations. Each lesson contains from three to eight activities. The curriculum focuses on science and integrates social studies, while utilizing language arts and math skills. All core content areas including science, social studies, math and language arts are utilized to teach state curriculum requirements, The Texas Essential Knowledge and Skill, (TEKS,) which are documented with each activity. The curriculum guide uses a variety of teaching methods to meet the needs of all students and applies learning in creative products and presentations to activate higher order thinking, and synthesis. Methods used include: field activities, journaling, games, models, computer and Internet lessons, science investigations and inquiry, writing activities, and role playing, and encourage the use of community resources. Rangeland lessons include investigations of soil, water, plants, wildlife, ecology, stewardship, and ecosystem services. The activities are easy to implement and classroom materials needed are minimal and inexpensive such as: plastic cups, string, Styrofoam balls, journals, and art supplies. Most other equipment used are those things required in the science TEKS and are things the teacher will already have access to such as hand lenses, rulers, and computers.

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*Presenter

337. EMPOWERING TEACHERS TO SPARK INTEREST IN RANGE. Lovina Roselle¹, Karen Launchbaugh¹, Gretchen Hyde*²; ¹University of Idaho, Moscow, ID, ²Idaho Rangeland Resource Commission, Emmett, ID

ABSTRACT

Knowledge and wise use of rangelands is inherently linked to sustaining social and economic infrastructures in rural western North America. Even though rangelands cover over half of the earth's land surface, these natural landscapes are relatively unknown to most people, especially compared to forests, agricultural lands, and urban areas. There is growing concern over the diminishing activity of young people on the wild and natural landscapes that surround them. A growing number of young people are distanced from agricultural and ranching lifestyles yet the demand for resources provided by rangelands continues to grow. One approach to address this growing gap between students and the natural landscapes that surround them starts close to home. Education programs that build awareness, knowledge, and skills useful on rangelands will forge connections between students and their immediate surroundings and foster concepts and habits of land stewardship. Our efforts to enhance youth rangeland education and career interest has four program components that are helping to bridge the gap between youth and their surrounding environment and include: 1) providing teacher resources and training to increase teaching competencies related to rangelands, 2) developing interactive and experiential activities to interest students in rangelands and offer them skills and knowledge to seize career opportunities, 3) strengthening relationships between university rangeland programs and high school educators to ensure curricula quality and increase its use in classrooms, and 4) engaging rangeland professionals in teacher workshops and student events to ensure that skills and concepts in whole program are relevant to contemporary range management activities.

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338. K-12 RANGELAND CURRICULUM SHOWCASE. Theresa A. Becchetti*¹, Dwayne Elmore², Lovina Roselle³, Doug Tolleson⁴, S L. Johnson⁵; ¹UC Coop Extension, Modesto, CA, ²Oklahoma State University, Stillwater, OK, ³University of Idaho, Moscow, ID, ⁴University of Arizona, Camp Verde, AZ, ⁵Welder Wildlife Foundation, Austin, TX

ABSTRACT

If you are interested in getting more rangeland and natural resource information into your local schools, be sure to join us for the first ever "K-12 Rangeland Curricula Showcase". Effort has already begun across the West to create curriculum for Kindergarten through 12th grade. SRM members and educators will be at the Showcase to provide interactive, hands-on displays of the curriculum each has developed. There will be curricula for all age levels, some that have been implemented widely, and others that are just beginning. In addition to the classroom curricula, Range Camps and regional rangeland and natural resource competitions will be at the Showcase. This will be a one-stop opportuni-

*Presenter

ty to see what others are doing, learn some new tips and tricks, and more importantly, find new ways to excite and encourage your state's youth to explore rangelands as a college major and a career. The next generation of Society members, and the future of our rangelands, is waiting for us to spark their interest through any one of these different opportunities to expose our youth to the rich diversity and opportunities rangeland can provide. Please be sure to join us for the Showcase.

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339. HOW CAN THE RANGE PROFESSION CONTRIBUTE TO DEVELOPMENT OF AG-STEM CURRICULA FOR MIDDLE SCHOOL STUDENTS? Kim Demoney*¹, Christine Griffin¹, Doug Tolleson²; ¹Oak Creek Middle School, Cornville, AZ, ²University of Arizona, Camp Verde, AZ

ABSTRACT

STEM education is a national priority in the US. The World Economic Forum ranks the US 52nd in STEM education. There will be a projected 14% increase in STEM jobs in the next 10 years. Agriculture (Ag) is an important but often overlooked STEM subject. Recent estimates indicate that < 1% of all Americans are involved in agricultural production. The projection of 9 billion people on Earth by 2050 highlights the need for efficient use of natural resources and agricultural output. This must occur in an ever shrinking agricultural land base and changing climate. As the US becomes more urbanized and less knowledgeable about agriculture and natural resources, professionals in these disciplines have called for more Ag-STEM education, starting at an early age. Public rangelands are the predominant land type in central Arizona. They provide a unique opportunity for students to gain knowledge and appreciation for agriculture and natural resources in their own "backyard". The principle for Oak Creek Middle School in Cornville, Arizona has recently implemented an Ag-STEM program there. The primary instructor previously worked with the extension range specialist for northern Arizona in the Range Rocks! outdoor education program for high school students. Collaborative efforts to bring Range Rocks! activities to younger students and to develop appropriate curricula are underway. These activities must: 1) engage the students, 2) provide hands-on experience, 3) foster an appreciation for science and agriculture, 4) be appropriate for the age level, and 5) provide opportunities to meet current STEM standards. The goal is to offer hands-on, experiential learning as much as possible. Schools who wish to provide these types of learning experiences can benefit from collaboration with rangeland professionals to provide access to venues for outdoor learning and expertise in subject areas such as soils, plant growth, water cycles, and grazing animals.

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340. A BRIGHT FUTURE IS CALLING! ATTRACTING HIGH SCHOOL STUDENTS TO RANGELAND CAREERS. Lovina Roselle*; University of Idaho, Moscow, ID

ABSTRACT

The outlook for skilled rangeland professionals needed in the workforce over the next decade indicates a staggering demand, due largely to an aging workforce in the federal and state government where about 75% of rangeland managers are employed. College graduates will be needed to fill these shoes. A clear way to raise young people’s awareness of the rangeland profession, and potentially satisfy the looming workforce need, is through the National FFA Organization which offers Career Development Events (CDEs) that connect thousands of American youth with agriculture and natural resource related subject areas. Our efforts to attract students into the rangeland profession led to creating the Western National Rangeland CDE that merges the longstanding tradition of National FFA sanctioned events with a unique field-based monitoring skill training and rangeland career exploration activities. The event spotlights many of the challenges facing rangeland managers west of the Rocky Mountains where the majority of rangeland is federally owned. Organizers from across Idaho, Nevada, Utah, and Wyoming collaborate to harness the competitive spirit of CDEs while showcasing the breadth of career opportunities to young people who will be the workforce caring for rangelands into the future.

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341. WILDLIFE HABITAT EDUCATION PROGRAM. Dwayne Elmore*; Oklahoma State University, Stillwater, OK

ABSTRACT

The Wildlife Habitat Education Program (WHEP) has been providing curriculum to 4-H students (age 8-19) since 1990. Over 10,000 students have participated at the national level, with many more active in state programs. While this national program focuses on habitat management for wildlife species, various range management techniques such as grazing, prescribed fire, invasive species control, and woody plant management are emphasized. Plant communities such as sagebrush, tallgrass prairie, shortgrass prairie, and montane forest are covered so that youth are exposed to a broad range of vegetation types and resource issues. This program has received national recognition as a 4-H Program of Distinction and the Conservation Education Award from The Wildlife Society. WHEP was recently opened to Future Farmers of America (FFA) to increase its impact. Data from evaluations reveals that the program has a high retention rate and that youth average 70 contact hours each year in the program. In addition to the youth directly impacted through 4-H and FFA, the curriculum is available online at whep.org.

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342. FACILITATED DISCUSSION- FORMING A NETWORK FOR K-12 RANGELAND CURRICULUM. Theresa A. Becchetti*¹, Dwayne Elmore², Lovina Roselle³, Doug Tolleson⁴, S L. Johnson⁵; ¹UC Coop Extension, Modesto, CA, ²Oklahoma State University, Stillwater, OK, ³University of Idaho, Moscow, ID, ⁴University of Arizona, Camp Verde, AZ, ⁵Welder Wildlife Foundation, Austin, TX

ABSTRACT

Our last session of the workshop will be a facilitated discussion. Many of us have the same goal: more classrooms, more kids learning about rangelands throughout the West. But everyone is busy and not every State has a dedicated person (or people) to develop and manage the curriculum. Our goal for this last session of the workshop is to formalize a network of range professionals all interested in K-12 education. Together, we can share developed curriculum to increase the number of students exposed to rangelands. Each state can make local adjustments to developed curriculum to tailor the information. Working together, we have the potential to increase our creative ability, reach more students, and get rangeland curriculum in more classes throughout the West.

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343. MONITORING FOR ADAPTIVE MANAGEMENT: INTRODUCTION TO THE BLM ASSESSMENT, INVENTORY, AND MONITORING (AIM) STRATEGY. Emily Kachergis*¹, Matthew R. Bobo¹, Robert Boyd¹, Melissa D. Dickard¹, Brian Hadley¹, Jason W. Karl², Michael “Sherm” Karl³, Sarah F. Lamagna⁴, Sarah E. McCord⁵, Scott W. Miller⁶, Carol Spurrier⁷, Gordon R. Toevs⁸; ¹BLM, Denver, CO, ²USDA ARS Jornada Experimental Range, Las Cruces, NM, ³U.S. Department of the Interior-Bureau of Land Management, Denver, CO, ⁴Bureau of Land Management, Denver, CO, ⁵USDA-ARS, Las Cruces, NM, ⁶Bureau of Land Management/Utah State University, Logan, UT, ⁷BLM, Washington, DC, ⁸Bureau of Land Management, Lake Ridge, VA

ABSTRACT

Monitoring is a critical component of adaptive rangeland management that enables managers to learn whether objectives are being achieved and make adjustments if they are not. The “Bureau of Land Management Assessment, Inventory and Monitoring Strategy for Integrated Renewable Resources Management” (BLM AIM Strategy) provides a process for collecting high-quality information about ecosystem conditions and trends to support adaptive management. Building on a review of BLM monitoring practices, the AIM approach to monitoring features five elements: 1) a standard set of core quantitative indicators and methods, enabling easy comparison of measurements in different places and over time; 2) a defensible and statistically valid way of selecting monitoring plots that informs resource conditions at multiple scales; 3) integration with remote sensing, providing a bird’s-eye view of conditions across the landscape; 4) electronic data capture and management, streamlining information access for BLM and our partners; and 5) a structured implementation process built on management questions and

*Presenter

an understanding of ecosystems. Land managers from Arizona to Alaska have applied the AIM approach to monitoring terrestrial and aquatic resources at multiple scales using field, remote sensing, and integrated approaches. Monitoring results address land managers' diverse management questions, from sage-grouse habitat condition to wildfire impacts to restoration effectiveness. Information derived by implementing AIM is collected once but can be used many times to enhance understanding of the structure and function of BLM lands and guide adaptive management.

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344. FROM SAGE-GROUSE TO SOLAR ENERGY: MONITORING AND LAND MANAGEMENT DECISIONS. Gordon R. Toevs*¹, Emily Kachergis²; ¹Bureau of Land Management, Lake Ridge, VA, ²BLM, Denver, CO

ABSTRACT

Public land managers face increasing pressure to provide a wide variety of goods and services from public lands. For the BLM, our enabling legislation includes a multiple-use and sustained yield mandate which increases the complexity of these decisions. The regulatory framework for the BLM mission is the fundamentals of land health (CFR 4180) which is based on sustaining ecosystem processes. These fundamentals provide a unified tool for evaluating the success of BLM decisions. In coordination with other agencies, the BLM has developed a strategy, the Assessment, Inventory, and Monitoring (AIM) Strategy, that when implemented informs these land health fundamentals. A key component of this program is standard indicators that describe the status and trend of terrestrial and aquatic resources, landscape pattern, and natural and anthropogenic disturbance. The information derived from these indicators describes the current status of BLM resources and can also be used to assess the departure from the desired condition. A departure from the desired condition initiates the adaptive management process that concludes with a determination of the causal factor(s). Management prescriptions can be developed to address the causal factor. The AIM monitoring approach, which couples standard indicators and methods, a statistically valid sampling framework, remote sensing technologies, and a robust data management, analysis, and reporting component, is currently being implemented through several major BLM initiatives. These include the BLM Western Solar Plan, the National Petroleum Reserve in Alaska, and the Greater Sage-grouse planning effort. The monitoring information will inform land managers when these, future, and ongoing programs of work require an adaptive management approach to meet the desired outcomes. The AIM program enables the BLM, stakeholders, and other agencies to look across scales, programs, and jurisdictions to make more informed decisions in this era of increased demand for goods and services from our public lands.

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345. NRCS NATIONAL RESOURCES INVENTORY RANGELAND RESOURCE ASSESSMENT. Veronica C. Lessard*; USDA-NRCS-Resource Inventory Division, Ames, IA

ABSTRACT

The US Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) conducts the National Resources Inventory (NRI) to inventory and monitor the conditions and trends of soil, water, and related resources. Since 2003, the NRI program has collected annual on-site data on a subset of its monitoring sites located on non-Federal rangeland to obtain more detailed information on those lands, using standard indicators and methods consistent with the BLM AIM strategy. The NRI Rangeland Resource Assessment, released in June 2014, is the second major report based on these data. Among the key findings, this report shows over 80% of the Nation's 409 million acres of non-Federal rangeland in the 48 contiguous states is in a relatively healthy condition and has no significant soil, hydrologic or biotic integrity problems based on rangeland health attributes. Non-native species are present on over half (53.8% ±1.0%) of the Nation's non-Federal rangeland. Invasive annual bromes are present on 30.1 (±1.0) percent of the Nation's non-Federal rangeland, cover at least 50 percent of the soil surface on 3.0 (±0.3) percent of these lands and make up at least 50 percent of the relative plant canopy cover on 1.7 (±0.2) percent of these lands. While mesquite species are present on 15.2 (±0.8) percent of the nation's non-Federal rangeland, they are present on only 4.5 (±0.4) percent in areas where they have not been part of reference conditions. Estimates for other quantitative data are reported for bare ground, inter-canopy gap size, and soil aggregate stability data primarily to establish a baseline for long-term monitoring. NRI grazing land on-site data provide a rich source of information for a wide range of uses. They are used as input and to refine the Rangeland Hydrology and Erosion Model (RHEM) and the Wind Erosion Model (WEMO), and are made available for use in developing and updating Ecological Site Descriptions.

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346. NATIONAL TERRESTRIAL MONITORING: BLM RANGELAND RESOURCE ASSESSMENT. Michael "Sherm" Karl*; U.S. Department of the Interior-Bureau of Land Management, Denver, CO

ABSTRACT

Rangelands are the largest type of land in the United States, covering 830 million acres in the lower 48 states and 205 million acres in Alaska. The United States Department of the Interior, Bureau of Land Management (BLM) manages nearly 204 million acres of these rangelands. BLM is directed by Congress to manage the public rangelands to achieve multiple use and sustained yield of the renewable resources. To ascertain if sustained yield was being provided, Congress directed BLM to periodically and systematically inventory the public rangelands and report on current public range-

land conditions and trends. The BLM Rangeland Resource Assessment (RRA) is a first-of-its-kind report on the status and condition of renewable resources on federal rangelands managed by the BLM. The BLM RRA, conducted on about 150 million acres of federal rangelands in the 13 western states exclusive of Alaska, augments the National Resources Inventory Rangeland Resource Assessment (NRI-RRA) which the Natural Resources Conservation Service conducts on non-federal rangeland. BLM's RRA reports on the status and condition of soil and vegetation resources on BLM federal rangelands using elements from BLM's Assessment, Inventory, and Monitoring Strategy (BLM AIM Strategy) of a statistically valid sampling design with a standardized set of attributes and indicators. BLM utilized the same sampling design, the same field methods, and the same trained data collectors, as was done for the NRI-RRA, to collect data for the attributes and indicators. Attributes of rangeland health—biotic integrity, hydrologic function, and soil/site stability, and indicators—bare ground, soil aggregate stability, intercanopy gaps, and presence and abundance of exotic invasive plant species, are portrayed to characterize the yield (productivity) of BLM federal rangelands. BLM intends to produce periodic RRA's to report on the trend in status and condition of soil and vegetation resources and productivity on federal BLM rangelands.

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347. PRELIMINARY RESULTS FROM THE BLM'S WESTERN RIVERS AND STREAMS ASSESSMENT. Scott W. Miller^{*1}, Sarah Judson², Jennifer Courtwright², Steven G. Paulsen³, Anthony R. Olsen³, Philip R. Kaufmann³; ¹Bureau of Land Management/Utah State University, Logan, UT, ²Utah State University, Logan, UT, ³U.S. Environmental Protection Agency, Corvallis, OR

ABSTRACT

The Bureau of Land Management (BLM), in collaboration with the U.S. Environmental Protection Agency (EPA), is conducting its first Western Rivers and Streams Assessment (WRSA), a survey of the condition of BLM streams and rivers throughout the contiguous western U.S. The objective of the WRSA is to generate unbiased, quantitative estimates of baseline conditions from which regional and national aquatic priorities can be established and future conditions compared. The BLM is partnering with the EPA to intensify the National Rivers and Streams Assessment (NRSA) design on BLM lands, and implement sampling of perennial streams and rivers to accomplish this task. In this partnership, BLM is using a comparable survey design and field methods and indicators as are the EPA and State. This level of partnership maximizes the use of the generated data and makes best use of taxpayer resources available for monitoring. The WRSA is a component of the BLM's Assessment, Inventory and Monitoring (AIM) strategy designed to standardize data collection and facilitate science-based decision making on public lands. The WRSA will answer three central questions: 1. What percentage of BLM's streams and rivers are in good, fair or poor biological condition; 2. What is the linear extent of streams and rivers experiencing stressors such

as excessive nutrients, high salinity, excess fine sediments and invasive invertebrates; and 3. What is the risk posed by the observed stressors to biological condition? To answer these questions, the BLM will sample approximately 300 statistically representative sites between 2013 and 2015, in collaboration with the EPA and western states. In this presentation, we will share preliminary results on the chemical, physical and biological condition of BLM streams and rivers, the first-ever statistically valid estimates of aquatic resources managed by the BLM.

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348. EVALUATING STREAM CONDITIONS USING LONG-TERM MONITORING DATA COLLECTED BY FOREST SERVICE AND THE BLM. Eric K. Archer^{*1}, Christy Meredith², Robert Al-Chokhachy³; ¹US Forest Service, Logan, UT, ²USFS, Logan, UT, ³USGS, Bozeman, MT

ABSTRACT

The PIBO Effectiveness Program is a large scale stream habitat monitoring program on public lands throughout the interior Columbia and Missouri River drainages. The goal of the program is to evaluate the status and trends of stream condition and to relate the effects of land management back to trends in fish habitat conditions. To address these needs, we assess stream condition using multiple lines of evidence including water temperature, macroinvertebrate species loss and an index of physical habitat condition. PIBO's approach is to compare the status of stream conditions at sites in 'managed' watersheds (watersheds exposed to disturbance from various management actions) to habitat conditions at sites within 'reference', or relatively pristine, watersheds, which are used as a benchmark or expected condition. Because all streams are affected by natural disturbance, in assessing status we are most interested in how the range of stream habitat conditions expressed at managed sites compares to what would be expected if the stream had experienced only natural disturbance. For over 15 years the PIBO program has evaluated over 2400 sites across the study area. These sites are repeated on a five year rotating panel and ~ ¾ of them have been sampled 3 or more times.

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349. APPLYING AIM IN NEVADA FOR SAGE GROUSE HABITAT AND GRAZING MANAGEMENT. Mark T. Coca^{*}; Bureau of Land Management, Reno, NV

ABSTRACT

BLM manages 48 million acres in Nevada that provide diverse benefits including habitat for the Greater sage-grouse (*Centrocercus urophasianus*). BLM Nevada began collecting standard terrestrial AIM indicators state-wide in 2011 to determine resource conditions for sage grouse habitat assessment as well as other applications. Simultaneously, we have been conducting Rangeland Health Assessments at the same sites to provide additional qualitative information about rangeland processes such as erosion. We present how results from three years of monitoring are being applied and lessons learned for broad-scale AIM implementation. Sage-

brush cover and height, perennial forb cover and height, and invasive species cover are being used to determine objectives in ongoing Resource Management Plan amendments. These and many other indicators are also used to complete Land Health assessments for grazing permit renewals. The combination of quantitative AIM data with the rapid qualitative Rangeland Health Assessment has been particularly useful for this application. Finally, plant cover is being used to evaluate effectiveness of post-fire restoration treatments. The state-wide monitoring implementation model of dedicated, seasonal field crews hired through partnership with Great Basin Institute and located in BLM district offices has worked very well. Data analysis remains the biggest challenge. Overall, AIM is providing an unprecedented amount and quality of information to support management of BLM Nevada landscapes.

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350. ASSESSING THE CONDITION OF UTAH BLM PERENNIAL STREAMS: A PILOT OF THE BLM'S NATIONAL AQUATIC MONITORING PROGRAM. Justin Jimenez^{*1}, Scott W. Miller², Sarah Judson³; ¹BLM Utah State Office, Salt Lake, UT, ²Bureau of Land Management/Utah State University, Logan, UT, ³Utah State University, Logan, UT

ABSTRACT

Condition and trend information is critical to ensure the maintenance or improvement of riparian and stream systems under the BLM's multiple use doctrine. Historically, the BLM has lacked a quantitative, standardized monitoring program to assess the condition and trend of lotic systems at multiple spatial scales. We worked collaboratively with the BLM Assessment, Inventory and Monitoring (AIM) Strategy to pilot use of the AIM National Aquatic Monitoring Program to obtain unbiased estimates of the chemical, physical and biological condition of Utah BLM perennial streams at multiple spatial scales. Our results show that 29% of UT BLM, perennial streams are in good biological condition, 32% in fair and 38% in poor biological condition compared to least-disturbed reference sites. Of the four UT BLM districts, the Canyon Country and Green River Districts present the greatest concerns, with 49% and 52% of stream kilometers in poor biological condition, respectively. The most ubiquitous stressors were excessive nutrient loading (64% of stream kilometers), salinity loading (62%) and riparian alteration (20%). In contrast, less than 10% of UT BLM stream kilometers have excessive sediment loading, thermal pollution or invasive invertebrates. For indicators with the greatest extent of stream kilometers in poor condition, we are using data from the BLM Rapid Ecoregional Assessments to identify the land uses associated with departures from expected conditions. For example, 65% of the spatial variability in salinity exceedances was related to the percent of agricultural activity, hydrologic alteration and oil and gas development within a watershed. UT BLM is using this data state-wide as an overall report card for the health of BLM streams systems, while at the district level aquatic restoration and conservation priorities are being established.

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*Presenter

351. MONITORING FOR ADAPTIVE MANAGEMENT IN ALASKA'S ARCTIC. Tina V. Boucher^{*1}, Scott Guyer²; ¹University of Alaska Anchorage, Anchorage, AK, ²Bureau of Land Management, Anchorage, AK

ABSTRACT

At 9.3 million hectares, the National Petroleum Reserve – Alaska (NPR-A), located on Alaska's North Slope, is the largest single block of federally managed land in the United States. The land in and around NPR-A is home to several Inupiaq villages whose residents use NPR-A's resources to support a subsistence lifestyle. Current management direction mandates the development of oil and gas resources while ensuring the protection of vital subsistence resources and wildlife habitat. To this end, NPR-A was selected as a demonstration area for implementing BLM's Assessment, Inventory and Monitoring (AIM) program in Alaska. AIM implementation began with framing the issue through identification of management questions and monitoring objectives. A conceptual ecosystem model was developed to outline hypotheses on the structure and function of landscapes within NPR-A. Through this process, a set of ecosystem indicators emerged which included AIM Core Indicators as well as a suite of supplemental indicators selected to monitor permafrost landscapes. A biophysical landscape stratification provides the backdrop for sample location selection. Given the logistical constraints of sampling across a vast landscape, a two-stage approach was developed whereby point locations were clustered within randomly selected blocks. Summaries of indicators by biophysical strata show clear differences between strata across this heterogeneous landscape, providing important baseline information about landscape variability within this remote region of the Arctic. Remote sensing techniques are under development using high-resolution aerial photography acquired at sample locations to extract monitoring indicators. These techniques will extend the functionality of field data and improve efficiency of data collection. The AIM Strategy will move the BLM toward a new paradigm where core data describing resource conditions are digitally collected in the field, stored in spatially enabled databases, and analyzed to determine the impact and effectiveness of management decisions pertaining the development of the oil and gas resources in NPR-A.

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352. USING AIM CORE INDICATORS FOR SAGE-GROUSE HABITAT MANAGEMENT: AN EXAMPLE FROM NORTHERN CALIFORNIA. Dereck Wilson^{*1}, Sarah E. McCord², Emily Kachergis³, Kenneth R. Collum⁴, Andrew Johnson⁴; ¹Bureau of Land Management, Redding, CA, ²US-DA-ARS, Las Cruces, NM, ³BLM, Denver, CO, ⁴Bureau of Land Management, Susanville, CA

ABSTRACT

The conservation and management of greater sage-Grouse (*Centrocercus urophasianus*) and its habitat is one of the Bureau of Land Management's (BLM) priorities. To effectively manage greater sage-grouse populations, we recognised

the need to collect information about the habitat across the landscape to support adaptive management decisions. The Eagle Lake Field Office has used BLM's Assessment Inventory and Monitoring (AIM) core terrestrial indicators in conjunction with other information to assess habitat conditions and to inventory important resources needed by sage-grouse. Through the assessment we were able to identify several issues potentially affecting the survival of sage-grouse across the landscape such as loss of habitat as a result of fire, invasive annual grass expansion, and juniper encroachment. AIM monitoring points were collected in 2013 and 2014 to answer several management question including the status and trend of sage-grouse habitat condition. The use of the core indicators monitoring data, coupled with sage-grouse telemetry data and local knowledge about sage-grouse habits, have resulted in prioritized actions to be taken in subsequent years to improve the chance of the bird's survival into the future. Actions include: restoring sage-brush steppe vegetation, removing juniper invading into habitat, protecting important areas from wildfire, establishing new stands of sagebrush, and establishing site specific objectives for livestock grazing and wild horse and burro management to maintain sage-grouse habitat. This example shows the utility of AIM data for adaptive management of sage-grouse habitat.

353. MONITORING OF NATIONAL CONSERVATION LANDS: GRAND STAIRCASE-ESCALANTE AND AGUA FRIA NATIONAL MONUMENTS. Kevin H. Miller¹, Paul Sitzmann^{*2}; ¹BLM, Kanab, UT, ²BLM, Phoenix, AZ

ABSTRACT

The Bureau of Land Management's National Conservation Lands contain 27 million acres of some of the West's most spectacular landscapes. Their mission is to "conserve, protect, and restore these nationally significant landscapes that have outstanding cultural, ecological, and scientific values for the benefit of current and future generations." One strategic goal is to better incorporate science into management, decision-making and outreach. In support of this mission, the Bureau's Assessment, Inventory and Monitoring (AIM) Strategy has been implemented to determine resource conditions across several National Conservation Lands units. This presentation will focus on two case studies, the Grand Staircase-Escalante National Monument (GSENM) and the Agua Fria National Monument (AFNM). At GSENM, land managers are interested in vegetation condition to inform grazing management decisions at planning and implementation scales. AIM terrestrial core indicators were collected in 2013 and 2014. AIM data were used with ecological site descriptions and rangeland health monitoring data to determine plant community composition for spatially-explicit forage availability estimates for land use planning, and in allotment-scale grazing management. Future applications include incorporating remote sensing into monitoring, and inventorying and assessing current condition and trends of additional Monument resources. At AFNM, the AIM terrestrial core indicators were collected in 2012 in partnership with The Nature Conservancy, Arizona Game and Fish Depart-

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ment and many other stakeholders. The resulting information was used to collaboratively develop resource objectives related to grazing and wildlife habitat. Future goals are to use the AIM core indicators to monitor resource conditions and inform adaptive land management decisions as well as continuing collaborative partnerships. These case studies highlight 1) how implementing the AIM Strategy supports National Conservation Lands mission and goals; 2) the utility of terrestrial core indicators for multi-scale grazing management decisions; and 3) the value of collaborative monitoring.

354. DISTURBANCE AND RECLAMATION MONITORING FOR OIL AND GAS DEVELOPMENT IN THE WHITE RIVER FIELD OFFICE. Zoe M. Miller^{*1}, Mary Taylor², Emily Kachergis³, Nelson G. Stauffer⁴, Sarah E. McCord⁴, Sarah F. Lamagna⁵; ¹Bureau of Land Management, Taos, NM, ²Bureau of Land Management, Meeker, CO, ³BLM, Denver, CO, ⁴USDA-ARS, Las Cruces, NM, ⁵Bureau of Land Management, Denver, CO

ABSTRACT

Ensuring successful reclamation of rangelands after oil and gas development is a major challenge in ecosystem management, especially in areas experiencing rapid development as well as those inhabited by greater sage-grouse (*Centrocercus urophasianus*). The Bureau of Land Management (BLM) in western Colorado is addressing this challenge by gathering monitoring data at multiple scales to improve the reclamation management process. In 2011, data collection of core terrestrial indicators began across BLM lands in the White River Field Office. Indicator estimates for different types of land across the broader landscape 1) provide baseline information about ecosystem conditions and variability and 2) help land managers set realistic and achievable objectives for reclamation. We also developed and piloted the collection of the terrestrial core indicators within reclaimed areas, including modifications to plot arrangement to accommodate different pad and pipeline shapes. We demonstrate that monitoring of reclaimed areas using standardized methodology can be used to verify that objectives and reclamation success criteria have been achieved. Disturbance and reclamation data will be tracked through an innovative data management system developed in partnership with the USGS. This effort represents a promising avenue forward for promoting reclamation success in an area with critical sage-grouse habitat, while also supporting many other ecosystem management applications.

355. INTEGRATION OF AIM WITH LANDFIRE FOR BROAD SCALE VEGETATION MONITORING. Henry Bastian^{*1}, Matthew R. Bobo²; ¹US Department of the Interior, Boise, ID, ²BLM, Denver, CO

ABSTRACT

LANDFIRE has been producing and updating land cover data products across all 50 United States for a decade. Although many have thought of it as only a wildland fire data set, the

rich array of data layers and databases (vegetation type, cover, and height; successional state and transition models and database; to national plot and polygon databases) have fundamentally improved information integration and decision support for managers and leadership across rangeland, fire, habitat, and natural resources. This presentation will explore the background and depth of the LANDFIRE program in advancing data integration and program partnerships in leveraging authoritative data sources through Earth observation computing, image and data processing to expand the utility and frequency of geographic land cover data. We will also look at the future of the LANDFIRE program to improve the suite of data products. LANDFIRE is expanding to cover larger geographic areas (insular areas), improving mapping change, and increasing data extents and processes to quantify both the state and condition of the landscapes with consistent wall to wall data. Integrating Bureau of Land Management's AIM (Assessment, Inventory and Monitoring) strategy data in LANDFIRE will provide managers with a consistent and efficient data framework that can be used at the field office, regional and national levels. The BLM AIM approach of collected quantitative data on the status, condition, trend, amount, location and spatial pattern of data supports LANDFIRE's national approach to mapping the diversity of all lands regardless of ownership for sustainable resources management. One example of BLM/LANDFIRE partnership and data integration efforts is the development of automated mapping keys that will enable species composition data collected by the BLM to be used directly in remapping efforts that will lead to improvements the characterization of grassland and shrublands systems in the West.

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356. REMOTE SENSING CHARACTERIZATION AND MONITORING OF SHRUBLAND COMPONENTS ACROSS THE WESTERN UNITED STATES. Collin Homer*¹, Matthew R. Bobo²; ¹USGS, Boise, ID, ²BLM, Denver, CO

ABSTRACT

Shrubland ecosystems occupy a large portion of the terrestrial surface over the conterminous United States and provide unique ecosystem services that are dependent upon the quality and quantity of this ecosystem. Most shrublands are located in arid and semiarid environments and are vulnerable to external disturbances such as grazing, human development activities, wildland fire, and climate change. The ability to quantify and understand how shrub canopy distribution and density changes modify terrestrial ecosystems and affect environmental conditions - and then ultimately monitor those changes is vital for both land management and scientific research. The USGS, BLM and other Federal partners are collaborating on producing a remote sensing-based quantification of western U.S. shrub lands. Products provide a 30 meter per-pixel canopy estimate of several main shrubland components including all shrub, sagebrush, herbaceous, annual herbaceous, litter, bare ground and shrub height. This approach relies on three major steps including creating training datasets using field measurements and high resolution satellite imagery at selected

sites, extrapolating these training datasets to the landscape level using medium resolution satellite images, and validating the final products with independent field measurements. Research has shown this approach quantifies landscape components in such a way as to enable successful monitoring. 2013 products have been developed for Southwest Idaho, Southeast Oregon, Northwest Nevada and Northeast California. 2014 products will include the Mojave Desert, the Great Basin, western Utah and southern Idaho, with other areas planned for subsequent years. Products will be integrated into the National Land Cover Database for future updating and monitoring. Products will also be directly used to support a variety of BLM activities including providing monitoring data for the inter-agency sage grouse initiative and the Assessment, Inventory, and Monitoring (AIM) program.

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357. FINE SCALE MONITORING WITH UNMANNED AERIAL SYSTEMS. Chris J. Cole*¹, Matthew R. Bobo¹, Brian Hadley¹, Samuel Cox²; ¹BLM, Denver, CO, ²BLM, Cheyenne, WY

ABSTRACT

The Bureau of Land Management (BLM) is a leader in the use of small unmanned aerial systems (sUAS) to fill the critical data gap faced by federal agencies in managing natural and cultural resources on public lands. Use of these platforms enables agencies to collect very large scale aerial (VLSA) imagery at sub-centimeter spatial resolutions, which is necessary to capture data for species composition and to provide field office personnel with data that are relevant on a localized project scale. VLSA imagery can be used to support decision-making for land management operations for applications including invasive weed control, micro-soil erosion monitoring, verification of the populations of potentially endangered species, and the rehabilitation of lands damaged by wildland fires. Additionally, sUAS represents a cost effective method for capturing VLSA imagery in locations that are difficult and/or unsafe to access with traditional field sampling strategies. BLM's Assessment, Inventory, and Monitoring (AIM) program relies in part upon an integrated remote sensing approach that leverages fine, moderate, and coarse scales of imagery to provide geospatial information that can be used to document land cover changes, cumulative impacts, unauthorized disturbances, and land treatment activities at the field, regional, and national scale. The AIM terrestrial indicators are comprised of a standardized set of quantitative methods that can be applied across all lands and ecosystems managed by the BLM for the measurement and analysis of key ecosystem attributes and their relevant status. The BLM has identified sUAS as an optimal imaging solution for capturing AIM's local and plot-level remotely sensed data requirements. VLSA imagery collected from sUAS platforms has been demonstrated to be an effective tool to supplement the sampling of large landscapes in order to generate estimates of rangeland attributes consistent with field-based measurements, and as validation information to support broader scale remote sensing efforts.

358. IMPLEMENTING AIM-BASED MONITORING FOR NATURAL RESOURCE MANAGEMENT. Jason W. Karl^{*1}, Sarah E. McCord², Emily Kachergis³, Jeffrey Herrick²; ¹USDA ARS Jornada Experimental Range, Las Cruces, NM, ²USDA-ARS, Las Cruces, NM, ³BLM, Denver, CO

ABSTRACT

Successful monitoring programs are built on clearly-defined objectives, thorough planning, and organized implementation. However, natural resource management decisions need to be made at many different organizational levels and scales – from local to national. Developing separate monitoring programs to address each of these levels can be an inefficient and costly approach. We present the monitoring process model that is used for design and implementation of Bureau of Land Management's (BLM) Assessment, Inventory, and Monitoring (AIM) monitoring projects. The AIM program provides a framework for collecting monitoring data which can be used many times for many objectives (e.g., land health assessments, Sage-grouse [*Centrocercus urophasianus*] habitat monitoring, grazing management). This framework places an emphasis on designing and implementing robust monitoring programs. While coordinated monitoring across scales is not always possible, the basic AIM principles (standardized core indicators and methods, statistically-valid sample designs, effective data management, and thorough documentation of the monitoring process) facilitate the use of monitoring data to answer the original objectives and allow for merging of monitoring data between efforts to meet additional objectives. The AIM monitoring implementation framework breaks the development and implementation of monitoring down into a series of achievable, iterative and documentable steps. These steps include: developing management and monitoring objectives; defining the monitoring area, stratification approach, and reporting requirements; selecting indicators and methods; developing data management and quality assurance/control procedures; establishing monitoring locations and collecting and evaluating monitoring data; and analyzing and interpreting monitoring results. Further, we discuss the various roles and skills needed for implementing a monitoring program. We illustrate the implementation steps and roles with examples from AIM projects in northern California and southern Idaho designed to inform land health assessments and evaluations of Sage-grouse habitat. Finally, we showcase tools, databases, and best practices available to assist in implementing AIM monitoring.

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359. HOW YOU CAN SUPPORT LANDSCAPE MONITORING, FROM COLLABORATIVE DESIGN TO DATA SHARING. Sarah F. Lamagna^{*1}, Emily Kachergis², Matthew R. Bobo²; ¹Bureau of Land Management, Denver, CO, ²BLM, Denver, CO

ABSTRACT

Data are the infrastructure of science and sound data are the foundation for good adaptive management decisions and improved conservation outcomes. As broad-scale con-

servation issues like sage-grouse drive land management to become more data intensive and collaborative, coordinated data collection and data sharing become even more important. Individuals and organizations outside the Bureau of Land Management (BLM) can support landscape monitoring through the BLM Assessment, Inventory, and Monitoring (AIM) Strategy in several ways. First, BLM implements standard data storage so that information is readily accessed, aggregated, shared, and used to evaluate and improve land management outcomes by BLM'sers and others. This is accomplished through electronic on-site data capture and centralized data management through BLM's national geospatial infrastructure. The AIM Strategy is enabling collaborative use of national monitoring data on rangelands by developing a national database (TerrADat) and analytical tools to provide easier data interpretation and assist in adaptive management decisions. Current and future use of these data include assisting in statewide sage grouse habitat mapping across political boundaries, developing ecological site descriptions, and using it as part of a national web data visualization and analysis tool. Second, non-BLM'sers can coordinate monitoring design, methods, data collection, and reporting with BLM AIM monitoring efforts, such that a consistent set of data is being collected across the landscape. The Forest Service, ranchers, and state environmental and wildlife agencies are working with BLM in this way at different locations and scales across the US. Through collaborative monitoring implementation and data sharing, you can help BLM achieve the AIM Strategy's goal of reaching across programs, jurisdictions, stakeholders, and agencies to provide key information for decision makers that can be collected once and used many times.

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360. KNOWLEDGE SOURCES, FLOWS, AND MANAGEMENT CHALLENGES. David D. Briske^{*}; Texas A&M University, College Station, TX

ABSTRACT

Management and scientific knowledge are both critically important to natural resource management, but tension often exists among them. Ecological scientific knowledge is necessary, but insufficient for effective natural resource management because it does not address human values and decision-making processes within human-ecological systems. Management knowledge has great value because it is derived from 'learning by doing', but it is seldom documented, and it is difficult to generalize and transfer to other applications because it is highly context specific. These knowledge sources have been developed by different actors, to achieve unique goals, and rely on separate approaches for their development so it should be expected that these sources occasionally support divergent management and policy recommendations. This establishes a clear need for a procedure to assess and blend existing management and scientific knowledge to synergistically inform natural resource management, in addition to the co-production of new knowledge among various stakeholders. Inconsistencies among man-

agement and scientific knowledge often originate from evaluation at inappropriate temporal or spatial scales, incongruous assumptions, or inappropriate framing of issues under consideration. Therefore, development of a framework capable of systematic evaluation of the assumptions, context, and conclusions of each knowledge source represents one approach to achieve this goal. A second approach involves the simultaneous, but independent, application of both knowledge sources to a common goal in an experimental setting so that the respective outcomes can be monitored. Agreement among knowledge sources will provide a robust knowledge base, while inconsistencies will provide hypotheses for further evaluation. The greatest short-term benefit of this procedure would likely be more constructive interaction, greater understanding, and increased trust among representatives of both knowledge sources.

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361. AN AGENCY KNOWLEDGE PERSPECTIVE. Pat L. Shaver* WOODBURN, OR

ABSTRACT

Professional agency knowledge is gained through education, experience working with managers and agency policy and ‘culture.’ It is unique in the scheme of knowledge transfer in that it is in the middle, between the researcher, or the developer of scientific knowledge, and the manager or practitioner of the management knowledge. Management and scientific knowledge are rarely exchanged directly, but rather flow through the programs and policies of land management and technical assistance agencies. Scientific knowledge is adopted and incorporated into the mission and culture of the agencies to support objectives and policies and it is modified by experience as well as changing societal demands and expectations. Professional agency knowledge defines the lens through which natural resource managers receive and interpret scientific knowledge, and scientists receive and interpret management needs. It is a major role of professional agency knowledge to bridge that gap between science and management. Understanding how scientific knowledge is developed and how management knowledge is applied is essential to professional agency knowledge and to the ability to communicate with both developer and user. Professional agency knowledge starts with education in the principles of rangeland ecology and management but that education must also include understanding and experience in business decision making skills, animal production and societal needs and desires. Professional agency knowledge is developed by working with managers and scientists over time, developing personal relationships and observing results of management actions based on scientific knowledge recommendations. It is very difficult to dedicate the time needed in today’s agency climates, and perceived gap between scientific knowledge and management knowledge to develop professional knowledge that meets the demands of the rangeland resources, the business enterprise and society.

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362. A SCIENTIFIC KNOWLEDGE PERSPECTIVE. Nathan F. Sayre*; University of California, Berkeley, Berkeley, CA

ABSTRACT

The strengths of scientific knowledge, based on methods of experiment, observation, deductive reasoning and hypothesis testing, are widely known. The limitations of these methods are less well understood, especially among policy-makers, and scientists are often not inclined to dwell on them. But these limitations have bedeviled rangeland management and policy for a very long time. Range science came into being because federal land management agencies needed to formulate policies that could simultaneously address both environmental and political problems. These twin crises compelled administrators to reach and implement conclusions well before scientists had had the time and resources needed to test and refine their theories fully, especially given the immensity and diversity of US rangelands. Of particular importance was the adoption of stable estimates of “carrying capacity” in public lands grazing leases, despite abundant evidence of extreme variability in forage production over space and time. This paper explores that crucial moment in the history of US rangeland policy in order to illuminate the management-science gap that we face today. The gap can be narrowed by scientific methods of inquiry, but only if humans—with all their variability and unpredictability—are included in the scope of investigation.

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363. MANAGEMENT RELEVANT SCIENCE. Justin D. Derner*¹, Kenneth W. Tate², David Augustine³; ¹USDA-ARS, Cheyenne, WY, ²University of California Davis, Davis, CA, ³USDA-ARS, Fort Collins, CO

ABSTRACT

Increasing understanding and exchange of various knowledge sources (experiential, experimental) for management of rangeland ecosystems entails approaches that use novel, participatory efforts to blend management, science and policy. Here, we showcase an example of management relevant science, and its strengths, weaknesses and needs in semiarid rangelands. Management relevant science, by definition, needs to be driven by desired outcomes within the operational context (ranch, grazing allotment) and constraints (human capital, biophysical resources, financial reality) of the manager/enterprise. Fundamental to the success of management relevant science, therefore, is a trusted partnership between managers and scientists for 1) clearly articulated outcomes, 2) well-defined, measureable and time-specific objectives, 3) applicable management practices to achieve these objectives, and 4) relevant metrics to measure/monitor for key attributes in order to provide time-sensitive (both within and between year) feedback that facilitates adaptive management to attain objectives. Logistical weaknesses of management relevant science include: 1) conducting replicated experimental designs at management-applicable scales (i.e., large pastures) and with relevant “control” treatments, 2) collection of large amounts of monitoring data for

scientific evaluation for documented changes in many ecosystem attributes (vegetation, soils, water, wildlife), 3) determining thresholds/triggers for management actions that are applied consistently throughout the duration of the experiment to prevent confounding issues, and 4) maintaining active and effective communication between managers and scientists. Needs for management relevant science encompass: 1) human dimensions (respect for opinions of all involved, maintenance of objectivity, decision-making), 2) economics (inputs, outputs, costs, time/labor, assigning values to non-commodity products/services), 3) "on the ground, in the field" meetings with managers and scientists to discuss effects of management actions, and 4) having a facilitator to promote active involvement by all participants during meetings. Successful application of management relevant science will strengthen conservation-production partnerships, as well as facilitate increased information uptake by managers.

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364. BEYOND NIFA'S INTEGRATED PROGRAMS: REQUIRING STAKEHOLDER CO-PRODUCTION AS AN INCENTIVE TO LINK SCIENCE WITH MANAGEMENT. James P. Dobrowolski*; USDA, Washington, DC

ABSTRACT

Within NIFA, the unique concept of integration is defined as bringing the three components of the agricultural knowledge system research, education and extension (REE) together focused on an issue. Integration can be at the project or program level mixing REE project work. Having an integrated authority compels coordination among REE components with budget recognition and REE-specific objectives. A project or program is optimally integrated if the components complement one another and are truly necessary for its ultimate success. Integrated projects support multifunctional, multi-institutional and multistate involvement to better realize needs and objectives, and to speed up the process of generating, translating and transferring new technology and knowledge. The Integrated Research, Education, and Extension Competitive Grants Program was authorized by Congress in Section 406 (7 U.S.C. 7626) of the Agricultural Research, Extension, and Education Reform Act of 1998 (AREERA) to fund the National Integrated Water Quality (NIWQP) and the Integrated Pest Management Programs (IPM), both examples of integrated programming successfully imposing collaboration among the REE components. Given that the relationship between management and scientific knowledge has received little attention, then observing the way NIFA deploys integration as the keystone requirement of a call for proposals is at best improving the transferability of science, and at worst, ignoring the ability to move REE outcomes toward behavior change and adoption. Expanding integration with stakeholder co-production as a competitive review requirement could strengthen or improve recognition of management linked with science. As a first step, NIFA will evaluate a sample of its award portfolio to identify possible correlations between integration and stakeholder involve-

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ment, followed by brainstorming a new vision for integration that requires co-production. For example, develop call for proposals language stronger than the typical nonbinding request to engage and collaborate with community groups during proposal development and throughout the life of the project.

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365. CO-PRODUCING AND SHARING KNOWLEDGE IN THE US AND INTERNATIONALLY: EPISTEMOLOGY, PRINCIPLES, CASES AND LESSONS. Robin Reid*, Maria Fernandez-Gimenez; Colorado State University, Fort Collins, CO

ABSTRACT

Today, the traditional, 'loading dock' model of science, where science delivers the answers (on the dock) for knowledge users to collect, is being transformed into new models of knowing our world. Range scientists reach out to pastoralists and ranchers around the world to integrate their long-term observations and ranch experimentation with scientists' knowledge collected through controlled repetition and manipulation of causes of change. Pastoralists and ranchers sometimes welcome opportunities to work more closely with scientists, especially when their own knowledge is fully recognized and integrated, and egalitarian co-production methods are used. Agency managers can serve as crucial 'boundary spanners' who attempt to integrate different sources of knowledge. In many developing country settings, NGO personnel often fill this boundary spanning role. We will start with a short overview of different ways of knowing and perspectives of what constitutes 'truth' in the cultures of science, management and those of other stakeholders. We will then describe some principles in use around the world to bring together diverse sources of knowledge or, more broadly, ways of knowing. These include practical methods such as workshops to brainstorm research questions and methods, rancher-led research projects, integrated manager-scientist field teams, 'what does it mean' workshops to interpret data, and co-production of knowledge products. We will then propose a general model for integrating different knowledge sources and co-production of knowledge, based on our case studies. We will conclude with a description of future directions for co-production and the potential for co-produced knowledge to be a catalyst for social change.

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366. NOVEL PARTICIPATORY RESEARCH APPROACHES TO INTEGRATE EXPERIENTIAL AND EXPERIMENTAL KNOWLEDGE ON RANGELAND MANAGEMENT AND CONSERVATION. Kenneth W. Tate*¹, Leslie M. Roche², Justin D. Derner³; ¹University of California Davis, Davis, CA, ²University of California, Davis, Davis, CA, ³USDA-ARS, Cheyenne, WY

ABSTRACT

Rangeland ecosystems encompass diverse lands across the globe, representing complex coupled human and natural systems in which conservation goals must be balanced with

the economic realities of agricultural production. Ranchers make decisions and adapt their management for multiple outcomes across numerous scales in response to the dynamic social-ecological systems within which their ranch enterprises are embedded. Rangeland research has predominantly focused on comparisons of a few biophysical outcomes between fixed treatments implemented over fine spatial and temporal scales. In the adaptive decision-making process, place-based expertise, trial-and-error learning, and heuristics passed on through generations and local knowledge networks all function to determine agricultural strategies and perceptions of management successes or failures. Integrating management and research knowledge bases will require enhanced collaboration between scientists and managers. Scientists must work with ranchers to identify and quantify the social, economic, and/or ecological benefits ranchers are deriving from their management strategies. Managers must become active participants in the design, implementation, and interpretation of management studies conducted at scales relevant to on-ranch conditions, decision-making, and adaptation. Novel, large scale, participatory research approaches are required to advance our collective understanding of on-ranch adaptive management strategies, and the mechanisms by which these place-based strategies provide the goods and services managers expect. Our project team has developed a multipronged approach to directly integrate management and science in addressing the challenges of providing for multiple and diverse outcomes on working rangelands, and to gain insights into decision-making and adaptation on rangelands. Here, we highlight collaborative research based on 1) surveys of over 800 ranchers in CA and WY, 2) semi-structured interviews of over 100 California ranchers, and 2) a long-term, stakeholder prescribed adaptive grazing strategy study. Results discussed will include ranchers' goals, perceptions about management practice effectiveness, on-ranch rotational grazing strategies, drought adaptation strategies, and views on climate change and risk.

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367. HAWAII'S DIVERSE RANGELAND ECOTYPES. Joseph A. May*; University of Hawaii, Kamuela, HI

ABSTRACT

Generally, the major range and forage types of Hawaii, which are principally naturalized plant communities, with a steady-state disclimax, can be categorized into about six groups. However, there are other, more seldom-occurring naturalized groups, and even less-often-occurring native, historic climax rangeland plant communities still present. The principal six naturalized range and forage types that typically compose a good majority of the grazing land acres are 1) Leeward Coastal Desert range type, 2) Leeward Semiarid Midgrass Steppe range type, 3) Subhumid and Humid Tallgrass range types, 4) Temperate Subhumid range type, 5) Humid Lowland/Humid range type, and 6) Humid Very Tall Grass range type. In this presentation, I focus on these six naturalized range and forage types that occur on six of the

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eight major Hawaiian islands (Kauai, Oahu, Lanai, Molokai, Maui, and Hawaii). The islands of Niihau and Kahoolawe are not included as I have no field experiences on these two other major islands. I have elected to present the ecological dynamics of each range type in a traditional Clements–Dyksterhuis range condition model for simplicity of reading and understanding. I hope to assist conservationists or professional agriculturalists in understanding the average annual forage production and ecological dynamics to better inform them for decision-making on ranches and public rangelands in the state of Hawaii. Key Words: Hawaii; range types; Clements–Dyksterhuis range model

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368. SOIL DIVERSITY AND IMPLICATIONS FOR RANGELAND MANAGEMENT IN HAWAII . Jonathan Deenik*; University of Hawaii, Honolulu, HI

ABSTRACT

The eight main Hawaiian Islands show a tremendous diversity of soil types despite their small combined land area of approximately 6,420 mi² (16,628 km²). Ten of the twelve soil orders are represented exemplifying Hawaii's tremendous biodiversity. Soils vary dramatically over small distances in Hawaii because the factors contributing to their formation also vary dramatically. The effect of time on soil diversity is evident when we compare the soils on Kauai with the soils on the island of Hawaii. At about 5 million years old, Kauai is the oldest island and it shows the greatest diversity with ten soil orders, whereas Hawaii is the youngest at 500,000 years old and has six soil orders represented. Likewise, the effect of rainfall on soil differentiation is clearly exhibited as you move from the dry coastal lowlands to the moist ridges of most islands. This diversity presents several challenges, but also opportunities, for rangelands. Judicious management of Hawaii's rangeland and pasture for grazing requires an understanding of soil diversity and its implications for soil fertility and forage production. With the significant reduction of land in sugarcane there is a unique opportunity for the Hawaii livestock industry to expand. Most of these lands, once abandoned, developed into grasslands where Guinea grass (*Panicum maximum* Jacq.) is now the dominant species. The soils on former sugarcane lands tend to be strongly acidic and deficient in important plant nutrients like N, P, K, and Ca and thus may limit the productivity of forages. Field trials show that despite low fertility, Guinea grass can be productive with careful grazing management and highly productive with added N fertilizer. Understanding animal and plant responses to soil management is key for prioritizing improvements especially in Hawaii's diverse soil environment.

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369. GRAZING MANAGEMENT FOR TROPICAL GRASS-FINISH BEEF PRODUCTION. Mark Thorne^{*1}, Glen Fukumoto², Yong-Soo Kim³, Chin N. Lee³, Matthew Stevenson⁴, Melelani Abran⁵; ¹University of Hawaii - Manoa, Kamuela, HI, ²University of Hawaii at Manoa, Kealakekua, HI, ³University of Hawaii-Manoa, Honolulu, HI, ⁴University of Hawaii at Manoa, Lihue, HI, ⁵University of Hawaii-Manoa, Kamuela, HI

ABSTRACT

The high cost of importing concentrate feeds into Hawaii brought about the demise of the feedlot industry in the early 1990's. Consequently, for the past twenty-five years the state has shipped the majority of its annual calf-crop to mainland stocker-finisher programs. In recent years the rising cost of shipping these weaned calves to the mainland has sparked interest in grass-finished beef production as profit margins shrink. Higher in essential fats such as omega-3s, forage-finished beef is perceived and marketed as a healthier choice than grain-fed beef; often commanding a premium above commodity beef prices. However, successful grass-finished beef production in the tropics requires different management tactics than conventional stocker-feeder programs. Grass-finished beef quality is a function of genetics, forage quantity and quality over the production cycle, age of animal at slaughter, and climatic conditions that affect forage production and animal performance. A thorough understanding of the interaction between these factors is critical to the success of forage-finished beef production in Hawaii. This presentation will highlight over twenty years of research by the University of Hawaii into various aspects of grass-finish beef production in the tropics. Results of these investigations have facilitated the development of recommendations for weight to age ratios of animals at slaughter, and herd management, pasture improvement and grazing management practices. The University of Hawaii has made significant contributions to the development of tenderness standards for grass-finished beef products.

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370. EVALUATION OF INCORPORATING AN IMPROVED LEUCAENA FORAGE FOR GRASS-FED BEEF PRODUCTION IN HAWAII. Glen Fukumoto^{*1}, Yong-Soo Kim², Perry Kealoha³; ¹University of Hawaii at Manoa, Kealakekua, HI, ²University of Hawaii-Manoa, Honolulu, HI, ³Kamehameha Schools, Land Asset Division, Kailua-Kona, HI

ABSTRACT

In Hawaii, there is an increasing demand by consumers to purchase locally grown agricultural food products. Within this food movement, demand for grass-fed beef is increasing and providing an opportunity for beef cattle producers to enter into this segment of the industry. However, the production of quality grass-fed beef in tropical pastoral systems is often limited by the high carbon and low nitrogen content of the forages, leading to low rates of gain, extended production time, and compromised carcass quality characteristics. With interest in expanding the grass-fed beef production sector in Hawaii, a study was initiated to evaluate the incorporation of

an improved variety of a high protein tree legume, leucaena (*Leucaena leucocephala* cv. Wondergraze), on animal growth performance, days to market and carcass and meat quality traits. Two treatment pastures were developed; the predominant grass in the control pasture was guinea grass (*Panicum maximum*) and the treatment pasture a mix of 60% guinea and 40% leucaena. Twenty-five crossbred weaned steers were randomly assigned to each pasture group and managed identically. Preliminary results show a significant improvement in average daily gain by leucaena incorporation (1.63 vs 1.17 lb/day). The average days to market at about 1,300 lb live weight were 432 days for the leucaena pasture and the animals in the guinea pasture are yet to reach the market weight. Carcass and meat quality traits will be analyzed and compared at the completion of marketing of all steers in the study.

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371. CONDITIONED PREFERENCE TRAINING OF LIVESTOCK FOR TROPICAL WEED MANAGEMENT. Matthew Stevenson^{*1}, Mark Thorne²; ¹University of Hawaii at Manoa, Lihue, HI, ²University of Hawaii - Manoa, Kamuela, HI

ABSTRACT

Hawaii ranchers identified reducing input costs as a priority for research and education. Cost of ranch inputs such as herbicides are high owing to lengthy transportation distance to Hawaii. Incorporating different types of livestock in a grazing system to exploit inherent differences in their foraging behavior has successfully replaced herbicides for managing certain weeds. Despite these successes, some plants remain problematic as livestock avoid them altogether or do not eat enough to check their increase in pasture. A promising method developed on the U.S. mainland to train livestock to eat unfamiliar plants, still under development, has not been systematically pilot-tested and demonstrated across pasture types in the tropics. By experience and in consultation with collaborating ranchers, we identified the following species as weeds to target: *Asclepias physocarpa*, *Elephantopus mollis*, *Leonotis nepetifolia*, *Schizachyrium condensatum*, and *Sphagnetocola trilobata*. The training attempts to create positive associations with unfamiliar feeds with the goal of increasing intake of target weeds. Over the course of 5-7 days, twice daily we offered small amounts of unfamiliar but high quality feeds such as corn, oats, timothy hay, and others to cattle, sheep, and goats that had lived entirely on pasture. On the last two days of training, the morning feedings were skipped to increase interest and the target weeds were introduced. While the preference conditioning was successful for all target plants except *A. physocarpa* in that animals initially ate them to various degrees, pasture monitoring did not reveal trends in overall weed control. One exception was a notable reduction of *E. mollis* in sheep grazed pasture. This pilot study indicates that conditioned preference training holds potential for some tropical weeds, but that further steps such as increasing animal density or attenuating plant toxins with supplements may be necessary to augment this approach for better control.

372. SCHINUS TEREBINTHIFOLIUS AND INDIGOFERA SUFFRUTICOSA POTENTIAL FOR REDUCING INTERNAL PARASITES IN GOATS. Matthew Stevenson*; University of Hawaii at Manoa, Lihue, HI

ABSTRACT

Parasite resistance to anthelmintic drugs is a growing problem, especially in small ruminant operations in the tropics, leading to dramatically reduced profitability. Range goats readily eat both *Schinus terebinthifolius* and *Indigofera suffruticosa*, and some Hawaii ranchers have identified these tropical plants as potentially having anthelmintic properties. Twenty-four variously crossed 6-7 month old goats averaging 18kg were randomly assigned to one of three groups: *S. terebinthifolius* supplement (SS), *I. suffruticosa* supplement (IS), and a control with a grass supplement (C). Parasite loads were estimated by fecal egg count on Day 1, Day 7, and Day 14 of the trial. Treatment feeds were cut and stored in a refrigerator for no more than 48-hours prior to offering. Goats were penned by treatment overnight then given access to supplements at 8:00 for two hours. Goats were then released to graze freely in grass dominated pasture. At 18:00 each day, goats were again penned overnight with access to water only. Owing to low intake rates of treatment supplements, starting on Day 8 goats were put in separate paddocks by group and allowed access to supplements all day. Intake increased but remained low overall. All groups maintained higher than 1,000 eggs per gram (EPG) during the trial, a level considered to require treatment with anthelmintics. Average EPG did not show a significant trend in any group. While not statistically significant, SS showed a decrease in average EPG from 3,800 to 1,600. Individuals varied greatly in both their supplement intake and EPG, and in the case of SS the two may be correlated. After attempting to determine the cause of poor intake of otherwise readily eaten forages, this study will be repeated with particular attention to *S. terebinthifolius* and with individual feeding stations to estimate dose responses in any effects.

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373. DROUGHT MANAGEMENT TOOLS FOR HAWAIIAN RANGELANDS. Mark Thorne*¹, Glen Fukumoto², Matthew Stevenson³, Melelani Abran⁴; ¹University of Hawaii - Manoa, Kamuela, HI, ²University of Hawaii at Manoa, Kealahou, HI, ³University of Hawaii at Manoa, Lihue, HI, ⁴University of Hawaii-Manoa, Kamuela, HI

ABSTRACT

Sustainable livestock production is dependent on reliable forage resources that maintain animal health and fecundity. Temporal and spatial variation in forage production in most range systems is closely linked to the timing and amount of precipitation. Livestock producers often make grazing management decisions based on their knowledge of past or average forage production levels with little certainty that sufficient precipitation will fall in time to produce what is anticipated. The cumulative effects of inaccurate grazing management decisions are loss in soil fertility, increased rates of soil

erosion, and establishment of weeds. Research has linked global precipitation patterns with the occurrence of grass, shrub, and forested lands and provided regression functions relating Aboveground Net Primary Production (ANPP) with Mean Annual Precipitation (MAP). These tools are sometimes used to understand the impacts of drought on forage production for a given land unit. However, these globally derived functions are of limited use for making management decisions as they cannot account for temporal and spatial precipitation patterns that also influence forage production. Managers faced with difficult decisions can be more proactive with the development and use of indexes that account for locally derived variations in precipitation and primary production. This presentation will highlight the research and development of the Hawaii Rainfall and Forage Production Index that is used for forecasting forage production and suitable stocking rates, drought planning and mitigation, and development of prescribed grazing standards.

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374. EFFECT OF TERRAIN HETEROGENEITY ON FEEDING SITE SELECTION AND LIVESTOCK MOVEMENT PATTERNS. Derek W. Bailey*¹, Mitch Stephenson¹, Marco Pittarello²; ¹New Mexico State University, Las Cruces, NM, ²University of Torino, Grugliasco, Italy

ABSTRACT

Feeding site selection is a critical part of livestock foraging that can constrain and/or increase choices available during diet selection. When livestock choose new feeding sites, vegetation and nutrient profiles can differ from previously visited sites. The objective of this study was to evaluate how terrain and corresponding heterogeneity may affect cattle feeding site selection patterns. Grazing patterns of mature cows were evaluated on 6 ranches located in Arizona, Montana and New Mexico. Eleven to 19 cows were tracked for 1 to 3 months at each ranch using global positioning system (GPS) collars. Positions were recorded at 10 or 15 minute intervals and used to identify where cows grazed during the early morning (0500 to 1000 hours). Pastures (336 to 9740 ha) at each ranch were divided into 7 to 9 sections (48 to 1082 ha) as an indicator of feeding sites. Classification was based on cattle density and topographical and vegetation types. Sequences of selected sections were evaluated using transition matrices. For all ranches, the sequence of section selection differed from what would be expected by chance indicating that the section selected on the following day depended on the section selected on the previous day. For ranches with relatively gentle terrain, cattle selected a different feeding site each day for about 70% of the tracking period. In contrast, cows at the ranch with the most diverse terrain stayed in the same feeding site for over 10 successive days for 42% of the tracking period. Smaller pastures with only mountainous terrain were intermediate. Cows grazing gentle topography alternate among feeding sites (sections in this study) more frequently than cows grazing in pastures with more rugged topography. This pattern could potentially help livestock mix forages and select a more diverse diet.

375. BEHAVIORAL SYNDROMES IN RANGELAND-BASED BRANGUS COWS. Laura E. Goodman*, Andres F. Cibils, Lyndi Owensby, Derek W. Bailey; New Mexico State University, Las Cruces, NM

ABSTRACT

Consistent behavioral differences among individuals across situations/time are known as behavioral syndromes (BSY). BSYs are suites of correlated behaviors which are used to classify animals into behavioral type groups. The BSY approach to studying individual variation in livestock behavior could be useful to identify individuals that are best suited to harsh grazing environments. However, we do not know whether cattle with BSYs adapted to one foraging context (rangelands) exhibit similar levels of adaptation to other foraging environments (feedlot confinement). We conducted tests to examine statistically detectable ($P \leq 0.1$) correlations between rangeland vs. confined arena behaviors of 12 adult Brangus cows selected on the basis of their supplement consumption rate (SCR) in confinement, a test previously used to identify animals with contrasting BSYs. Cows with higher SCR explored smaller areas of rangeland pastures ($r = -0.52$; $P = 0.1$), traveled shorter distances on rangeland during daytime hours (-0.71 ; $P = 0.01$) but longer distances at night ($r = 0.54$; $P = 0.08$), and tended to exhibit more sinuous travel trajectories ($r = -0.51$; $P = 0.11$). Cows that traveled longer distances during 24 h periods on rangeland exhibited faster chute exit velocities ($r = 0.56$; $P = 0.07$), lower levels of boldness ($r = -0.53$; $P = 0.09$) and marginally higher vigilance ($r = 0.50$; $P = 0.12$) while foraging in an arena containing a predator decoy. They also consumed less unfamiliar feeds in confinement ($r = -0.55$; $P = 0.08$). Cows with more sinuous trajectories while traveling on rangeland also exhibited slower chute exit velocities ($r = 0.6$; $P = 0.05$) and showed higher levels of boldness in the predator decoy arena tests ($r = -0.70$; $P = 0.02$). Individuals better adapted to explore large desert pastures, might be less well adapted to confined foraging contexts where they appear to exhibit higher levels of shyness and food neophobia. More research is needed to determine whether Brangus mother cows that exhibit desert-adapted BSYs raise calves that are less well adapted to feedlot confinement.

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376. CATTLE GRAZING ON FALLOWS FROM THE ANDEAN AREA SOUTH OF COLUMBIA. Carlos Alvear¹, Jairo R. Mora-Delgado*², Gisou Diaz²; ¹M.Sc. student, Universidad del Tolima, ibague, Colombia, ²Universidad del Tolima, ibague, Colombia

ABSTRACT

Traditional livestock production in Colombia has been developed on rangelands in flat and slope landscapes in the Andean area, which in the past were tropical forest. Tropical rangelands for cattle-rearing typically contain a wide variety of forbs, shrubs and grasses, which have important forage potential. Unfortunately, many of these plants, which have high nutritional value, have not yet been studied despite evi-

dence of high consumption by livestock. This study aimed at making an inventory of the floristic diversity of fallows grazed by cattle and evaluating the consumption of species under different scenarios, according to the topography of the land and season of year. In a preliminary inventory, around 108 species were identified, of which 36 were highly consumed by cattle (10 grasses; 26 forbs and shrubs). A completely randomized 2x2 factorial design was used, where the factors were season (dry and wet) and topography (slope and flat). The data were analyzed under a general linear mixed model, in which the farms, and within transects, was considered as a random effect. It was found that the factors (season and topography) have significant effects, and independently, the number of bites, while no significant interactions were found. In the rainy season, bite numbers are higher (288 ± 17) than in the dry season (263 ± 17). Furthermore, in the flat land there were more bites of grasses (327 ± 17) with respect to slopes (223 ± 17 bites). From this perspective, it is considered very important to redesign cattle grazing systems, using grazing distribution practices in fallows. In addition, cattle growers could establish a balance between conservation and grazing management, in order to find a dynamic balance in the system, by enrichment of herbaceous and shrub species and managing the selectivity of ruminants grazing on fallows.

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377. ASPEN INTAKE AND PREFERENCE BY SHEEP: IMPLICATIONS FOR HERBIVORY AND ASPEN DECLINE. Elizabeth A. Burritt*, Juan J. Villalba; Utah State University, Logan, UT

ABSTRACT

Quaking aspen (*Populus tremuloides*) is the most widely distributed tree specie in North America. It provides habitat for wildlife, improves water retention, and supports high levels of biodiversity. Browsing by ruminants is likely a key factor inhibiting aspen regeneration, but evidence indicates that not all aspen clones are equally susceptible to herbivory. Aspen produces chemicals, phenolic glycosides (PG) and tannins, which have been shown to deter herbivory and may affect intake of and preference for aspen leaves. We conducted two trials to determine 1) the effect of PG and tannins on intake of aspen leaves by sheep and 2) the preference for aspen leaves by sheep when offered with a forb (Utah pea; *Lathyrus pauciflorus*), and a grass (smooth brome; *Bromus inermis*); forages that may grow in the understory of an aspen stand. Poor intake of aspen leaves by sheep indicates plant secondary compounds likely regulate aspen intake. During the preference study, sheep ate all three forages, but preference for aspen increased by September. However, their preference for aspen was highly variable. Individual intake of aspen by sheep was also highly variable and persisted throughout the growing season. Young aspen trees produce very little forage dry matter. Based on our results, ruminants can consume a large number of aspen suckers even if aspen leaves only make up a small percentage of the diet.

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*Presenter

378. SEASONAL VARIABILITY IN DIET SELECTION BY SHEEP GRAZING AT THE SEMI-ARID RANGELANDS OF THE KORDOFAN REGION OF SUDAN. Mohammed M. Abdelkreim*, Babo M. FADLALLA; college of forstry and range science, khartoum, Sudan

ABSTRACT

This study was conducted at El- khuwei Locality, Kordofan region, Sudan. Two sites were selected, El-Rosa enclosure and a control in the open area nearby. This study investigated seasonal variability in diets selection by sheep grazing. Vegetation measurements were conducted and botanical composition of the diet selected by sheep was determined using the bite count technique. Moreover, voluntary feed intake was assessed using the product of the quantity of feces collected over a specific period of time and in vitro digestion coefficient of forage plants selected by sheep. During the flowering season, plants with highest relative preference index (RPI) in the enclosure were *Zornia* spp. (12.9), *Merremia* spp. (12.6) and *Desmodium* spp. (2.0). In the open range the plants with highest (RPI) were *Desmodium* spp. (15.9), *Ipomea eriocapa* (15.7) and *Echinochloa colonum* (5.1). The most important plants selected by sheep at the seed set stage within the enclosure as indicated by RPI were *Ceratothera* spp. (22.4), *Zornia* spp. (2.1), *Desmodium* spp., and *Eragrostis tremula* (1.7). In the open range the plants with highest RPI were *Desmodium* spp. (10.4), *Zornia* spp. (6.5) and *Ipomea eriocapa* (2.5). The crude protein (CP%) of biomass at flowering stage within the enclosure was 10.9%. That of the simulated diet at the same time was 15.3%. In the open range CP% of biomass was 10%. That of the simulated diet at the same time was 11.9%. Individual herbaceous plants found to contain high CP% were *Acanthus* spp. (18.4%), *Zornia* spp. (16.6%) and *Desmodium* spp. (16.6%). Sheep can select a diet superior to the average quality of the vegetation. The most preferred plants by sheep in this study were *Desmodium dichotomum*, *Zornia* spp., and *Ceratothera* spp.

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379. DO MOVEMENT PATTERNS OF GPS-TRACKED CATTLE ON EXTENSIVE RANGELAND PASTURES SUGGEST INDEPENDENCE AMONG INDIVIDUALS? Mitch Stephenson*, Derek W. Bailey, Adrienne Lipka, Steven Lunt; New Mexico State University, Las Cruces, NM

ABSTRACT

In grazing behavior studies, livestock within the same pasture usually are not considered as independent experimental units because of potential social interactions among individuals. However, treating individual animals as independent experimental units in extensive rangeland pastures may be useful for some experimental designs. The objective of this study was to evaluate the association patterns among Global Positioning System (GPS) tracked cattle grazing at 6 different study sites in the western United States. Association among 11 to 17 GPS-tracked cows grazing in herds ranging from 37 to 250 cows were analyzed over 33 to 90 d periods

using the computer program ASSOC1. Half-Weight Index (HWI) association values were calculated for each pair of GPS-tracked cows (i.e., dyad) at each study site to determine the proportion of time cattle were within 75 m and 500 m from each other. Cattle at 2 study sites exhibited relatively low mean HWI-association values (i.e. less than 0.23 HWI at 500 m); whereas, associations at the other study sites tended to have greater mean HWI associations (i.e., greater than 0.35 HWI at 500 m). Distinguishing features between study sites that had low and high association values were management of cattle prior to the study, herd size, pasture size, and number of watering points. At 5 of the 6 study sites, at least 75 % of all dyads had HWI association values less than 0.5 at 500 m, indicating that most of the GPS-tracked cows were greater than 500 m from each other for over 50 % of tracking period. While interactions among cattle in the same pasture are often inevitable, movement patterns of a sub-set of individual GPS-tracked cows grazing in extensive pastures may have levels of independence sufficient to be considered as individual experimental units under some situations.

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380. TARGETED SHEEP GRAZING IN AGRICULTURAL ECOSYSTEMS: EFFECTS ON COVER CROP, WINTER WHEAT, AND SHEEP GAINS. Jasmine K. Westbrook*, Craig Carr, Patrick Hatfield, Perry Miller, Fabian Menalled; Montana State University, Bozeman, MT

ABSTRACT

Targeted sheep grazing has been proposed as an alternative to conventional cover crop management. This study assessed the use of targeted sheep grazing to terminate a field pea (*Pisium sativum*) cover crop as part of a rotational winter wheat production system. Rambouillet yearlings grazed the cover crop for 32 days during summer 2013 either in rotational or continuous grazing systems. The effects on cover crop termination, sheep live weight gains, and subsequent winter wheat emergence and yield were quantified. Sheep grazing was compared with tillage and chemical termination methods. Sheep grazing was the most effective termination method using post-treatment plant cover (77% dead pea, 1% live pea, 22% bare ground), then tilled (60% dead pea, 5% live pea, 35% bare ground) and chemically treated (18% dead pea, 73% live pea, 9% bare ground) plots. Cover comparisons among treatments were significantly different ($p < 0.05$) except percent live pea cover between grazing and tillage. Average daily gains (ADGs) did not differ between grazing treatments with sheep exhibiting ADGs of 0.40 lbs day⁻¹ and 0.34 lbs day⁻¹, for rotational and continuous treatments, respectively ($p = 0.117$). Winter wheat seedling emergence post grazing was higher under the continuous grazing treatment ($p = 0.0172$). However, there was no difference in wheat yield ($p = 0.914$). Winter wheat yield did not differ between grazed and chemical termination (84.9 bu ac⁻¹ and 85.9 bu ac⁻¹ respectively), but was lower in tilled plots with 74.4 bu ac⁻¹ ($p = 0.0144$). Results indicate that targeted grazing is a viable method of cover crop termination.

381. STOCKMANSHIP TECHNIQUES TO FOLLOW GRAZING PLANS WITHOUT CROSS FENCING. Bob Kinford*; 2lazy4U Livestock & Literary Co, Van Horn, TX

ABSTRACT

It only takes a week or possibly two, of proper handling to instill herd instinct into cattle. Once this is done, it is a simple matter of picking up the herd when they are ready to come off water and start grazing them in the desired direction for the day. The training process is fairly simple as well, and consists of suggesting to the cattle they all come to water at the same time, then once again suggesting they go out to graze together. The key word is “suggest” as you are not actually “driving” the cattle but using a series of movements which take pressure off of the cattle to get them to go where you want. Presentation will include instilling herd instinct into a herd of 2,000 mother cows in Queensland, Australia and will show video from the rider’s point of view, as well as the POV from a third party.

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382. CONTINUOUS VERSUS ROTATIONAL GRAZING, AGAIN: ANOTHER PERSPECTIVE FROM META-ANALYSIS. Kristina M. Wolf*¹, Marc R. Horney²; ¹University of California, Davis, Davis, CA, ²Cal Poly, San Luis Obispo, San Luis Obispo, CA

ABSTRACT

In an effort to close the continuous- (CG) versus rotational-grazing (RG) debate that has roiled rangeland management discussions for over a century, Briske et al. (2008) reviewed 47 journal articles comparing CG with various RG systems. They used vote counting to tally the number of studies that found significantly greater, equal, or lower production for CG relative to RG for three response variables: animal (AP, both kg/head and kg/ha) and plant production (PP, kg /ha). They concluded that grazing research does not show these two systems produce different results, and that advocates for RG are likely relying more on biased perceptions or anecdotal evidence. Yet vote counting may not be a valid approach for discriminating among influential variables. Our meta-analysis of the same studies revealed some differences between CG and RG not detected by Briske et al.’s review. In general, AP was higher for CG than RG, but PP was not different. However, for every additional year of treatment, AP (kg/ha) under RG increased by 1% relative to CG. Moreover, regression of AP and PP by scale of study (whole ranch vs. research plot) revealed that while AP was higher for CG than RG at the research scale, there was no difference between the two systems at the ranch scale. Additionally, observations that in arid climates AP/head is lower under RG than CG was supported at the research scale, but this was not the case at the ranch scale, suggesting scale plays a significant role in productivity outcomes. Very limited numbers of ranch-scale research studies in the Briske et al. analysis, however, make strong statements regarding grazing system effectiveness difficult. As grazing occurs on over 25% of the world’s terrestrial surface, understanding

how productivity is impacted by grazing system in real-world conditions is extremely important for economic and ecological sustainability.

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383. IPHONE BEEF CATTLE INVENTORY APPLICATION. Larry C. Forero*¹, Jeffery W. Stackhouse², James W. Oltjen³, Clint Kellar⁴, Art Stackhouse⁴; ¹UC Cooperative Extension, Redding, CA, ²University of California Cooperative Extension, Eureka, CA, ³University of California Cooperative Extension, Davis, CA, ⁴VESTRA, Redding, CA

ABSTRACT

Maintaining cattle inventory records by pasture becomes more difficult as the complexity of a ranching operation increases. Keeping track of the class of beef cattle spatially allows the operator to develop stocking data at a pasture level. The BeefTracker application (currently in beta test) allows operators to set up operational parameters, add ranches and pastures, adjust inventory, locate improvements as well as archive and retrieve geo-located monitoring data. The inventory feature is iPhone based and affords operators the ability to update inventory numbers and location at the time the changes occur. Set up of the system is simple and maintenance of inventory information on the iPhone is largely intuitive. Using this system over time will provide ranchers and range managers with pasture level stocking information across years.

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384. WHAT IS USABLE SCIENCE? AND WHY SHOULD WE CARE? Lori Hiding*^{*}; Arizona State University, Tempe, AZ

ABSTRACT

As funding and public support for science becomes more competitive, it is incumbent upon researchers, scientific institutions, government agencies and funding organizations to ensure that the needs and interests of decision makers, land managers, and the public are being met – that the information being produced is “usable.” Usable science is simply defined as science that meets the changing needs of decision makers. It can be basic or applied science; it is not new science, but rather a particular approach to science that informs decision-making and responds to societal capabilities and goals. It differs from our standard linear understanding of the link between knowledge production and knowledge use. The usability of science is a function of the context of its potential use and of the process of how the scientific knowledge is produced. The process of identifying usable science should start with a knowledge user’s need, rather than a research question. Then, repeated conversations between the producers and users of scientific knowledge are critical to creating usable science. This iteration is the result of actions of the scientists and decision makers to build relationships and mechanisms that foster co-production of knowledge. Given a funding future for rangeland research that likely will remain quite competitive, there is great value to be gained

by more closely aligning on-the-ground scientific information needs with topics being considered by both university and agency rangeland researchers and major research funding organizations.

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385. USABLE SOCIO-ECONOMIC SCIENCE FOR RANGELANDS: RESULTS OF AN AGENDA-SETTING WORKSHOP. Mark Brunson*¹, Lynn Huntsinger²; ¹Utah State University, Logan, UT,²University of California Berkeley, Berkeley, CA, CA

ABSTRACT

Usable science is “science that meets the changing needs of decision makers.” To conduct usable science, it is therefore critical for scientists to understand and regularly monitor the needs of decision makers. For rangelands, there are different levels of decision-making depending on the management or policy context. Decision makers can include ranchers and grazing permittees, government agency personnel from the field level to Washington, DC, elected officials, and interest group representatives – the needs of each should be considered when determining what is usable science. To do so, we joined other range scientists as well as ranchers and livestock industry professionals, government agency land managers, and NGO representatives for a workshop on usable science, convened in Ardmore, Oklahoma, in June 2014. Participants convened in teams organized around general topics. This presentation reports on the outcomes of the socio-economics team. Team members first identified issues they believed were relevant to decisions and worthy of scientific inquiry. The entire group then ranked all 142 issues. Four issues proposed by the socio-economics team were among the top 20 identified overall. From these issues, the socio-economics team then identified four multi-faceted research questions as having the greatest potential to produce usable science: (1) How do rural communities best prepare for, adapt to, and recover from impacts of increased environmental and socio-economic variability? (2) What motivates land owners to cooperate across boundaries for environmental stewardship, and how do we use that information to create and/or improve incentives and reduce disincentives for stewardship? (3) Who needs what sorts of information about rangelands, and what are the barriers and opportunities for information transfer? (4) What are the barriers and opportunities for new people to enter and persist in rangeland occupations, and how can we use that information to increase numbers of adults who choose such careers?

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386. IDEAS FOR USABLE SCIENCE RELATED TO ANIMALS AND RANGELAND SUSTAINABILITY. Paul J. Meiman*¹, Doug Tolleson²; ¹Colorado State University, Fort Collins, CO, ²University of Arizona, Camp Verde, AZ

ABSTRACT

As part of a recent effort to chart a research agenda for future directions of usable science for rangeland sustainability, is-

ssues and potential research questions related to and involving rangeland animals were discussed. The resource group focusing on rangeland animals consisted of 6 members who represented natural resource consultants, ranchers, livestock industry organizations, land grant universities, and non-profit conservation organizations. The rangeland animal resource group identified and discussed 36 issues which were then presented to, and prioritized by a larger group consisting of university and agency researchers, public and private land managers, producers, non-governmental organizations, and representatives of funding agencies and organizations. Proactive drought planning and matching management and production systems to the rangeland resource were ranked as the two highest priority issues. Following the ranking exercise, potential research questions and outreach efforts were identified for each issue. Proactive drought planning could be strengthened by identification, synthesis and presentation of appropriate rangeland management decisions to improve drought tolerance of rangelands. This would likely require improved understanding of effective drought and weather variation indicators, management decision triggers and management actions needed before, during and after drought. Matching management and production systems to the resource could be strengthened by clarifying the major resource characteristics that drive production system options, improving the ability to properly match animals to the resource base, more effectively demonstrating the benefits of stocking rate flexibility and helping producers implement this approach, and exploiting knowledge of animal behavior, animal distribution and stockmanship to achieve rangeland management and production goals.

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387. USABLE SCIENCE FOR RANGELAND WATER. James P. Dobrowolski*¹, David M. Engle²; ¹USDA, Washington, DC, ²Oklahoma State University, Stillwater, OK

ABSTRACT

~As a key ecosystem driver, water impinges on other ecosystem components and processes, and ecosystem components and processes impinge on water. Moreover, water has always been highly sensitive to the dynamics of socio-economics, acting within landscapes at all scales. Pressure on rangelands to provide ecosystem services, including water, will continue to increase while ecosystem and landscape change will increasingly influence the water cycle and water available to support other rangeland processes. These challenges provide a rich suite of pressing research opportunities to produce usable science supporting management of rangelands, which our water research subgroup identified. Opportunities that workshop participants ranked highly include proactive tools for monitoring and predicting drought; and enhancing the nation’s water related data by improving or establishing stream gages in watersheds that cross political boundaries. Proactive rangeland watershed management, including invasive pest management, appropriate use of fire and grazing, wildlife habitat management, appropriate recreation pressure, etc. and protecting high quality

rangeland watersheds was viewed as high priority usable science that crosses ecological and social systems. Policies are needed that minimize the focus on restoration and maximize efforts to prevent degradation. A usable science research priority is constructing water budgets for rangelands from local to regional scales to inform management decisions from brush management to adapting to climate change. A pressing need is the development of technologies to productively restore abandoned cropland to rangeland, driven by aquifer depletion, drought, and climate change. Economic evaluation, particularly cost-benefit analysis, of rangeland restoration is usable science required to support this challenge. Our subgroup found that extending science and best management practices to users through Extension is a fundamentally necessary to building system resilience. Fortunately, water is equally recognized by the nation (e.g., The Six Grand Challenges of APLU) and international organizations, and funding to support this research is certain to follow.

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388. FUTURE DIRECTIONS OF USABLE SCIENCE FOR SUSTAINABLE RANGELANDS: SOIL HEALTH. Justin D. Derner¹, Chuck Stanley^{*2}; ¹USDA-ARS, Cheyenne, WY, ²USDA NRCS, Fort Worth, TX

ABSTRACT

Fundamental to sustainable rangelands is a healthy soil. This foundational component of sustainability, however, is often overlooked given the belowground “black box” mentality attributed to soils. Until transformative changes occur with soils (e.g., accelerated erosion), this attribute of integrated rangeland ecosystems is largely taken for granted. Nevertheless, benchmark events (e.g., Dust Bowl of the 1930s) provide relevant context for the importance of maintaining healthy soils for the provision of ecosystem goods and services for society. Promotion of soil health, and the associated co-benefits (enhanced soil water holding capacity, increased nutrient cycling), increases the resilience of rangelands to weather/climatic variability and predicted climate changes. Future directions of usable science for sustainable rangelands involving soil health should address: 1) spatial aspects of soil health indicators, 2) characterization of soil health indicators for sensitivity levels that affect transitions/thresholds of state-and-transition models (STMs) in ecological site descriptions (ESDs), 3) influences of management practices, predicted climate changes, and extreme events on soil health indicators, and 4) how soil health is affected by prescribed fire and wildfires. Successful attainment of usable science for rangelands and soil health is predicated on completing soil surveys for the Nation, and updating already completed surveys to include metrics of soil health.

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389. OUTCOMES OF THE SUSTAINABLE RANGELAND ROUNDTABLE SPONSORED “USABLE SCIENCE” WORKSHOP-VEGETATION. Joel R. Brown^{*1}, Samuel Fuhlendorf²; ¹USDA NRCS, Las Cruces, NM, ²Oklahoma State University, Stillwater, OK

ABSTRACT

The primary finding of the vegetation working group was that spatial scale should become a central focus of rangeland vegetation research, extension and management. In particular, the impacts of spatial scale in determining how management is applied and assessed should be clearly communicated to users, whether land-managers, advisors or policy makers. Recommendations for specific tasks developed by the group include: How best to describe and communicate resilience of rangeland landscapes to extreme events An improved understanding of the motivations of different user groups for landscape level planning Quantifying the effects of spatial pattern of plants and soils on livestock production, wildlife habitat, and water quality Integrating spatiotemporal variability to improve the accuracy of rangeland monitoring systems Determining the effects of invading native and exotic species on rangeland ecosystem goods and services

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390. USING MULTI-STATE MODELING TO DESCRIBE OPTIMAL TREATMENT WINDOWS FOR MEDUSAHEAD AND BARBED GOATGRASS. Philip Brownsey^{*1}, Sheila Barry², Theresa A. Becchetti³, Josh Davy⁴, Morgan P. Doran⁵, Larry C. Forero⁶, John M. Harper⁷, Jeremy J. James⁸, Royce Larsen⁹, Stephanie R. Larson-Praplan¹⁰, Emilio Laca¹¹; ¹University of California Division of Agriculture and Natural Resources, Browns Valley, CA, ²UC Cooperative Extension, San Jose, CA, ³UC Coop Extension, Modesto, CA, ⁴UC Cooperative Extension, Red Bluff, CA, ⁵UC Cooperative Extension, Fairfield, CA, ⁶UC Cooperative Extension, Redding, CA, ⁷University of California, Ukiah, CA, ⁸Sierra Foothill Research and Extension Center, Browns Valley, CA, ⁹UC Cooperative Extension, Templeton, CA, ¹⁰UC Cooperative Extension, Santa Rosa, CA, ¹¹UC Davis, Davis, CA

ABSTRACT

Medusahead (*Taeniatherum caput-medusae* (L.) Nevski), an exotic annual grass has invaded rangelands across California and the Great Basin where it successfully outcompetes cheatgrass (*Bromus tectorum*L.) and other introduced annual grasses. Barbed goatgrass (*Aegilops triuncialis* L.) is also a problematic, exotic annual grass that has invaded rangelands in California. Both of these species significantly impact ecosystem services in sites they have invaded, including livestock production. These two species are similar in habitat requirements, life stages, and life form, but different in that barbed goatgrass has delayed germination, dimorphic seeds, lower silica content, and greater resistance to defoliation. We describe phenological states at which each of these species may be most susceptible to targeted grazing or mowing treatments using defoliation studies and nutritional analysis. We estimate when, and

*Presenter

for how long, each of these species is most susceptible to grazing or mowing treatments using multi-state modeling and phenology observations from across their range in California. Preliminary results indicate that medusahead enters the phenological state most susceptible to precision grazing 158.5 days (+/- 19.6 s.e.) after germinating rain in the fall, remains in that state for 9.2 days (+/- 1.9) and then enters the optimal phenological state for mowing treatment, remaining in that state for 9.3 days (+/- 2.1), after which it fully matures and then senesces. Barbed goatgrass enters its optimal phenology for precision grazing treatment 170.6 days (+/- 42.8) after germinating rainfalls, remains in that state for 7.3 days (+/- 2.6) and then enters the optimal phenology for mowing treatment, remaining in that state for 11.7 days (+/- 3.7). We use the resulting multi-state models as "early-warning" tools to allow managers to schedule control treatments in an efficient and timely fashion.

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391. STATEWIDE PRIORITIZATION OF CHEATGRASS INFESTATIONS. Brian A. Mealor, Cara E. Noseworthy*; University of Wyoming, Laramie, WY

ABSTRACT

Cheatgrass is an invasive winter annual grass prevalent enough in the state of Wyoming to warrant concern from public and private land managers. It is one of many detrimental invasive species in the state, which means prioritizing to ensure the most efficient use of time and resources is important. Current distribution models do not provide enough information for effective prioritization. This project has three objectives: 1) synthesize distribution data from around Wyoming, (2) develop a distribution model, and (3) develop a spatially-explicit prioritization model based on invasion status, estimated recovery potential, and potential as wildlife habitat. We developed a rapid assessment protocol to classify survey points into invasion levels based on measures of cheatgrass, native plants and other qualitative measures (disturbance, other invasive grasses, etc.). Over 1800 sites were surveyed in the past two summers, and including these surveys, we have compiled cheatgrass data for over 20,000 sites. Roughly 60% of the sites classified had no cheatgrass. Survey goals included balancing spatial representation of the state the first season and targeting dominant cheatgrass infestations the second season. Distribution prediction models are almost complete for the state as well as more focused regional models for primary drainage basins in Wyoming. These models will be used to identify areas of high risk for cheatgrass dominance, and in conjunction with habitat indicators, to prioritize areas for management action. The final goal is to provide a tool to land managers that will be the first step in a statewide cooperative approach to managing cheatgrass.

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392. INFLUENCE OF HIGH-ENERGY SUPPLEMENTS, SILICA AND INDIVIDUAL VARIATION ON MEDUSAHEAD INTAKE AND PREFERENCE BY SHEEP. Juan J. Villalba*, Elizabeth A. Burritt; Utah State University, Logan, UT

ABSTRACT

Grazing may be a sustainable alternative for the control of medusahead infestations but intake of medusahead by ruminants is typically low. We determined in sheep whether 1) high-energy supplements enhance medusahead intake and preference relative to no supplementation and 2) individual differences in medusahead intake influence the ingestion of a ration containing silica. Groups of lambs (n=10) were individually penned and randomly assigned to 3 supplementation treatments: 1) Control (no supplement); 2) beet pulp:barley:Ca propionate (67:30:3); or 3) beet pulp:barley:yeast culture (65:30:5). After supplementation, all animals had ad libitum access to medusahead in late vegetative to mid-reproductive (Trial 1), and late-reproductive phenological stages (Trial 2). Medusahead preferences were evaluated by offering animals a choice between medusahead and tall fescue hay. Plant part preferences were measured by offering a choice between medusahead seed heads including awns and stems+leaves. Intake of medusahead was low and cyclic, declining at the end of each trial (P < 0.0001), but there were no differences among treatments (P > 0.10). Lambs preferred tall fescue hay to medusahead. They also preferred seed heads to stems+leaves (P < 0.0001). Supplemented lambs gained more weight than Controls (P < 0.10). In Trial 3, two new groups of lambs were formed based on their intake of medusahead during Trials 1 and 2 (n=10). One group ate more medusahead and more of a ration containing alfalfa and silica (97:3) than the other (P < 0.10). Thus, supplemented lambs performed better than non-supplemented controls without reducing ingestion of medusahead. Intake of medusahead was low but a significant and consistent degree of individual variation was observed among lambs -irrespective of supplementation- in their ability to ingest medusahead and silica. This variation represents a promising option for maximizing use of medusahead by livestock foraging rangelands infested with medusahead.

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393. EVALUATING MULTI-SPECIES TARGETED GRAZING FOR CHEATGRASS CONTROL. Brian A. Mealor, Cara E. Noseworthy*; University of Wyoming, Laramie, WY

ABSTRACT

Cheatgrass is a widespread, damaging invasive plant across rangelands in western North America. Although a good early spring forage, it is considered unreliable. Herbicides are commonly used to control downy brome, but targeted grazing could provide an alternative option for land managers. Few studies have directly compared herbicides and targeted grazing for downy brome control. This study's objectives are to: determine the effectiveness of targeted grazing for downy brome control, determine the effects of

livestock species and timing on downy brome populations, and compare the results to those of commonly used herbicide treatments. Plots are located in Lingle, Wyoming and arranged in a randomized complete block design with three replicates of twelve treatments. Grazing treatments included two factors: species (cattle, sheep, or both) and timing (spring, fall, or both spring and fall). Stocking density was constant across all treatments at approximately 247 au ha⁻¹ with a goal of 90% utilization. Treatments were applied in spring and fall of 2013 and spring of 2014. Herbicide treatments included imazapic at 123 g ai ha⁻¹ and rimsulfuron at 52.5 g ai ha⁻¹ applied early post-emergent in fall 2013. Canopy cover data were collected pre and post treatment and biomass and seed production data were collected mid-summer 2014, and analyzed using a two-way ANOVA. Almost all treatments reduced cheatgrass cover ($p=0.005$). Spring grazing treatments decreased cheatgrass biomass regardless of livestock species ($p < 0.001$). From this preliminary analysis, we conclude that targeted grazing in the spring has potential as a control method for cheatgrass, especially small infestations, but extensive infestations would likely require large inputs of labor, time, and funds.

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394. WEATHER VARIABILITY CREATES THE NEED FOR FLEXIBILITY IN GRAZING MANAGEMENT, ESPECIALLY WITH CHEATGRASS, BROMUS TECTORUM. Sherman R. Swanson^{*1}, Ryan Shane², Brad Schultz³, Rick Orr⁴, Kelly McGowan⁵; ¹University of Nevada, Reno, Reno, NV, ²Nevada Division of Forestry, Carson City, NV, ³University of Nevada, Reno, Winnemucca, NV, ⁴Sustainable Grazing Coalition, Caliente, NV, ⁵Nevada Department of Agriculture, Carson City, NV

ABSTRACT

Whether the impact of a grazing animal on vegetation is favorable or unfavorable depends at least as much on when grazing occurs (timing) as on defoliation intensity. Annual heavy grazing of perennial bunchgrasses in the boot stage puts their persistence at the greatest risk because soil moisture usually is declining and the probability is low of sufficient rainfall to permit adequate restoration of the leaf area to replace carbohydrate reserves. Long grazing periods without animal movement to other areas facilitates repeated defoliation and reduced leaf area, which is especially harmful. Grazing that enables rapid regrowth within and among years sustains perennial grasses. Grazing cheatgrass in the early spring has long been studied as a possible strategy for shifting moisture to bunchgrasses, harvesting high quality forage, and consuming fuel. However, the amount of cheatgrass available for forage is usually not known until only a few weeks before livestock typically shift their forage preference to perennial grasses (if present). Animal preference suddenly shifts to bunchgrasses within patches and variably across pastures. Optimal grazing management of landscapes with a mix of cheatgrass and perennial grass uses timing variation among years and animal movement during the growing period, especially when and after cheatgrass forms seeds

and palatability declines. Cheatgrass can become preferred forage by cattle after the perennial grasses become dormant and the cheatgrass drops most of its seeds. Unless rain or time has leached or degraded nutrients, cheatgrass can have up to 6% crude protein late summer, fall, and early winter. Energy rich fine stems remain highly palatable. Protein supplements make energy rich forage more sought after. Thus, cheatgrass which is both forage and fuel can be consumed in the fall with little worry about cattle shifting preference to or damaging perennials that are quite important to rangeland resilience. However, fall grazing may impact wildlife winter forage plants like bitterbrush if present. Fall; more than spring, grazing can be tremendously useful for economic fuels management using preplanned grazing or criteria-based temporary nonrenewable grazing. Most big fire years occur when residual fuels from wet years remain abundant. This fuel could have been grazed in the preceding fall at negative risk to the resistance and resilience needed for sagebrush ecosystem persistence. Ecological site descriptions, range conditions, and grazing prescriptions assist in planning for greater flexibility in permitted grazing that could benefit perennial grasses, manage fuels, and increase rangeland resilience strategically across landscapes. Research and demonstrative management applications are needed for new paradigms to develop.

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395. HERBICIDE EFFICACY AND PERENNIAL GRASS ESTABLISHMENT ON CHEATGRASS-DOMINATED RANGELANDS. Charlie D. Clements^{*1}, Dan Harmon²; ¹USDA, Reno, NV, ²USDA ARS, Reno, NV

ABSTRACT

Cheatgrass (*Bromus tectorum*) invasion has astronomically altered native plant communities throughout the Intermountain West. Cheatgrass truncates secondary succession by outcompeting native plant species for limited resources, thus building persistent seed banks to take advantage of conditions that occur in arid environments. Cheatgrass increases the chance, rate, spread and season of wildfires. Rehabilitation of cheatgrass infested rangelands is a daunting task that faces land owners and resource managers annually. The establishment of long-lived perennial grasses is key to suppressing cheatgrass densities and fuel loads. The ability of resource managers to have tools available to them to control such aggressive weeds as cheatgrass is instrumental in the success of rehabilitation efforts. The objective of this study was to test the efficacy of herbicides; [Imazapic (Plateau), Rimsulfuron (Matrix), Sulfometuron Methyl (Landmark)] on controlling cheatgrass and allowing for the establishment of seeded species. Herbicide treatments were applied in the fall of 2011 and 2012: 1) Imazapic @ 6oz/ac, 2) Rimsulfuron @ 4oz/ac, and 3) Sulfometuron Methyl @ 1.75oz/ac rates in a completely randomized block design at two separate sites in northern Nevada. The treated plots were fallowed for one year and then seeded to Siberian wheatgrass (*Agropyron fragilla* ssp. *sibiricum*) at 7 lbs/ac rate (fall 2012 and 2013). Sulfometuron Methyl yielded the highest control of

cheatgrass above-ground densities from 24.7/ft² down to 0.4/ft² (98.7%) followed by Imazapic, 17.6/ft² down to 0.8/ft² (95.6%) and Rimsulfuron 13.1/ft² down to 1.1/ft² (91.9%). The control plots averaged 39 cheatgrass plants/ft². Siberian wheatgrass seedling densities in the Sulfometuron Methyl treated plots yielded 6.5/ft², followed by Imazapic, 4.1/ft² and Rimsulfuron, 1.5/ft². Control plots yielded 1.1/ft² despite only receiving 6.2" of annual precipitation. The use of herbicides can aid in the suppression of cheatgrass.

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396. DID RANGELANDS CAUSE HUMAN EVOLUTION? CLIMATE CHANGE, VEGETATION AND THE HOMINID FOSSIL RECORD. James Ansley*; Texas A&M AgriLife Research, Vernon, TX

ABSTRACT

The hominid fossil record and recent mtDNA data increasingly support the theory that Homo species first evolved in east Africa and later evolved into different Homo species, including H. sapiens, that migrated from Africa to other continents. Isotopic $\delta^{13}C$ analysis of fossil herbivore molar enamel indicates a shift from C3 tropical forest to C4 grassland savanna (i.e., "rangeland") vegetation beginning about 10 Ma in many regions, including east-central Africa, as a result of global cooling and drying. This coincides with the two most significant shifts in hominid evolution, first to a bipedal locomotion in Australopithecus, and later an enlargement of cranial capacity with several Homo species. Current theory suggests Australopithecus evolved bipedal locomotion as an adaptation to life away from the forest as forests declined, but their existence was constantly threatened by predatory mammals until natural selection increased cranial capacity at about 2 Ma (the first Homo species) that may have provided greater cognitive abilities to cope with life in the new environment. An alternate natural selection strategy exhibited by Paranthropus, which also branched off of Australopithecus, was the development of large molars to eat the tougher plant foods found on rangelands. Paranthropus had some success but ultimately became extinct. This paper will review current data on hominid evolution, hominid cranial capacity, and paleo-climate and paleo-vegetation analysis that support the argument that were it not for the shift in central African vegetation toward rangeland, the evolution of modern humans may never have occurred.

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397. THRESHOLDS OR GRADIENTS: THE IMPORTANCE OF SLOW, REVERSIBLE CHANGE IN A GRAZING-ADAPTED RANGELAND . Lauren Porensky*¹, Kevin E. Mueller², Justin D. Derner³, David Augustine¹; ¹USDA-ARS, Fort Collins, CO, ²ARS - Rangeland Resources Research Unit, Fort Collins, CO, ³USDA-ARS, Cheyenne, WY

ABSTRACT

Both equilibrium and non-equilibrium dynamics are recognized as important drivers of rangeland ecosystems. Conceptual state-and-transition models (STMs) attempt to in-

corporate both equilibrium and non-equilibrium dynamics by including phase shifts as well as state transitions. Phase shifts are reversible with changes in climate or "facilitating" management practices (e.g., reduced grazing), while state transitions are reversible only with "accelerating" practices (e.g., erosion control, reseeding, brush removal). Grazing management is a pervasive driver of state transitions in existing STMs. In a northern mixed-grass prairie ecosystem, we documented plant community responses to (1) grazing intensity treatments (none, light, moderate and heavy) that were imposed continuously for 32 years, and (2) new experimental treatments in which pastures grazed heavily for 25 years were subjected to either light or no grazing for 7 years. Long-term grazing treatments were associated with distinct, but not stable, plant communities. From year 22 to year 32, more intense grazing was associated with increases in the cover of the dominant warm-season grass and decreases in the cover of dominant cool-season grasses and forbs. After 25 years of heavy grazing, pastures converted to light or no grazing for 7 years showed signs of incipient recovery, particularly for dominant cool-season grasses. However, recovery rates were quite slow. After 7 years of light or no grazing, the cover of dominant cool-season grasses in formerly heavily grazed pastures was similar to that in long-term moderately grazed pastures, but was still only 61% of cover in long-term lightly grazed pastures. In this grazing-adapted rangeland, our long-term grazing treatments did not drive the system into resistant alternative states, but instead caused continuous, directional, and reversible phase shifts with critical management consequences. In some systems, documenting gradients and rates of change within a single state may be more important for managers than identifying thresholds between alternative stable states.

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398. HISTORICAL VEGETATION IN SOUTHWEST OREGON, AS AFFECTED BY INDIAN BURNING PRACTICES, BASED ON GLO SURVEYS. Gene Hickman*¹, John A. Christy²; ¹USDA-NRCS (retired), Bend, OR, ²Oregon Biodiversity Information Center, Portland, OR

ABSTRACT

This project southeast of Roseburg, Oregon, was conducted to develop a landscape perspective of historical vegetation at the beginning of European settlement. The study area is transitional between dry interior valleys of the Umpqua River and the moist Cascade Mountains. Historical GLO (General Land Office) land survey notes were used to create a baseline vegetation cover for the study area from surveys that began in the 1850's. The historical vegetation matrix included prairie, brushfields, oak-mixed conifer savanna, and open to thick forest types. Natural prairies and open grassy oak-conifer types were enhanced and probably enlarged by periodic burning as an Indian cultural practice. However, GLO surveys recorded small scattered brushfields which we attributed to wild fires. Partly stocked mixed conifer woodlands with shrubby undergrowth may be from either wildfire or incidental burning by the Indians. A prominent historical land-

scape feature was open grassy savanna types found primarily on warm southerly topography. Most were converted from oak-mixed conifer woodland or dry mixed conifer forest, to savanna types, through periodic understory burning by the Indians. This was the largest landscape feature in the project area that was an artifact of historical burning treatments. With fire exclusion, most of it has reverted to denser canopies and woody undergrowth. For very moist forest types there was no GLO evidence of widespread type conversion to open savanna. Surveys identify mostly full canopies and shrubby understories. However, witness tree data suggest canopies were a composite of small patches, quite variable in tree diameters, stand ages, species composition and density. We believe these were due to both numerous incidental ignition sites by Indians and small wildfires throughout the forest. In the moist forest ecosystems, important Indian impacted treatment areas probably surrounded important cultural sites. None appeared to have impacted large areas of adjacent moist forest.

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399. TROPHIC INTERACTIONS BETWEEN CATTLE AND BIODIVERSITY: THE KENYA LONG-TERM EXCLOSURE EXPERIMENT (KLEE). Truman Young^{*1}, Corinna Riginos², Kari E. Veblen³, Wilfred O. Odadi⁴, Kimuyu Duncan⁵, Lauren Porensky⁶; ¹UC Davis, Davis, CA, ²Teton Science Schools, Jackson, WY, ³Utah State University, Logan, UT, ⁴Edgerton University, Eldoret, Kenya, ⁵Karatina University, Karatina, Kenya, ⁶USDA-ARS, Fort Collins, CO

ABSTRACT

On rangelands worldwide, cattle interact with many forms of biodiversity, most visibly with other large herbivores that share similar diets. Since 1995, we have been manipulating the presence and absence of cattle, medium-sized herbivores, and mega-herbivores (elephants and giraffes) in a series of large 4ha (10-acre) plots at the Kenya Long-term Exclosure Experiment (KLEE). These exclosures simulate different land management strategies. One of our goals is to disentangle the complex relationships between livestock and wildlife in a biome where worldwide, uneasy coexistence is the norm. We and our collaborators have shown that cattle have a wide variety of cascading effects on soils, hydrology, trees, grasses, herbs, microbes, insects, birds, reptiles, rodents, carnivores, and wild ungulates. 1) Cattle reduce habitat use across a broad array of ungulates, from grazers to browsers. 2) Conversely, wildlife often reduce (but sometimes facilitate) cattle weight gain. In particular, wildlife, being very responsive to fire, can greatly reduce the benefits of fire for cattle. 3) The trade-offs between cattle and (larger) wildlife are likely strongly buffered by compensatory responses of both elephants and smaller herbivores, especially rodents. 4) The absence of domestic and/or wild ungulates increases not only native rodents, but also their associated ticks and fleas, and the pathogens they carry. Conversely, dipped cattle act as 'sweepers' of ticks, greatly reducing tick numbers on the landscape scale. 5) Cattle help maintain a diverse plant community whose composition remains more

stable in the face of drought than when cattle are absent. In summary, the relationships between cattle and native biodiversity are complex, and include competitive, facilitative, and compensatory responses.

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400. A CENTURY OF GRAZING: LONG-TERM RESEARCH ON NORTHERN GREAT PLAINS RANGELAND. Matt A. Sanderson^{*1}, Holly Johnson¹, Mark A. Liebig¹, John R. Hendrickson¹, Scott Kronberg¹, David Toledo²; ¹USDA-ARS, Mandan, ND, ²USDA-ARS, Bismarck, ND

ABSTRACT

Early research at the Northern Great Plains Research Laboratory (NGPRL) near Mandan, ND focused on the ecology and management of native grasslands. In 1916, agronomist J.T. Sarvis began a stocking rate experiment on 250 acres of native mixed grass prairie at NGPRL. Part of that experiment continues today. Our objective is to document and present the origin, evolution, and scientific outcomes from this nearly century-old experiment. The central question was how many acres of native prairie were necessary to support a beef steer during the grazing season. In 1916, four pastures of 30, 50, 70, and 100 acres were laid out and stocked at one beef steer per 3, 5, 7, and 10 acres, respectively. The 30-acre pasture was expected to be overgrazed and the 100-acre pasture was expected to be undergrazed. Pastures were stocked continuously from May until October each year. The experiment was designed and conducted before modern principles of experimental design and replication were common. Sarvis, however, realized the need for controlling variables and chose an experimental site that was very uniform in slope, soils, and vegetation. Initial (30 year) results indicated that a moderate stocking rate (7 acres/steer) was sustainable on the northern Great Plains mixed grass prairie. In addition to answering the initial question, select pastures have been used to address additional diverse research questions dealing with drought, soil quality, greenhouse gas emissions, invasive species, and climate change during the history of this experiment.

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401. CASE STUDY: LONG-TERM LIVESTOCK GRAZING INFLUENCE ON VEGETATION IN COYOTE FLAT, CALIFORNIA, USA. Robert A. Pearce^{*1}, Ken Lair², Gary Frasier³; ¹Natural Resources Conservation Service, Bishop, CA, ²Lair Restoration Consulting, Hesperia, CA, ³Retired Agricultural Research Service, Fort Collins, CO

ABSTRACT

Coyote Flat is located in the eastern Sierra Nevada Region of Inyo County, California. Six Parker Three-Step transects, in four clusters, with photos and data spanning 49 years and 44 years, respectively, have been monitored on three U.S. Forest Service allotments in Coyote Flat. Since 1918, livestock numbers have been drastically reduced and the grazing season significantly shortened. Interpretation of the historical allotment records, vegetation data, and photos in-

dicates that, 1) range condition has remained fair since 1931, 2) willows, sage, and pine species are increasing in the Coyote meadows, and 3) springs have been drying up over several decades. Reasons for the static ecological condition, and shrub and tree encroachment, remain unclear.

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402. **SUCCESSIONAL STATUS AFTER 33 YEARS OF CANYON GRASSLANDS IN THE HELLS CANYON NATIONAL RECREATION AREA.** Samantha J. Pack*¹, Lesley Morris²; ¹Oregon State University, La Grande, OR, ²SRM, Bismark, SD

ABSTRACT

The interactions between topography and grassland associations have shaped the many cultural land-uses of the Hells Canyon National Recreation Area (HCNRA) throughout history. In order to assess the long-term changes in vegetation across the HCNRA, we conducted a repeat study using 19 different sampling points within four plant associations of the Lower Imnaha Subbasin. The original study used plant cover and frequency data from a 1981 survey to describe the different seral stage classifications within each plant association. Using Nonmetric Multidimensional Scaling (NMDS) and Indicator Species Analysis (ISA), we were able to determine that the species composition of each plot was significantly different between the 1981 and 2014 sampling. ISA results show that plots within the later-seral stages tended towards a greater presence of key bunchgrass and forb species for that association, while earlier-seral plots tended towards exotic species dominance and reduction in native bunchgrass cover. Our findings demonstrate that the species composition shifts across the 33-year-time-period include a decrease in indicator species for each plant association, an increase in early-colonizer species, and an increase in exotic forb and grass species. Our results also show that many of the plots sampled have changed seral stages between 1981 and 2014, with many of them transitioning to early seral over time rather than moving toward later stages. The direction of these shifts appears to be highly dependent upon the slope and location of the plots. For example, shifts to earlier seral stages are most common on or near the benches. The topography within these canyon grasslands not only shapes the cultural land-uses within HCNRA in the past and the present but also the successional trajectory of its grassland communities.

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403. **IDENTIFYING RELATIONSHIPS BETWEEN LONG-TERM GRAZING PRACTICES AND RESOURCE CONDITION IN A WESTERN PINE FOREST.** Kurt Chowanski*¹, Roger Gates²; ¹South Dakota State University, West River Ag Center, Rapid City, SD, ²South Dakota State University, Rapid City, SD

ABSTRACT

Managing Western pine forests for multiple-use is increasingly important for sustainable and efficient provisioning of ecosystem goods and services. A better understanding of

*Presenter

the relationships among livestock grazing practices, timber and forage production, plant community composition, wildlife, and aesthetics is critical to reduce uncertainty and optimize management. To investigate relationships between past resource use and present forage production, pine seedling recruitment and plant community composition, we surveyed grazed meadows and forests in 18 pastures in the Black Hills, SD across gradients of duration and intensity of livestock use. Plant species richness was positively correlated with a 30 year normal 1981 to 2010 precipitation estimate (0.61, n = 129, P < 0.001), and negatively correlated with intensity of use (-0.37, n = 129, P < 0.001). Herbaceous production was positively correlated with estimated productivity (0.45, n = 108, P < 0.001), litter cover (0.55, n = 108, P = 0.001), and visual obstruction readings (0.28, n = 54, P = 0.037) which were negatively correlated with intensity of use (-0.49, n = 54, P < 0.001). During a favorable growing season estimated long-term intensity of use was more closely related to plant species richness and plant stature than days of occupancy. This work suggests that intensity of use can be used to identify stocking rates which balance livestock production and aspects of ecological integrity.

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404. **WATER SHORTAGE, CLIMATE CHANGE, AND AGENCY LAND MANAGEMENT.** D. T. Booth*¹, J. C. Likins²; ¹USDA-ARS (Retired), Cheyenne, WY, ²USDI-BLM (Retired), Lander, WY

ABSTRACT

Between 1966 and 2006 the total surface area of 44 Wind River Mountain glaciers decreased 38%. Glaciers and other frozen “assets” have supplied 75% of water for the western United States. Nonetheless, annual April snowpack measurements taken between 1956 and 2014 document decreasing water yield from about 80% of western mountains. Frozen-storage losses could be mitigated by liquid storage in wetlands, marshes, beaver ponds, peat beds, and other riparian features. However these wetlands, in order to retain or increase water yield, must be in proper functioning condition. We review data collected from public-land riparian systems to illustrate what has been lost. We also review successes in restoring riparian function. These successes have required 20 or more years to implement for a variety of reasons. Land management agency action to regain or protect proper functioning riparian systems has been and will continue to be successful. Under expected climate-change scenarios, worsening West-wide water shortages are likely to continue unless the liquid-water storage capacity of the region can be restored.

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405. VALIDATING RIPARIAN STATE-AND-TRANSITION MODELS. Miranda A. Meehan*¹, Kevin K. Sedivec², Jeff Printz³, Jack Norland²; ¹Carlson McCain, Inc., Bismarck, ND, ²North Dakota State University, Fargo, ND, ³US-DA-NRCS, Bismarck, ND

ABSTRACT

A collaborative project is being conducted in North Dakota to develop riparian complex ecological site descriptions (RCESDs) and state-and-transition models (STMs). A STM for a riparian ecosystem is comprised of three states: 1) the stable potential channels, 2) the unstable channels, and 3) the confined stable channels. Data has been collected on forty-one cross-sections along eight different streams within three major land resource areas using Rosgen's classification of natural rivers. A cluster analysis was conducted from which it was determined that four clusters resulted in the strongest groupings. An indicator analysis was conducted to determine the significant hydrogeomorphic factors driving each group. The strongest factor influencing the groups was entrenchment ratio (ER) ($P \leq 0.05$). According to Rosgen's classification system ER has the greatest influence on channel morphology. Width-to-depth ratio (WDR) and sinuosity also had a significant influence on the groupings ($P \leq 0.05$). Within a riparian STM change in ER indicates that a transition between states is taking place; whereas, changes in WDR and sinuosity are responses to a state change and are indicative of phase changes occurring within a state. The findings of this analysis support the concepts being developed for RCESDs and STMs.

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406. EVALUATING THE DECLINE OF CLOSED-BASIN PONDS IN BRITISH COLUMBIA'S SEMI-ARID RANGELANDS. Aaron J. Coelho*, Wendy Gardner, Tom Pypker; Thompson Rivers University, Kamloops, BC

ABSTRACT

British Columbia (BC) grasslands represent 1% of the provincial land base, 95% of which are working rangelands. They have provided economic and cultural services for centuries. They are extremely valuable as a source of carbon sequestration, clean water and air and high quality low cost forage for the ranching industry. Classified as semi-arid, the grasslands have limited sources of fresh water to support wildlife and cattle. In areas without a nearby river, stream or lake fresh water is found mainly in closed-basin ponds that form in depressions in the terrain. Closed Basin Ponds take their name from operating as a "closed system" meaning that except for surface runoff and direct precipitation, there are no other external sources of water to feed them. Also, water does not flow out of the system to other water sources. It leaves the system by evaporation and uptake by wildlife, vegetation and cattle. These ponds are breeding grounds for water fowl and amphibians and are used as drinking water sources for cattle during grazing. Changes in water levels of closed-basin ponds are controlled by hydrological processes. Many of these processes are sensitive to changes

in climate. Recently, the ranching community has expressed a concern regarding an observed decline of closed-basin ponds in BC's semi-arid rangelands. However, to date, there is no official evaluation of changes in number and surface area of closed-basin pond to support these observations. Moreover, there are limited weather data analyses and field studies to explain the observed changes. This project aims to quantify the degree of decline in the abundance of ponds using remote sensing techniques and reveal significant changes in weather variables that may explain the declines.

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407. ECOHYDROLOGIC INTERACTIONS IN RANGELAND RIPARIAN SYSTEMS. Carlos G. Ochoa*, Grace L. Ray, Michael Borman; Oregon State University, Corvallis, OR

ABSTRACT

The need for having better information regarding water quantity and water quality issues in riparian systems in the state of Oregon has been discussed by different stakeholders including producers, state and federal agency personnel, and researchers. Particular interest has been expressed for research studies that address concerns regarding stream temperature and sediment levels in riparian corridors. Proper understanding of surface water and groundwater interactions in riparian systems and how they can be impacted through land management practices becomes critical to properly address these water quantity and quality concerns. In a semi-arid watershed in north-central Oregon, we are conducting a 3-yr pilot study that will enhance base knowledge regarding the relationships between stream temperature, sediment load, and riparian vegetation composition and distribution. Objectives of this study are: 1) To better understand how stream water temperature is affected by the interactions between surface water and shallow groundwater, and 2) To determine the overall effects that different land and vegetation management practices have in stream water temperature and runoff/sediment generation processes. A systems approach is being taken to better understand the complexities of multiple human and natural interactions in this and similar riparian systems. We are conducting intensive monitoring of selected ecologic and hydrologic parameters to determine surface water and groundwater relationships and their effects on stream water temperature and other water quality parameters. Also, we are conducting extensive field work to characterize, map, and assess water uptake by riparian vegetation along two-paired riparian corridors. In addition, runoff plots are being instrumented to evaluate sediment load in response to different natural and human disturbances (e.g., livestock and wildlife grazing) along the riparian areas. This pilot study contributes to our longer-term, broader, research effort in understanding resilience of riparian systems in the Western US.

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408. EFFECTS OF UNGULATE EXCLUSION ON RIPARIAN PLANT COMMUNITY COMPOSITION. Caleb P. Roberts*¹, Robert D. Cox¹, Robert Parmenter², Orrin Myers³, William Barnes², Martina Suazo²; ¹Texas Tech University, Lubbock, TX, ²Valles Caldera National Preserve, Jemez Springs, NM, ³University of New Mexico, Albuquerque, NM

ABSTRACT

Riparian plant communities often represent the most diverse communities in temperate zones. Also, many studies have shown that riparian communities can be susceptible to overgrazing by wild ungulates and livestock. At the Valles Caldera National Preserve in north-central New Mexico, we tested the effects of ungulate grazing on riparian plant community diversity and composition. To do this, exclosures were erected at various riparian sites: each site included exclosures excluding all ungulates (UE), exclosures excluding only livestock (LE), and control plots excluding no ungulates (C). Baseline species diversity (1/λ) data were collected in 2002 (UE = 8.87, LE = 7.55, C = 9.18), exclosures were erected in 2004, were surveyed yearly through 2008, and were resurveyed in 2014. Diversity initially increased for all treatments, peaking in 2007 (UE = 11.15, LE = 9.93, C = 12.49). In 2008, diversity began to decrease, and had decreased to levels lower than the baseline data by 2014 (UE = 7.18, LE = 7.48, C = 8.89). Initially, UE plots had the greatest diversity, but after 2006, C plots' diversity became highest and remained highest through 2014. While LE plot diversity was lowest at the outset, by 2014 LE and UE diversity indices nearly converged. We suggest that higher disturbance from grazing in control plots contributed to their higher diversity.



409. EFFECTS OF DEER AND ELK BROWSING ON RIPARIAN RESTORATION IN THE ABSENCE OF CATTLE. Mary Rowland*¹, Bryan A. Endress², Joshua Averett², Michael Wisdom³, Kent Coe³, Bridgett Naylor³; ¹USDA Forest Service, LA GRANDE, OR, ²Oregon State University, La Grande, OR, ³USDA Forest Service, La Grande, OR

ABSTRACT

Intensive herbivory by domestic and wild ungulates may affect riparian vegetation establishment and long-term sustainability. These effects are of particular concern in rangeland riparian systems of the western U.S., where long-term herbivory by ungulates can substantially reduce or eliminate deciduous, highly palatable species such as aspen (*Populus tremuloides*), willow (*Salix* spp.), and cottonwood (*Populus* spp.). These species are often key components of riparian plant communities systems that support healthy salmonid habitat and thus benefit fish populations. Thus, most riparian restoration activities targeted for salmonid conservation include labor-intensive and costly efforts such as planting thousands of deciduous seedlings, often in protective exclosures. Despite recognition that ungulates can markedly affect the success of riparian restoration, little is known about effects of domestic versus wild ungulates on restoration plantings for effective recovery of riparian systems. Here we report results of phase I of a long-term study of ripari-

an restoration, including a new livestock grazing system, at Meadow Creek within the Starkey Experimental Forest and Range in northeastern Oregon. We examined effects of wild ungulate (mule deer [*Odocoileus hemionus*] and elk [*Cervus elaphus*]) browsing on a subset of >40,000 seedlings in the absence of cattle (*Bos taurus*), which will be introduced to the site in 2015. Plants protected from deer and elk browsing by circular wire "pods" were significantly taller than unprotected plants, although differences varied by species. Moreover, seedlings exposed to deer and elk browsing were less likely to survive to year 1. We discuss implications of our results for integrated ungulate management and current riparian restoration practices for salmonids in riparian ecosystems.



410. ESTABLISHMENT OF A RIPARIAN BUFFER STRIP FOR ALLEVIATING LAKE EUTROPHICATION IN EASTERN CHINA. Michael L. Kennedy*¹, Kozma Naka², Yongbo Wu³; ¹Humboldt State University, Arcata, CA, ²Alabama A&M, Huntsville, AL, ³Nanjing Forestry University, Nanjing, Peoples Republic

ABSTRACT

Riparian buffer strips are a growing conservation practice to control and mitigate non-point source pollution (NPS) in Asia. China has seen rapid population growth and economic development in the last 50 years, coupled with a rapid increase in environmental pollution. Freshwater ecosystems have been particularly affected. Lake Tai, China's 3rd largest freshwater lake by volume, has seen a severe reduction in water quality since economic reforms began in the 1970's. Thus, significant interest for establishing riparian buffer strips in agricultural watersheds and freshwater systems within China is warranted. Eight, 50m X 20m plots adjacent to a Rice-Phragmites farm were cleared within the Lake Taihu basin region, Yixing Municipal District, Jiangsu Province, China. Seven plots were planted with either a Poplar hybrid, Cypress hybrid or a combination of both at varying densities, while the control and final plot had none. Soil, tree and groundwater samples were collected from all plots and analyzed for nitrogen and phosphorus concentrations. Preliminary results were analyzed for NO₃ concentrations within soil and total nitrogen concentrations within water. Final results will be analyzed using a Tukey's separation of means procedures.



411. HISTORIC USE OF NATIVE SEED, INCLUDING SOURCE IDENTIFIED, BY FEDERAL AGENCIES. Scott M. Lambert*; Rainier Seed Inc., Meridian, ID

ABSTRACT

An overview of seeding projects utilizing native seed, including Source Identified, on lands managed by the federal government. Concentrating on native seed applied on areas in the western states receiving less than 12 inches mean annual precipitation and how the usage of native seed has changed in the recent past.

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412. THE CONCEPT AND UTILITY OF SOURCE IDENTIFIED REVEGETATION SEED. Stanford Young*; Utah State University, Logan, UT

ABSTRACT

Seed Certification as a means to track genetic identity and purity for seed of traditional agricultural crop varieties has been formalized in the United States and Canada for almost 100 years, as implemented by the Association of Official Seed Certifying Agencies (AOSCA). More recently, the genetic identity and genetic purity of native and naturalized plant materials utilized in range revegetation efforts have garnered more attention. AOSCA thus developed Pre-Variety Germplasm (PVG) Requirements and Standards (as distinctive categories of certified seed) to provide for genetically verified marketplace movement of both wildland collected and field grown species destined for revegetation use. According to AOSCA, Source Identified plant materials are unevaluated germplasm of a species where only the location (minimum of state, county, and elevation) of the original wildland growing parents is known. Selected plant materials are those for which distinctive traits have been recognized and show promise for desired applications on the landscape. Tested plant materials are those for which such distinctive traits have been shown to be heritable, but the uniformity and stability of such traits, as well as the proven area of adaptation, have not been defined to the extent required for formal variety release. The intent of the PVG concept is to track the identity and purity of plant materials that are needed for timely (often immediate) restoration of specific geographic areas, where the market potential is usually limited to those areas. In cases where a locally collected material is shown to be adapted and marketed over a much larger geographic area, formal variety release should be pursued.

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413. NATIVE AND RECLAMATION SEED TESTING, CERTIFICATION, AND LAWS - IS THERE A NEXUS? Victor Shaul*; Washington State Department of Agriculture, Yakima, WA

ABSTRACT

The use of native seed in rangeland reclamation is still a relatively new industry in comparison to agronomic seed crops. Little is known about many species and the Association of Official Seed Analysts and yet the Society of Commercial Seed Technologists is charged with the research to produce repeatable purity and viability seed testing results. The Association of Official Seed Certifying Agencies has developed the Pre-Variety Germplasm certification program; however this is used extensively by some states and customers, and not at all by others. The Federal Seed Act covers only a few cool season grass species and most state seed laws do not cover native or reclamation species. This could mean that native and reclamation seed is sold and traded with absolutely no consumer protection under the various laws. End users vary in size, and have varying opinions, expectations and understandings of how seed testing, certification and

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seed laws can and should be impacting the product they depend upon. The native and reclamation segment of the seed industry is still an evolving entity and is vitally important to the scientific community and society as a whole.

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414. PROCUREMENT AND USE OF SOURCE IDENTIFIED SEED WITHIN THE BLM. Paul Krabacher*; BLM, Boise, ID

ABSTRACT

The procurement of source identified seed by the Bureau of Land Management has occurred for many years. Procurement specifications were recently changed to allow for selection of lots based on their source location. Additionally, the 2013 sagebrush seed buy in 2013 expanded procurement selection based on provisional seed transfer zones developed by the US Forest Service. Project locations guide seed transfer zone identification and source identified seed selection for procurement. The BLM is assessing specifications in future bids to include empirical seed transfer zones that have been established for other species of interest.

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415. NRCS PLANT MATERIALS PROGRAM NATIVE GERMPASM DEVELOPMENT AND USAGE FOR WESTERN RANGELANDS. Derek Tilley*; USDA-NRCS, Aberdeen, ID

ABSTRACT

Pre-varietal germplasms have been used in recent years to hasten the availability of plant species and ecotypes that were previously difficult to acquire or not available in sufficient quantities. The pre-varietal germplasm mechanism was adopted to allow commercial release of germplasm in significantly less time than a cultivar. NRCS Plant Materials Centers are charged with the collection, assembly, and selection of new plant materials. These materials have undergone comparative performance evaluations among numerous collections. Using the pre-varietal germplasm format, promising plants can be selected for release in a relatively short amount of time. Over the past two decades the NRCS Plant Materials Program has released or cooperated in the release of several pre-varietal germplasms to meet specific conservation demands. In this, the pre-varietal germplasm program has been very successful at providing new species and ecotypes to restoration and reclamation needs in the West. Some NRCS pre-varietal releases such as Anatone Germplasm bluebunch wheatgrass have gained widespread acceptance and have been broadly utilized on private and public lands throughout the western states. This scale of use however may be beyond the scope intended by pre-varietal release. The pre-varietal germplasm release system should not be seen as a replacement for cultivar development. Some pre-varietal germplasms that have been field tested and shown to have a broad area of adaptation and wide usage may warrant advancement to cultivar status.

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416. USING SOURCE IDENTIFIED SEED TO RESTORE RANGELANDS IN UTAH. Jason L. Vernon*, Danny Summers; Utah Division of Wildlife Resources, Ephraim, UT

ABSTRACT

Utah's Watershed Restoration Initiative (WRI) is a partnership-driven effort to conserve, restore and manage ecosystems in priority areas across the state to enhance Utah's. The WRI serves as a clearinghouse to coordinate and share participants' conservation concerns and priorities, discuss and implement solutions, and promote an atmosphere of collaboration among landowners, private organizations, and state and federal agencies. The Utah Division of Wildlife Resources (DWR) Great Basin Research Center and Seed Warehouse (GBRC) facility provides a 'one stop shopping' choice for partners to order custom mixed seed, schedule the use of rangeland seeding equipment, and provide habitat restoration monitoring. The structure of the WRI creates an atmosphere where partners are able to proactively plan restoration projects. This proactive approach presents an opportunity to improve the success of projects, especially when selecting the kind and sources of seed to be planted. The ability to plan projects in advance also provides the project manager with enough time to request seed collection, by seed vendors, from locations nearby the planned projects. By so doing, we feel we are able to choose seed sources that are adapted to local biotic and abiotic factors.

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417. SOURCE ID NATIVE SEED IN THE WILD WILD WEST. Mike N. Ingham*; Rainier Seeds Inc., Davenport, WA

ABSTRACT

SOURCE ID NATIVE SEED IN THE WILD WILD WEST It has been quite a few years since the development of the source ID certification program. Initially this was a way to insure that native collections of shrub seeds that were being used in reclamation in the western US were a naturally growing population occurring in a known or defined geographic area and that these seeds did indeed originate from the indicated location. Fast forward to today and we see the source ID certification program has morphed to include native collections of grasses and wildflower seed that are collected and then grown under irrigation with no testing conducted before they are sold. The seeds are then sold and used in reclamation projects in the western US. Prices paid for these source ID species are often several times higher than what cultivars of these same species that were developed at the Plant Materials Centers. People with little or no training are collecting seeds and turning them into certified source ID seed stocks. There is speculation within the seed industry as to whether many of these did originate from the indicated location and whether they are a naturally growing population or something that was introduced over time. In many states there is not adequate regulatory oversight. Is there peer reviewed science that would justify the use of these source ID native species? There are people in the seed industry that believe that some native seeds don't fall under the Federal

Seed Act, and they are not required to provide seed tests for those seeds that have been native collected. I think that it is time to take a look at the whole system. Admitting what we have problems, identifying the problems that exist and fixing what needs to be fixed. If we don't take these steps it will continue to be business as usual in the wild wild west.

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420. INFLUENCE OF DUFF DISTRIBUTION ON POST-FIRE VEGETATION RECOVERY PATTERNS IN WESTERN JUNIPER WOODLAND. Nathan I. Weiner, Eva K. Strand*, Stephen C. Bunting, Alistair Smith; University of Idaho, Moscow, ID

ABSTRACT

Woody plant expansion is a global phenomenon that alters the spatial distribution of nutrients, biomass, and fuels in affected ecosystems. Altered fuel patterns across the landscape influences ecological processes including fire behavior, fire effects, and can impact post-fire plant recovery. The purpose of this study was to determine how accumulations of ground fuels in maturing western juniper (*Juniperus occidentalis* ssp. *occidentalis*) woodlands affect post-fire species response and to demonstrate new methods in wavelet analysis to quantify fuel loading patterns. Sampling and analysis was conducted across environmental gradients following the Tongue-Crutchter Wildfire Complex in 2007 to determine conditions that were most influential in vegetation recovery. Of the multiple environmental gradients analyzed, duff depth and fire severity were determined to be the two most influential factors affecting post-fire vegetation response. Decreasing species richness was represented along the increasing duff depth gradient as well as the exclusion of some species at certain depths. Species response grouped by fire severity revealed significant presence of cheatgrass (*Bromus tectorum*) in low severity sites and a dominant presence of snowbrush *Ceanothus* (*Ceanothus velutinus*) in higher severity sites. Native perennial bunch grass cover was greater in unburned areas compared to burned areas of the landscape six years post-fire. Landscape scale representations of fuel loading for duff/litter were derived from the recognition of individual crowns using a discrete wavelet transformation. Determining sub-crown surface fuel characteristics on a landscape scale make it possible to predict future patterns and processes as they relate to vegetation recovery and fire severity components.

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421. AVIAN DIVERSITY AND STABILITY ALONG A FIRE AND GRAZING DEPENDENT HETEROGENEITY GRADIENT. Torre J. Hovick*¹, Dwayne Elmore¹, Samuel Fuhlen-dorf¹, Robert G. Hamilton²; ¹Oklahoma State University, Stillwater, OK, ²The Nature Conservancy, Pawhuska, OK

ABSTRACT

Grasslands are inherently dynamic in space and time evolving with frequent disturbance from fire and herbivores. As a consequence of human actions, many remaining grasslands

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have become homogenous which has led to reduced ecosystem function, biodiversity loss, and decreased ecological services. Previous research has shown that restoring inherent heterogeneity to grasslands can increase avian diversity, but the amount of heterogeneity (i.e., number of patches or fire return interval) and the impact on avian community stability have yet to be investigated. We used a unique landscape level design to examine avian response to interacting fire and grazing across multiple experimental landscapes that represented a gradient of fire and grazing dependent heterogeneity. We used seven landscapes (430-980 ha; = 627) with varying levels of patchiness ranging from annually burned (one single patch) with spring only fires to a four year fire-return-interval with spring and summer fires (eight patches). This design created a range of heterogeneity as a result of pyric herbivory, an ecological process in which fire and grazing are allowed to interact in space and time. We found that greater heterogeneity across experimental landscapes resulted in increased avian diversity and stability over time. An index of bird community change, quantified as the sum of the range of detrended correspondence analysis axis site scores, was nearly four times greater in the most homogeneous experimental landscape when compared to the most heterogeneous experimental landscape. Species responses were consistently positively associated with increased heterogeneity at the landscape scale and within experimental landscape responses were most often related to litter cover, litter accumulation, and vegetation height. We conclude that increased fire and grazing dependent heterogeneity can result in high variability in the bird community at finer, transect scales but increased diversity and stability at broad landscape scales. We recommend future management efforts in rangelands focus on restored disturbance processes to increase heterogeneity and improve grassland bird conservation.

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422. EFFECTS OF EARLY SPRING WILDFIRE ON CRESTED WHEATGRASS DOMINATED PASTURELANDS AND RANGELANDS OF SOUTH DAKOTA. Katherine C. Kral*¹, Kevin K. Sedivec¹, Ryan F. Limb¹, Amanda Gearhart²; ¹North Dakota State University, Fargo, ND, ²University of Idaho, Twin Falls, ID

ABSTRACT

Fire is extensively studied in the Southern Great Plains, but few studies focus in the Northern Great Plains. The ability to use fire as a management tool could provide more cost-effective ways to control problematic herbaceous species like crested wheatgrass (*Agropyron cristatum*) and increase grazing distribution and forage palatability. Frequency, density, phytomass, and basal cover were collected on 142 plots in 2008 using two perpendicular 150-m transects in the Grand River National Grasslands, Perkins County, South Dakota, USA. On April 4, 2013, a wildfire spread over several pastures, including 25 of the plots previously monitored in 2008. The same methods were replicated to compare herbage production, species composition, and basal cover

on sandy and shallow sandy ecological sites. Three burned and non-burned sites were chosen on native dominated rangelands and crested wheatgrass pasturelands on sandy sites for a total of 12 plots. Native dominated sites were chosen on shallow sandy sites, three burned and non-burned. Species composition, herbage production, and basal cover were compared between years and treatments (burned/non-burned) for each ecological site using perMANOVA, NMS and Student's t-test. Sandy native and sandy crested sites were different ($p \leq 0.05$) by year and treatment for species composition. However, no interaction [year x treatment] occurred. There were no effects ($p \leq 0.05$) on shallow sandy sites. Fire reduced ($p \leq 0.05$) basal litter and increased ($p \leq 0.05$) bare ground in 2013, but only burned crested sites had more ($p \leq 0.05$) bare ground in 2014. NMS scores indicated site variability was responsible for changes seen in species composition and not attributed to fire treatments. Changes in plant composition were not apparent one year after burning. The Northern Great Plains has a long evolutionary history of fire, and plants are well adapted to fire disturbance.

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423. THE EFFECT OF FIRE ON POA PRATENSIS AND NATIVE TALLGRASS PRAIRIE SPECIES UNDER GREENHOUSE CONDITIONS. Joseph W. Thomas*, Ryan F. Limb; North Dakota State University, Fargo, ND

ABSTRACT

Exotic cool-season grasses such as Kentucky bluegrass (*Poa pratensis*) are invasive in northern tallgrass prairie. Prescribed fire is a potential tool for management of these invasive cool-season grasses. Understanding of different grass species' response to fire is important for proper implementation of prescribed fire as a management technique in rangelands. We designed an experiment to examine basic growth responses to fire among common northern tallgrass prairie grass species under controlled greenhouse conditions. The experiment was conducted at the North Dakota State University Agricultural Experiment Station Research Greenhouse in Fargo, North Dakota. Kentucky bluegrass was tested along with four native species including *Pascopyrum smithii*, *Nassella viridula*, *Bouteloua gracilis*, and *Schizachyrium scoparium*. All plants were seeded in vermiculite and seedlings transplanted into pots containing a 3:1 regional soil to sand mix. Plants were burned using six different fuel loads (2,500 kg/ha, 3,000 kg/ha, 3,500 kg/ha, 4,000 kg/ha, 4,500 kg/ha, 5,000 kg/ha). Timothy hay was used as a reliably consistent fuel source. Fire treatments were applied using a metal burn table. A clipping treatment was also included to simulate grazing as well as a non-treated check. All treatments were applied 24 weeks after germination. Plant survival and time required for regrowth were observed. Once survival was established plant height was recorded 4, 7, 14, and 28 days after treatment. Root and shoot biomass were measured 28 days after treatment. Results provided valuable information on these species' basic response to fire and will serve as a comparison to field experiments.

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424. PRE- AND POST-FIRE GREATER SAGE-GROUSE LEK COUNTS AND MOVEMENT. Gregg E. Simonds*¹, Eric D. Sant²; ¹Open Range Consulting, Park City, UT, ²Open Range Consulting, Park City, UT

ABSTRACT

Populations of Greater Sage-grouse are dependent upon live sagebrush for their production throughout the year and across their entire range. In northern Nevada the greatest threat to sagebrush and Sage-grouse is wildfire. These conflagrations convert large landscape from sagebrush to expansive monocultures of annual and/or perennial grasslands. Sagebrush recovery can take from decades to more than a century. This is an alarming fact for a candidate species that is threatened or endangered and is a sagebrush obligate. Squaw Valley Ranch is a 368,000-acre ranch north of Battle Mountain Nevada. Eighty six percent of the sagebrush habitat of this ranch has burned at least once since 1998 and over 30% has burned twice. Prior to 2003 grazing practices were continuous and season-long. After 2003, grazing management has focused on matching rest periods with current range conditions. All the known leks on the ranch have been counted annually since 2002. These counts indicate that male attendance has generally increased over time but fall dramatically after every large fire. Additionally, radio telemetry of sage grouse has shown that they avoid areas on the ranch in which the sagebrush has been lost.

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425. HIGH LIVE FUEL MOISTURE IN C3 GRASS REDUCES FIRE BEHAVIOUR IN SOUTH AFRICAN C4 GRASSLAND. Devan A. McGranahan*¹, Sally Archibald², Kevin P. Kirkman³, Tim G. O Connor⁴; ¹North Dakota State University, Fargo, ND, ²Council for Scientific and Industrial Research, Pretoria, South Africa, ³University of KwaZulu-Natal, Pietermaritzburg, South Africa, ⁴South African Environmental Observation Network, Pietermaritzburg, South Africa

ABSTRACT

When substantially-different fuel types are introduced to plant communities, several elements of fire regime can change. Species that are photosynthetically active during the dormant season of the species that typically carry fire (such as C3 grasses in C4-dominated grassland) can have such high live fuel moisture so as to reduce the intensity and spatial extent of fire. But this phenomenon has been described most often within the context of alien plant invasions, and not native plant species in natural ecosystems. In the Drakensberg of KwaZulu-Natal, South Africa, patches of *Festuca costata*, a native C3 grass, are interspersed in grassland comprised of *Themeda triandra* and other C4 grasses. We show that in the fire-prone weeks prior to the first spring rains, fine dead fuel moisture in Drakensberg grassland is around 30% while live *F. costata* moisture ranges from 100-200% moisture on a dry-weight basis. We use fire behaviour modelling software to demonstrate how high live fuel moisture might reduce fire spread rate in the Drakensberg. We also use a

spatially-explicit fire spread model to test how patch size might reduce the spatial distribution of fire. We discuss how sufficiently-large patches of *F. costata* might prevent fire spread and increase fire return intervals in these grasslands. We highlight the effects of fire spread heterogeneity on plant community dynamics in grassland managed with prescribed fire.

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426. PATTERNS OF HETEROGENEITY IN TALLGRASS PRAIRIE: COMPARING RANGELANDS MANAGED FOR HOMOGENEITY VS HETEROGENEITY. Callie D. Griffith*¹, Dirac Twidwell², Walter H. Schacht¹; ¹University of Nebraska-Lincoln, Lincoln, NE, ²University of Nebraska - Lincoln, Lincoln, NE

ABSTRACT

Lands enrolled in the Conservation Reserve Program (CRP) have served as the basis for grassland conservation on private lands. To date, disturbances such as fire and grazing have been minimized on CRP grasslands and many public-owned conservation lands, resulting in homogeneous grasslands characterized by high herbaceous biomass. This approach contrasts with the modern purview that heterogeneity in vegetation structure is needed to support the diverse habitat requirements of grassland species. In this study, we (1) quantify the degree of structural heterogeneity in non-grazed grasslands, and (2) compare measures of heterogeneity in non-grazed grasslands to lands managed with patch burn grazing. To assess these objectives, we measured vegetation structure in three different burn and grazing treatments in the Grand River Grassland region of Southern Iowa. The three treatments were 1) patch burn graze-early intensive stocking 2) patch burn graze-conventional stocking and 3) burn non-grazed. Each treatment was replicated twice. We measured visual obstruction and canopy cover of vegetation every three meters on 300m transects which crossed two or more topographic types (top, slope or bottom). One transect was set up in each patch of the patch burn grazed sites, and in each of the non-grazed sites. In this paper we will discuss how topographic characteristics, an invasive cool season grass, and grazing deferral after fire, interact and influence patterns of heterogeneity on non-grazed lands compared to patch burn grazed lands. We will consider how the patterns and processes of heterogeneity can affect the ability to manage for heterogeneity in grasslands and the implications for land management.

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427. CONSERVATION OF PATTERN AND PROCESS IN HETEROGENEOUS GRASSLANDS IN A CHANGING CLIMATE. Christine H. Bielski*¹, Dirac Twidwell², Brady Allred³, Samuel Fuhlendorf⁴, David M. Engle⁴, Tyson Ochsner⁴, J.D. Carlson⁴, Erik S. Krueger⁴; ¹University of Nebraska-Lincoln, Lincoln, NE, ²University of Nebraska - Lincoln, Lincoln, NE, ³University of Montana, Missoula, MT, ⁴Oklahoma State University, Stillwater, OK

ABSTRACT

Based on current climate projection models, extreme climatic events are expected to occur more frequently in central North America during the next century. Previous studies indicate variability in precipitation and increasing temperatures can have a range of impacts on vegetation dynamics such as altered plant maturation rate and production, as well as ecosystem structure and function by altering disturbance regimes such as fire and grazing. These trends have been used as indicators of the potential for future vegetation responses in the face of climate change. We assessed the relationship between fire and grazing with plant biomass production, crude protein production, and resulting landscape heterogeneity before (2009) and after (2012-2013) an exceptional flash drought in 2011. This study was conducted on three 60 ha experimental grasslands at the Oklahoma State University Research Range. In each experimental landscape, fire and grazing is used to create a heterogeneous, shifting mosaic landscape with different patches at various stages of recovery from focal disturbance (burned this year, burned last year, burned two years ago). Plant biomass and crude protein production were measured bi-weekly from May-November and landscape heterogeneity was defined as the average standard deviation of plant biomass and crude protein that occurred among patches within each landscape. To analyze the strength of the fire-grazing interaction on plant biomass and crude protein, coefficients of temporal autocorrelation were calculated as a function of time since fire and grazing. While mean plant biomass and crude protein did not differ following drought, temporal autocorrelation results showed the strength of the fire-grazing interaction was significantly altered, which reduced vegetation contrasts among patches and led to a more uniform and homogeneous landscape. Based on these findings, managing for heterogeneity in grasslands may become more difficult with increasing frequencies of drought and rising temperatures in the future.

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428. DETECTING LONG-TERM VEGETATION CHANGE IN AN ARID RANGELAND ECOSYSTEM: INVESTIGATING EFFECTS OF SPATIAL IMAGE SUPPORT WITHIN SATELLITE TIME-SERIES. Jonathan J. Maynard*¹, Jason W. Karl², Dawn M. Browning³; ¹USDA-ARS, Las Cruces, NM, ²USDA ARS Jornada Experimental Range, Las Cruces, NM, ³USDA-Agriculture Research Service, 888003, NM

ABSTRACT

Arid rangelands within the southwestern United States have been severely degraded over the past century due to intensive land-use practices (e.g., livestock overgrazing, recreation) and the increasing effects of drought and climate change. Consequently, there is a critical need to develop monitoring approaches that can detect significant changes in vegetation health and distribution across vast spatial extents. Multi-temporal remote sensing techniques are ideally suited to address these challenges; however, considerable uncertainty exists regarding the effects of changing image

resolution on the ability to detect ecologically meaningful change from satellite time-series. The main objective of this study was to explicitly test the effects of changing image resolution on the ability of NDVI time-series to detect observed long-term changes in plant biomass. Satellite time series of NDVI were compiled for the period between 2000 and 2013 from the Landsat (30-meter, ~16-day resolution) and MODIS (250-meter, 16-day resolution) sensors at the Jornada Experimental Range (JER) in southwestern New Mexico. Each time-series image was coarsened using mean resampling to yield a range of spatial resolutions (i.e., Landsat: 30, 90, 240, 990 meters; MODIS: 250, 500, 1000, 3000 meters). Long-term plant biomass data from 15 sites at the JER, representing both grassland and shrubland ecosystems, were used to examine these scaling effects. Each time-series was decomposed into seasonal and long-term trend components using the Breaks For Additive Seasonal and Trend (BFAST) model and significant deviations from modeled trends were identified. Plant biomass data was then regressed against the decomposed time-series, with model results used to identify optimal spatial scales. Preliminary results indicate that finer resolution imagery produces stronger correlations with temporal shifts in plant biomass. However, when considering the use of finer resolution imagery, any potential improvement in identifying shifts in vegetation dynamics must be weighed against the higher computational requirements involved with its use.

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429. USING THE BEST AVAILABLE DATA: INTEGRATING FIELD DATA AND REMOTE SENSING IMAGERY TO MONITOR RANGELANDS. Sarah E. McCord*¹, Jason W. Karl²; ¹USDA-ARS, Las Cruces, NM, ²USDA ARS Jornada Experimental Range, Las Cruces, NM

ABSTRACT

Monitoring of rangelands poses significant challenges to land managers due to broad extent and many uses of rangelands. The Bureau of Land Management's (BLM) Assessment, Inventory, and Monitoring (AIM) program seeks to efficiently collect standard, quantitative monitoring data which is collected once and used multiple times to address a range of management questions. However, the cost of collecting field data to sufficiently monitor landscapes can be prohibitive. Remote sensing image classification provides an opportunity to derive rangeland indicators over large areas and at more frequent intervals than field data collection campaigns. We demonstrate a hierarchical Bayesian approach for maximizing the efficiency of monitoring data collection where existing AIM field plots are used to a) train remote sensing image classification and b) provide finer resolution data in areas of management concern. Where available, high spatial resolution images (e.g., RapidEye) are classified and the results of this classification are used together with field data to improve the moderate spatial resolution image (e.g., Landsat OLS) classification. Results of our classification of 2.7 million acres in northern California show remote sensing-derived estimates of bare ground, shrub cover, and herbaceous cover are the most accurate but other indicators,

such as soil aggregate stability, plant density, and vegetation species composition, are best estimated using field collected data. Utilizing AIM field data together with remote sensing enables a strategic rangeland monitoring approach where field data meet multiple monitoring objectives. Combining multiple types of data improves estimates of indicators thus providing higher quality monitoring data to rangeland managers.

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430. ENHANCING APEX TO MODEL GRAZING LANDS FOR THE CONSERVATION EFFECTS ASSESSMENT PROJECT (CEAP). Cody J. Zilverberg^{*1}, Loretta Metz², Jimmy Williams³, Jay Angerer⁴; ¹South Dakota State University & Texas A&M, Temple, TX, ²USDA-NRCS, Temple, TX, ³Texas AgriLife Research, Temple, TX, ⁴Texas A&M University, College Station, TX

ABSTRACT

The Conservation Effects Assessment Project (CEAP) uses science to inform policy decisions, enrich conservation planning and implementation, and improve management decisions. A process-based model, APEX, is being used in the cropland phase of CEAP, and will be used for the rangeland and pastureland phases as well. In addition to simulating plant growth, APEX simulates processes of environmental concern, including soil loss, cycling of C, N, and P, and recharge to aquifers and surface waters. However, the grazing module of APEX must be enhanced to better simulate the complexity found on grazed lands, particularly rangelands. We will present the current status of improvements, challenges faced during module enhancement, example output, and plans for additional features. Specific changes already implemented include: simulation of forage digestibility, grazing selectivity by herbivores based on forage nutritive value, user-defined options for intake quantity, excretion of nutrients based on diet composition, and multiple herds or animal species grazing the same area simultaneously. When the grazing module upgrade is complete, APEX will be able to model individual states from within state-and-transition models, and do so under alternative management scenarios. APEX will not model the transition from one state to the next, but it can model the consequences, both for production and for the environment, of a state change brought about by implementation of a conservation practice.

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431. APPLYING ALTERNATIVE DATA SOURCES TO ECOLOGICAL SITE CLASSIFICATION AND DESCRIPTION. Jeb C. Williamson^{*1}, Brandon T. Bestelmeyer², Jeff DiBenedetto³, Walstad Kirt⁴; ¹New Mexico State University, Las Cruces, NM, ²USDA-ARS Jornada Experimental Range, Las Cruces, NM, ³USDA Forest Service, Billings, MT, ⁴USDA-NRCS, Bozeman, MT

ABSTRACT

Field inventories are a fundamental component of most science-based approaches to ecological site classification and description. The high cost of field sampling, however, cou-

pled with budgetary and workforce constraints, means that field datasets are often not as comprehensive or statistically rigorous as might be desired. We describe the use of two alternative data sources to support ecological site classification in the Central Rocky Mountains Major Land Resource Area. The first resource was a field dataset previously collected during a terrestrial ecological unit inventory (TEUI) of the Beartooth Mountains. The second resource was high resolution satellite imagery offered through the ArcGIS Online World Imagery map service, which we used to manually attribute a sample of randomly located points. Both datasets were employed to study abiotic factors influencing the distribution of two locally important vegetation types: big sagebrush shrubland and plant communities dominated by introduced perennial grasses. TEUI field data enabled us to study edaphic effects on vegetation patterns without conducting an extensive ecological inventory ourselves. Image interpretation points provided a larger and more statistically rigorous sample useful for studying broad-scale relationships between target vegetation types, climate, and landform. We found these two datasets to be complementary, each providing unique types of information and together affording insights that neither could alone. Alternative data sources such as those employed here are likely to be increasingly utilized in ecological site classification and description as collaboration among interested parties grows and new datasets become available.

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432. FORAGE MONITORING ON THE CALIFORNIA CENTRAL COAST SHOWS TREMENDOUS VARIATION. Royce Larsen^{*1}, Karl Striby², Marc R. Horney³; ¹UC Cooperative Extension, Templeton, CA, ²USDA-NRCS, Templeton, CA, ³Cal Poly, San Luis Obispo, San Luis Obispo, CA

ABSTRACT

To better understand forage production (above ground biomass) and precipitation patterns in the Central Coast region of California, a rangeland forage production monitoring network was started in 2001. We began by establishing six sites within San Luis Obispo County, and by 2013 we had 18 sites, that were spread out into three different rainfall zones: greater than 63 cm (coastal), between 20 cm and 63 cm (central) and less than 20 cm (eastern). Forage production was measured each spring. Annual precipitation ranged from less than 5 cm to over 100 cm depending on the site and year. Total production ranged from 32 kg, to over 11,200 kg ha⁻¹ depending on the site and year. Total annual precipitation was closely related to total production. Monthly distribution of that precipitation also influenced forage production. This data has helped local ranchers, agricultural commissioners, resource conservation districts and others in making management decisions for rangelands on the Central Coast, ranchers being particularly interested. This project will continue, and the data will also be useful for comparing changes that may occur due to climate change in the coming years.

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433. BIOLOGICAL CAPABILITY OF SELECTED ECOLOGICAL SITES IN THE WESTERN DAKOTAS. Lauren N. Klempel*¹, Kevin K. Sedivec¹, Jack Norland¹, Ben A. Geaumont², Dustin Ford¹; ¹North Dakota State University, Fargo, ND, ²North Dakota State University, Hettinger, ND

ABSTRACT

Visual Obstruction Reading (VOR) is a nondestructive method used to determine the height and density of vegetation on rangelands and commonly used by United States Forest Service (USFS) to assess vegetative structure of wildlife habitat. In this study, three ecological sites (loamy, thin loamy, and claypan) were assessed to determine if they were biologically capable of producing high structure (VOR greater than 8.89cm, or 3.5in) at the end of the grazing season (October). Two study locations were established on the McKenzie (LMNG) and Grand River (GRNG) Ranger Districts of the USFS Dakota Prairie Grasslands. Each location had 24 – 60m x 60m exclosures, eight within each ecological site. The VOR was recorded within each exclosure every 10m along a 200m transect in the summer and fall of 2012, 2013 and 2014; with mean VOR calculated for each site. Phytomass was collected every 20m using a 0.178m² hoop, then dried and weighed. Afterwards, mean VOR and standing crop weights were tested for correlation using a linear regression model. Mean VOR surpassed the 8.89 cm threshold in the fall of 2012 and 2013 on the loamy sites at LMNG, while the thin loamy and claypan sites did not achieve the high structure threshold. At the GRNG, the mean VOR surpassed the high structure threshold only on the claypan sites in 2013. In conclusion, only the loamy ecological site on the LMNG achieved high structure when assessing the mean levels; however, all ecological sites had the potential when assessing the VOR range within each ecological site. Although only the claypan ecological site achieved a mean VOR ranking of high structure on the GRNG in 2013, all ecological sites had a VOR range that achieved high structure. Weather conditions did impact VORs during the study, with dry conditions and heavy snow lowering mean VORs.

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434. WEIGHING THE COSTS OF DIFFERENT ERRORS WHEN DETERMINING STATISTICAL SIGNIFICANCE DURING MONITORING. Jason W. Karl*¹, Robert S. Unnasch², Jeffrey Herrick³; ¹USDA ARS Jornada Experimental Range, Las Cruces, NM, ²The Nature Conservancy, Boise, ID, ³USDA-ARS, Las Cruces, NM

ABSTRACT

Selecting appropriate significance levels when constructing confidence intervals and performing statistical analyses with rangeland monitoring data is not a straightforward process. This process is burdened by the conventional selection of “95% confidence” (i.e., Type I error rate, $\alpha = 0.05$) as the default with no consideration as to whether, or in what circumstances, it is appropriate. The value of $\alpha = 0.05$ has its origins in hypothesis testing for scientific research where variation is controllable and the costs of making different errors are fairly easily quantifiable. A core belief in scientific research is

that the cost of committing a Type I error is much higher than committing a Type II error – i.e., it is better to miss an experimental effect than to erroneously conclude that effect occurred. Yet, when managing rangeland resources, the costs of committing Type I and Type II errors are not the same as in research – and often vary with objective and scale. In many rangeland resource applications making a Type II error (i.e., failing to detect a change) may actually be catastrophic – e.g., failing to detect increases in bare ground cover may lead to continued overgrazing, soil loss and permanently decreased range health. Accordingly, for rangeland monitoring the selection of appropriate error rates should be based on: 1) the relative costs of making the two types of errors associated with statistical tests, and 2) the role the data analysis is to play in making management decisions and committing resources. We present a tiered framework for selecting appropriate error rates for rangeland monitoring designed to be sensitive to detecting change at its broadest level but have high specificity at finer levels depending on the costs of making errors at each of those levels. This approach enables statistical analyses that support proactive rather than reactive decision-making for natural resource management.

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435. DEVELOPMENT AND USE OF A USDA-NRCS PLANNING FORM WITHIN A CALIFORNIA MEDITERRANEAN-TYPE RANGELAND. Michael Higgins*¹, Julie Finzel²; ¹USDA-Natural Resources Conservation Service, Hanford, CA, ²University of California Cooperative Extension, Bakersfield, CA

ABSTRACT

Throughout the USDA-Natural Resources Conservation Service, conservation planning assistance forms have been used to showcase the before and after effects of conservation practices. Within California, there was a need to develop a qualitative rangeland worksheet that would evaluate practices within California’s Mediterranean-type rangeland. With 30 plus years of University of California rangeland research, the NRCS and University of California Cooperative Extension developed a worksheet for NRCS, California. The worksheet is completed in the field with NRCS customers and entails: Residual Dry Matter, Grazing Intensity, Composition Change, Condition of the Soil Surface and Annual Rainfall/Temperature. This talk will present the worksheet and how it is being utilized throughout California.

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436. DELINEATING AND CLASSIFYING NATIVE GRASSLANDS OF SOUTH DAKOTA’S PRAIRIE COTEAU FOR DAKOTA SKIPPER CONSERVATION. Diane M. Narem*¹, Lan Xu², Gary Larson², Dave Ode³; ¹South Dakota State University, Brookings, SD, ²South Dakota State University, Brookings, SD, ³South Dakota Game Fish and Parks, Pierre, SD

ABSTRACT

Located in the tallgrass prairie ecoregion, South Dakota’s Prairie Coteau is a unique geologic formation that still re-

tains a relatively large amount of native tallgrass prairie and provides habitat for numerous species, including the USFWS proposed threatened species, the Dakota skipper butterfly (*Hesperia dacotae*). However, prairie remnants continue to vanish due to cropland conversion and degradation from invasive species. In order to best inform a conservation plan for the Dakota skipper and other endemic prairie species, the identification of high quality prairie habitat is urgently needed. The objective of this study was to delineate and classify upland prairie within a 58,275-ha region of South Dakota's Prairie Coteau chosen for its high concentration of Dakota skipper occurrence records. All grasslands within the study area were identified using aerial imagery to create an ArcGIS layer to guide on the ground field surveys and vegetation sampling. During field surveys, grassland condition was ranked and delineated in ArcGIS. Vegetation sampling used 10-m X 10-m relevé plots subjectively placed in uniform, native plant communities, according to Minnesota County Biological Survey protocol. Sixty-eight plots were sampled from July 8 to August 20, 2013 and 2014. Within each plot, cover by species within three strata was estimated using Braun-Blanquet cover classes and ecological site factors (e.g. elevation, aspect) and management regime (grazed, hayed or rested) were recorded. NMS ordination of relevé plots produced a 3-dimensional solution with 52.1% and 18.5% of variation being explained by axes 1 and 2 respectively. Axis 1 was found to represent a moisture gradient while management type was found to influence the second axis. Agglomerative hierarchical clustering was applied to classify the plant communities. The classification will enable mapping, assessment and inventory of habitat for the Dakota skipper and other upland prairie species on South Dakota's Prairie Coteau.

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437. POINT BLUE CONSERVATION SCIENCE'S RANGELAND WATERSHED INITIATIVE: MEASURING THE SOIL, VEGETATION, AND WILDLIFE. Wendell C. Gilgert¹, Elizabeth Porzig^{*2}, Geoff Geupel², Breanna Owens¹; ¹Point Blue Conservation Science, Chico, CA, ²Point Blue Conservation Science, Petaluma, CA

ABSTRACT

Point Blue Conservation Science (PBCS) is collaborating with the USDA-Natural Resources Conservation Service (NRCS), cooperating ranchers, and several partners in an effort to improve soil, vegetation (forage) and wildlife habitat on foothill rangeland watersheds in California's Great Valley. By applying prescribed (planned) rangeland grazing and management practices, ranchers with support from NRCS Farm Bill programs, PBCS including the newly established PBCS's Rangeland Monitoring Network (RMN) and conservation partners seek to increase soil water retention in foothill watersheds and Sierra Nevada meadows, improve water supply reliability downstream, improve abundance and diversity of plant functional groups, enhance ranch productivity, improve habitat for fish and wildlife and provide proactive adaptation to climate change. In addition, we are partnering

with and mentoring ranchers as Leopoldian land stewards to ensure long-term ecological and production benefits on their land. There is little empirical data available related to grazing management and long-term soil and vegetation response on California's Annual Rangelands. We are measuring an array of soils attributes, including infiltration, organic matter, and bulk density for both benchmark and planned grazing implementation. We are also taking vegetation measurements to document plant functional group demographics and invasive and noxious plant data and bird point counts and area searches to characterize ranch level avian changes that occur due to changes in management.

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438. UNINTENDED CONSEQUENCES? : UNDERSTANDING THE INTERACTIONS BETWEEN CULTURE, LIVELIHOODS, RESOURCES AND SPECIES PROTECTION. Corrie N. Knapp^{*1}, F.S. (Terry) Chapin², Jim Cochran³, Nathan F. Sayre⁴, Gary Kofinas⁵; ¹Western State Colorado University, Gunnison, CO, ²University of Alaska Fairbanks, Fairbanks, AK, ³City of Gunnison, Gunnison, CO, ⁴University of California, Berkeley, Berkeley, CA, ⁵University of Alaska Fairbanks, Fairbanks, CO

ABSTRACT

The Gunnison Sage-grouse is an iconic species being considered for protection under the Endangered Species Act (ESA). In Colorado's Gunnison Basin, ranchers own the majority of water rights and productive river bottoms, and approximately 30% of the most important Gunnison Sage-grouse habitat. This project uses interviews to document how ranchers plan to respond if the grouse is listed. Results suggest that listing may result in the sale of water rights that could negatively impact grouse habitat, ecology, aesthetics and livelihoods in the region. Ethnographic studies are critical for understanding the tradeoffs between livelihoods and conservation in an increasingly interconnected world.

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439. RUSTLING QUALITIES: THE RISE AND FALL (AND RISE) OF THE TEXAS LONGHORN. Joshua A. Specht^{*}; Berkeley - College of Natural Resources, Berkeley, CA

ABSTRACT

Rustling Qualities examines the history of the Texas Longhorn, the iconic cattle breed descended from the first cattle to arrive in North America. Prized for its ability to fend for itself on the range—known as having “rustling qualities”—as well as for its hardiness on the cattle trail, the Texas Longhorn was well suited for the age of the long cattle drive. Yet these benefits came at a cost; meat from Longhorns was lower quality and the animals did not gain saleable weight as effectively as rival breeds. As rail networks intensified, Northern ranchers embraced European breeds that required a more hands-on approach but also fetched higher prices. The Texas Longhorn fell out of favor until the twentieth century when cattle breeders, particularly in Texas, celebrated the Longhorn for its connection to Texas and Western histo-

**Presenter*

ry. I will highlight the relationship between the Texas Longhorn and the history of the cattle ranching industry in the United States. In the process, I hope to explore the linkages between economic systems and the biology of domesticated animals. Similarly, in examining the mythology of the Longhorn, I hope to understand how popular beliefs about cattle ranching and the West solidified the centrality of beef in the American diet.

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440. CHINA'S PASTORAL LANDS: A RESOURCE ON THE EDGE. Victor R. Squires*; Freelance International Consultant (formerly Univ of Adelaide), Adelaide, Australia

ABSTRACT

China's extensive pastoral lands cover about 4 million hectares of north and north-west China and both the lands and the people who occupy them are under increasing pressure as pastoral lands lose their traditional role as the major animal husbandry base. This pressure is already being manifested as livestock inventories rise as herders increase herds to compensate for falling returns. In addition, new needs for cash in the market economy and rising demand for red meat from urban dwellers puts additional pressure on agro-pastoral and agricultural regions. Greater grazing pressure is being exerted on smaller and smaller areas of pastureland as the government tries to implement more ecologically-based restoration methods that rely on fencing and grazing bans. The pastoral areas of China present a variety of problems that are both different and similar to those found in other areas. Resolving them will be difficult and will require policies sensitive to spatial and climatic variability. Because the ecological constraints are different from those found in other parts of China, new cross-disciplinary paradigms that account for interactions between local communities, the natural resource base, markets and the socio-political environment are necessary. This paper reviews the government response to the problems of rangeland degradation that are occurring among land users whose incomes hover around the poverty line. The legislative, regulatory and institutional framework has been reformed, and there is now recognition that management of pastoral lands requires cross-sectoral coordination and dialogue with land users. Finally, some ideas are advanced here, including land-related policy measures, on what can be done to enhance livelihoods, conserve biodiversity and protect land from further degradation.

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441. WHAT IS CHANGING IN THE RANGELANDS, WHY AND HOW THESE CHANGES OCCUR: CASE STUDY FROM THE SOUTH GOBI OF MONGOLIA. Batkhishig Baival*¹, Altanzul Tsevee¹, Maria Fernandez-Gimenez²; ¹Nutag Partners, Ulaanbaatar, Mongolia, ²Colorado State University, Fort Collins, CO

ABSTRACT

What is changing in the rangelands, how do herders characterize these changes and why are such changes are hap-

pening? These were the questions we asked in the beginning of collaborative rangeland monitoring in three mining impacts areas in the South Gobi of Mongolia. The community wanted to know the causes and dynamics of the rangeland changes they witness on daily basis. We facilitated formation of multi-party collaborative rangeland monitoring teams in three areas and organized a series of workshops, trainings and consultations to train community members in rangeland sampling and monitoring. Members of monitoring team collaboratively designed what, where, why and how to monitor their rangelands. We emphasized drawing on local experience and expert knowledge to institutionalize collaborative rangeland monitoring in these areas. Provincial and sub-provincial Agriculture Offices provided full support and participated in order to understand the principles and processes of rangeland monitoring with the aim of scaling up this initiative across the province. The main outcome of this project is that collaborative rangeland monitoring teams could serve as models for how local government, agency, private sector and users can collaborate in rangeland monitoring and improve their capacity for implementing efficient rangeland management strategies not only in mining impact zones, but also in other areas that face land degradation. We collaboratively documented participatory processes that we followed to implement rangeland monitoring. In addition, by setting three cases of participatory rangeland monitoring, we will contribute in increasing local technical capacity for land use planning, monitoring, and implementation by using Ecological Site Description methods and supporting local governments to use their legal authorities to implement better rangeland management plans.

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442. A STATE-AND-TRANSITION APPROACH TO DETERMINE THE TRADE-OFFS ASSOCIATED WITH LIVESTOCK PRODUCTION AND OTHER ECOSYSTEM SERVICES. John Ritten*¹, Maria Fernandez-Gimenez², Emily Kacherigis³, Willow Hibbs⁴, James Pritchett⁵; ¹University of Wyoming, Laramie, WY, ²Colorado State University, Fort Collins, CO, ³BLM, Denver, CO, ⁴Wyo Game and Fish, Douglas, WY, ⁵CSU, Fort Collins, CO

ABSTRACT

Stewards of western rangelands manage increasingly complex social-ecological systems with few decision-making tools to assist them. Our integrated research team has developed a linked ecological and economic state-and-transition model (STM) to help ranchers and land managers understand the effects of economic decisions on land health and ecosystem services, including the impacts of changing ecological conditions on ranch economic viability and profitability. Our model is parameterized for the Elkhead Watershed in Northern Colorado. The STM model was developed using both field collection and local knowledge as inputs. The STM model consists of three distinct ecological sites (Claypan, Mountain Loam, and Aspen), in addition to riparian habitat, hay production and pastures. Production estimates were determined for all potential states of the three ecological sites.

*Presenter

States and transition probabilities were incorporated into a Stochastic Dynamic Programming (SDP) model which was developed to determine the optimal cattle management decisions in order to maximize an infinite stream of returns to a “representative” ranch in the watershed (representing the overall mix of ecological sites as observed across the watershed). Management options include stocking decisions, spraying of each ecological state, and haying operations while stochastic variables include random precipitation and fire events. The model was also run for scenarios that aim to maximize the various ecosystem services (including wildlife habitat for grouse, elk or deer, as well as overall plant diversity and soil erosion potential). Results show that both current ecological states and economic conditions impact optimal behavior. Results also show that management decisions are altered when accounting for ecological state impacts on ecosystem values, and the costs of conserving such ecosystem services (preventing transitions) is far less than the costs of restoration (reversing undesirable transitions).

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443. EQUILIBRIUM OR NON-EQUILIBRIUM ECOLOGICAL DYNAMICS: WHAT IF THE MARKET IS CONSIDERED? Wenjun Li*¹, Yanbo Li²; ¹Peking University, Beijing, Peoples Republic,²Yunnan University, Kunming, Peoples Republic

ABSTRACT

The non-equilibrium paradigm of range ecology (NEPORE) emerged in the late 1980s in international range management circles to specifically address the ecological dynamics of arid and semi-arid rangeland systems. Based mainly on lessons from Africa, it questioned existing equilibrium-based theories of vegetation change and argued that the animal density-dependent model is not useful in highly variable and unpredictable environments. NEPORE’s focus on abiotic determinants of primary productivity served to downplay fears of overgrazing in arid systems, coupled to the belief that livestock grazing would be unlikely to cause range degradation under normal circumstances. Such a view is premised on the expectation that grazing pressure will decline following periods of low rainfall and low productivity, due to livestock removal either through mobility or mortality. This scenario does not consider that livestock might receive supplemental feed from outside sources, like in some parts of Inner Mongolia where, since the 1980s, market forces have swamped traditional, more mobile, pastoral practices and overgrazing appears to remain a leading factor in the reduction of the productive potential of rangeland through soil loss and vegetation change. Livestock numbers still fluctuate with precipitation, but are also heavily influenced by market prices for livestock, imported forage, and micro-credit availability. If the market price of meat is high enough to cover the cost of buying forage from elsewhere, in drought years herders can keep and even increase their herd size. Market forces allow sustained high livestock populations, regardless of rainfall, resulting in consistent livestock perturbation that has caused vegetation to cross thresholds and to state changes in rangelands unaccounted for by standard interpretations of NEPORE.

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444. COMMUNICATING IN GLOBAL RANGELANDS. Lauren Svejcar*¹, Tony Svejcar²; ¹Eastern Oregon Agricultural Research Station, Burns, OR, ²USDA-ARS, Burns, OR

ABSTRACT

Globally there are a wide variety of social and environmental issues affecting rangelands. In many cases there is research from one part of the world that can be applied to other regions, but significant barriers exist to knowledge transfer. Research is often concentrated and extensive in countries with high gross domestic product (GDP), and less robust in countries with restricted access to knowledge resources and funding. Two factors that constrain knowledge transfer and research potential for range management science are communication (language barriers) and cost of travel. In this study we analyze the diversity of languages in rangelands and address novel solutions to knowledge transfer between range management scientists and professionals at a global scale. Land degradation, invasive species management, and general sustainability could all be improved with a consistent method for ensuring that sound information is shared across cultures.

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445. ANALYZING THE 2014 FARM BILL INSECT AND DISEASE RESTORATION PROVISION -- TRUE GIFT OR FALSE HOPE? Jamilee E. Holmstead*; Utah State University, Logan, UT

ABSTRACT

Federal land management is often criticized for being slow and cumbersome, particularly when insect, disease, and fire demands a rapid response. The 2014 Farm Bill contained an amendment to the Healthy Forest Restoration Act (HFRA) that potentially addresses this concern. This amendment would allow for the insect and disease restoration projects on US Forest Service land to fall under National Environmental Policy Act (NEPA) as a categorical exclusion, provided that collaboration occurs while creating and implementing the projects. This could allow for the US Forest Service to implement restoration projects at a faster rate than they had previously been able to. Each state was required to nominate restoration lands on their National Forests. These nominations ranged from very detailed to extremely vague and from just a few watersheds to entire national forests. This research documents the variation in designation nominations in their detail and the amount of acres requested. It also examines the collaborative processes used in projects to determine if it contributes to or impedes the speed and quality the national forests are looking for in restoration projects. In the end this research document intends to give recommendations for effective utilization of this legal authority for the future.

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446. SHEEP AND GOAT OWNERS NEAR BIGHORN SHEEP HABITAT: REDUCING PATHOGEN TRANSMISSION THROUGH AWARENESS, ALTERNATIVES, AND ACTION. Laura M. Heinse*¹, Linda H. Hardesty², Richard Harris³, Rod Cool⁴; ¹Washington State University, Pullman, WA, ²Washington State University, Pullman, WA, ³Washington Department of Fish and Wildlife, Olympia, WA, ⁴Chelan High School/Chelan FFA, Chelan, WA

ABSTRACT

We surveyed 30 owners of sheep and goats living near wild bighorn sheep (*Ovis canadensis*) habitat in central and southeast Washington. We explored small flock owners' knowledge about pathogens that domestic sheep and goats can transmit to wild bighorn sheep and mountain goats (*Oreamnos americanus*), as well as their interests in mitigating, reducing, and preventing interactions between the wild and domestic species. We identified flock owners via aerial photography, systematic visual sampling in habitat and at fairs, and from contacts provided by FFA and 4-H leaders, state-agency biologists, livestock breeders, and extension agents. A majority of small flock owners were unaware of the substantial risk posed by interactions between their animals and bighorn sheep from pathogen spillover. However they were willing to help by contacting wildlife biologists if bighorn were sighted, sampling their flocks for bacteria, fencing, changing livestock species, and other methods to reduce interaction.

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447. THE INFLUENCE OF WATER DISTRICTS ON RANGELANDS IN THE NORTH CENTRAL SIERRA NEVADA, CALIFORNIA. Matthew W. Shapero*; Range Ecology and Management, Oakland, CA

ABSTRACT

Over one thousand water agencies control, manage, or distribute surface water in the state. These water agencies function as special districts—an unusual political instrument unique to California—and it is this designation that has defined their history, structure, priorities, and current accountabilities. Over the last century, water agencies have been critical to both agricultural and urban development. As a result, they lie today at the social and economic boundaries of the Sierra foothills' urban-rural divide. Expressly founded to benefit the region's farmers and ranchers, the practices of water districts in the north central Sierra are examined and show how water agencies are now quietly facilitating the urbanization of those same rural, agricultural communities. I examine first how agency infrastructure—raw water ditches, water-treatment facilities, hydroelectric generation-plants—is allowing foothill communities to develop to greater densities; and second, how water agencies are potentially becoming increasingly less useful to the agricultural community as the price of raw water threatens to surpass its value to production agriculturalists. Given the political structure of the water agency as special district, it is unclear whether these agencies reflect communities they serve or have themselves helped to define their constituent communities.

*Presenter

448. THE INCIDENTAL HABITAT: THE CALIFORNIA BLACK RAIL AND THE WATER ECOLOGY OF THE FOOTHILLS. Lynn Huntsinger*¹, Tracy Hruska²; ¹University of California Berkeley, Berkeley, CA, CA, ²UC - Berkeley, Berkeley, CA

ABSTRACT

Gold Rush Era water developments changed the water ecology of the northwestern Sierran Foothills, having a profound effect on land use, wildlife, and vegetation. Water conservation efforts, land use change, and drought threaten this anthropogenic ecosystem. As part of a multi-pronged coupled human-natural systems project examining the wetland habitat of a rare bird, we used interviews and a mail survey to determine how landowner attitudes, values, practices and goals affect the future of this overlooked resource. Ranch lands provide much of the bird's habitat, largely as a consequence of irrigation systems that provide the leaks and tailwater that support shallow wetlands. However, while landowners highly value wildlife and construct the region's many ponds in some part to enjoy such wildlife, creation and support of rail habitat is almost always accidental. This challenges existing institutions for conservation of habitat through education or regulation. Landowners are, however, surprisingly receptive to the idea of creating rail habitat under the right conditions.

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449. FOLIAR-APPLIED HERBICIDES FOR SALT CEDAR CONTROL IN SOUTHWEST KANSAS. Walter H. Fick*; Kansas State University, Manhattan, KS

ABSTRACT

Saltcedar (*Tamarix ramosissima*) is an introduced deciduous shrub found throughout the Great Plains and southwestern U.S. The species has been used as an ornamental and grows in floodplains, along riverbanks, marshes, and roadsides. In Kansas, saltcedar is found primarily along the Cimarron and Arkansas rivers. The objective of this study was to compare the efficacy of nine foliar-applied herbicides for saltcedar control. The study site was located on the Cimarron National Grasslands near Elkhart, KS. Herbicides were applied with a backpack sprayer at 467 L ha⁻¹ total spray solutions with the addition of a 0.5% non-ionic surfactant. Herbicides were applied on July 27, 2012 and August 13, 2013 with 10 to 25 trees per treatment. Saltcedar mortality was determined the growing season after application. Chi square analysis was used to determine differences among treatments at the 0.05 level of probability. The most effective treatments were imazapyr at 1.2 and 2.4 g L⁻¹ providing greater than 80% mortality both years. Other treatments providing at least 50% mortality both years included imazapyr + glyphosate at 1.2 + 5.4 g L⁻¹, imazapic at 2.4 g L⁻¹, and triclopyr at 4.8 g L⁻¹. Aminopyralid + triclopyr amine (0.3 + 3.6 g L⁻¹) provided no more than 40% mortality both years.

Control with aminopyralid + metsulfuron (0.26 + 0.05 g L⁻¹), aminopyralid + metsulfuron + triclopyr (0.26 + 0.05 + 1.2 g L⁻¹), and aminocyclopyrachlor + metsulfuron (0.44 + 0.14 g L⁻¹) were more effective when applied in 2013. Greater than average precipitation in June and July 2013 apparently enhanced control. Further research is needed with herbicides such as imazapic, aminopyralid, and aminocyclopyrachlor that cause less damage to understory species when treating saltcedar.

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450. SUCCESSIONAL TRENDS AFTER TREATING PINYON-JUNIPER ENCROACHED SAGEBRUSH STEPPE TO REDUCE FUELS. Bruce A. Roundy^{*1}, April Hulet², Nathan L. Cline¹, Ben Rau³, Richard Miller⁴, Robin Tausch⁵, Jeanne Chambers⁵; ¹Brigham Young University, Provo, UT, ²USDA-ARS, Burns, OR, ³USDA/ARS, Tifton, GA, ⁴Oregon State University, Corvallis, OR, ⁵USDA Forest Service, Reno, NV

ABSTRACT

Vegetation response after fuel treatments in sagebrush steppe encroached by pinyon and juniper trees is a function of the pretreatment plant community, disturbance treatment, and site environmental conditions. Three years after fire or mechanical fuel control, perennial grass cover had increased about 10% over pretreatment cover for 9 sites spread across the Great Basin. Perennial grass cover is a key component in these systems in avoiding the crossing of a biotic threshold by reducing weed dominance and avoiding crossing of an abiotic threshold by reducing interspace erosion. Although cheatgrass cover was < 6% after fuel reduction on most sites 3 years after treatment, many sites had patches of cheatgrass dominance, especially after prescribed fire, and two sites had >27% cover. This presentation examines vegetation response on these sites 6 years post-treatment and in relation to site environmental characteristics. This information should help guide managers by suggesting which kinds of sites are most resilient after fuel reduction treatments.

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451. GOATS: A TOOL TO REDUCE ENCROACHMENT OF COYOTE BRUSH INTO GRASSLANDS, FORT ORD NATIONAL MONUMENT. Bruce C. Delgado¹, Suzanne Worcester^{*2}, John Inman³; ¹BLM-Fort Ord National Monument, Hollister, CA, ²CSU-Monterey Bay, Seaside, CA, ³Calif. State University, Monterey Bay, Seaside, CA

ABSTRACT

Native perennial grasslands have declined in California over the past 200 years. On the Fort Ord National Monument perennial grasslands are being replaced by coastal scrub dominated by coyote brush (*Baccharis pilularis* ssp. *consanguinea* DC.). Decades of sheep grazing has been insufficient to prevent this encroachment and a new tool was needed in order to maintain perennial grassland habitat. In January 2014, goats were used on an experimental basis to reduce *B. pilularis* cover. Paired control and grazed plots were constructed in dense stands of *B. pilularis* and percent cover

was measured before and after grazing. Results showed no significant change in *B. pilularis* cover over the first three months of the study. The goats did, however, defoliate all *B. pilularis* branches within reach (< 2m in height) and this was followed by a flush of spring *B. pilularis* growth. Continued annual grazing by goats is expected to substantially reduce *B. pilularis* cover in this historically sheep grazed area. Even at less than one year into this multiyear study, goat grazing has been shown to be a better management tool than sheep grazing for reduction of a shrub species.

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452. PLANT COMMUNITY RESPONSE TO PINYON-JUNIPER REDUCTION IN UTAH. Kevin L. Gunnell¹, Thomas A. Monaco^{*2}, Danny Summers¹; ¹Utah Division of Wildlife Resources, Ephraim, UT, ²USDA, Agricultural Research Service, Logan, UT

ABSTRACT

The encroachment of pinyon (*Pinus* spp.) and juniper (*Juniperus* spp.), i.e. P-J, into sagebrush (*Artemisia* spp.) rangelands in the Intermountain West is well documented. Encroachment has negative impacts on sagebrush communities, threatens wildlife habitat, and diminishes watershed functioning. The Utah Watershed Restoration Initiative (UWRI) was enacted in 2004 to mitigate the impacts of P-J encroachment throughout the state of Utah through interagency cooperation to implement large-scale mechanical vegetation manipulations. Using data collected by the Utah Division of Wildlife Resources (UDWR) Range Trend Project from 68 UWRI projects located on 32 different ecological sites throughout the state, we used meta-analysis to assess the efficacy of three common P-J removal methods (tree mastication, chaining, and 'lop-and-scatter') over nine years. With the exception of chaining, all treatments increased total shrub and sagebrush cover. Perennial grass and forb cover also increased, but this response varied by treatment and post-treatment timeframe. While perennial grass cover was significantly more abundant in the chaining and lop-and-scatter treatment, only perennial forb cover was more abundant in the mastication treatment. Without exception, all treatments led to significantly lower bare ground and greater soil surface litter cover. We relate these differences among treatments to the severity of pre-treatment P-J encroachment, differing ground cover disturbance, and supplemental seeding. We also assessed plant community composition changes over time with indicator species analysis. In general, exotic forbs were significant indicator species in the first three years after mastication and lop-and scatter treatments, yet native forbs and shrubs were indicators after six and nine years, respectively. In contrast, seeded grasses, forbs, and shrubs were significant indicators in post-chaining communities. We conclude that although P-J reduction has greatly augmented herbaceous and shrub vegetation, additional analyses based on ecological sites are needed to evaluate how vegetation structure stabilizes into alternative stable states in response to treatments.

453. SPATIAL RESILIENCE IN A SEMI-ARID SHRUBLAND: IMPLICATIONS FOR OPERATIONALIZING RESILIENCE IN ECOLOGICAL RESTORATION. Carissa L. Wonkka*¹, Dirac Twidwell², Jason B. West³, William E. Rogers³; ¹University of Nebraska Lincoln, Lincoln, NE, ²University of Nebraska - Lincoln, Lincoln, NE, ³Texas A&M University, College Station, TX

ABSTRACT

Restoration success in systems with alternative stable states is dependent on the ability to use interventions to shift resilience mechanisms from those that maintain a degraded state to those that support a desirable state. However, the utility of the resilience concept has been limited in practice by the difficulty of quantifying thresholds associated with management actions and ecosystem transformability. An alternative to quantifying ecological thresholds is to ascertain the relative resilience of an ecological state across identifiable ecosystem properties. We designed an experiment to determine the relative resilience of the shrub-dominated state in a brush encroached semi-arid rangeland across soils with different textures, ranging from fine clay to coarse sand. We randomly assigned plots on each soil type to one of three treatments: untreated control, hand-cutting followed by herbicide application, and roller-chopping. Despite widespread application in the study region, the two brush reduction methods assessed were not ubiquitously effective at overcoming the resilience of the shrubland state. Total woody cover differed among soils in treated plots three years following treatment, suggesting that the resilience of the woody-dominated state differs across soils. On both sandy and sandy-loam soils, chemical and mechanical brush removal temporarily restored grass dominance in the system, but woody plants quickly regained pretreatment levels of dominance. However, on clay soils, grass remained dominant for the duration of the study, suggesting that for these soils, both cut herbicide and mechanical treatments overcame shrubland resilience. Studies such as this one which explore relative resilience across a range of environmental conditions can be used to map areas of high and low resilience to intervention, allowing managers to target areas with underlying conditions that are more conducive to restoration. This is essential in systems such as the encroached rangeland in this study where broad-scale restoration efforts are cost prohibitive.

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454. TARGETING SHRUB AND INTERSPACE MICROSITES FOR RESTORATION SEEDINGS AND PLANTINGS IN GREAT BASIN SAGEBRUSH COMMUNITIES. Kari E. Veblen*¹, David Pyke², Troy Wirth², Maike Holthuijzen¹, Nicole DeCrappeo²; ¹Utah State University, Logan, UT, ²USGS, Corvallis, OR

ABSTRACT

In the Great Basin the most effective defense against annual grass invasion may be targeted restoration of competitive herbaceous plants in existing stands of sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), rather than areas

where sagebrush has been removed due to fire or other disturbances. This type of approach requires an understanding of where, within a mosaic of canopy and inter-canopy gap microsites, restoration actions will lead to maximum plant establishment success. We therefore examined restoration planting success, from seeds and seedlings, with respect to canopy and gap microsites across three sites in the Great Basin. We targeted two bunchgrasses, bottlebrush squirreltail (*Elymus elymoides*) and bluebunch wheatgrass (*Pseudoroegneria spicata*). For both species, we found that restoration plantings from seed showed high (61-74%) establishment success across both canopy and interspace microsites after seven months, but declined markedly after the first year (3-11%). Restoration plantings from seedlings also showed high (81-99%) initial establishment rates (after 7 months), though establishment of *E. elymoides*, appeared to be greater in interspace than canopy microsites at the driest site. Interestingly, this is in contrast to distributions of mature, naturally-established *E. elymoides* plants which occur in higher densities in canopy microsites, particularly at drier sites. Together these results illustrate how plant responses to canopy vs. gap microsites may differ according to species, life stage and both short- and long-term moisture conditions. Ultimately our results can be used to help guide restoration in sagebrush-dominated systems.

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455. EVALUATING SIX MECHANICAL TREATMENTS IN BIG SAGEBRUSH 10 YEARS POST TREATMENT IN NORTHERN UTAH. Danny Summers*¹, Bruce A. Roundy²; ¹Utah Division of Wildlife Resources, Ephraim, UT, ²Brigham Young University, Provo, UT

ABSTRACT

Big sagebrush (*Artemisia tridentata* Nutt.) is important ecologically in shrub-steppe ecosystems but dense, competitive stands lack perennial herbaceous diversity and abundance. To determine the ability of sagebrush thinning treatments to retain shrub and herbaceous components while improving diversity, we evaluated the effects of 6 mechanical treatments and revegetation on a Wyoming big sagebrush community in northern Utah. We measured shrub, residual, and seeded herbaceous cover at 1, 2, 5, and 10 years post treatment. Mechanical treatments were one-way and two-way pipe harrowing, disking and imprinting, one-way Ely chaining, and fall and spring aerating. The treatments were seeded with a mixture of grasses, forbs, and fourwing saltbush. By 10 years after treatment, seeded grass cover was < 2% on all treatments except the drill imprinter treatment, which had 14% cover. Seeded forbs followed the same trend while residual forbs decreased then returned to pretreatment cover after 10 years. All treatments increased perennial grass cover by about 10%, but disk and imprinting increased it by > 20% by increasing establishment of seeded grasses. Sagebrush cover was reduced from about 20 to < 5% for all treatments but was recovering to 8-14% on all treatments except disk imprint. Thus, most successful herbaceous revegetation was associated with

greatest sagebrush control. Mechanical treatments to increase herbaceous cover might best be applied in a mosaic when sagebrush cover needs to be preserved. Treatments such as these may be useful while understanding ecological departure of the communities vegetation structure to create a mosaic of successional classes.

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456. HERBIVORE EFFECTS ON GRASSLAND RECOVERY POTENTIAL IN THE CHIHUAHUAN DESERT. Lauren Svejcar*¹, Brandon T. Bestelmeyer², Darren James³; ¹Eastern Oregon Agricultural Research Station, Burns, OR, ²USDA-ARS Jornada Experimental Range, Las Cruces, NM, ³USDA-ARS, Las Cruces, NM

ABSTRACT

Increased native rodents and lagomorphs herbivore abundance associated with shrub encroachment of grasslands could have an indirect effect on grassland regeneration and restoration. In the Chihuahuan Desert, herbivore abundance can be up to two times greater in degraded Prosopis glandulosa shrub dominated states than intact Bouteloua eriopoda grassland states. We tested the recovery potential of B. eriopodapatches in shrub dominated, grass dominated and ecotone (grass and shrub co-domination) states that were exposed to or protected from native rodent and lagomorphs herbivores. Herbivore cage exclosures and control quadrats were established in a replicated blocked design. A disturbance of 40cm x 40cm was created in the center of a B. eriopoda patch in each treatment quadrat in 2001, whereby all above ground biomass was removed in order to examine the ability of B. eriopoda to recolonize. The disturbance areas were measured for recruitment and reestablishment of B. eriopoda in 2002, 2005 and 2008. Although herbivore abundance was greater in shrub dominated areas for the given time periods, there was little difference in recruitment and reestablishment of B. eriopoda among shrub dominated, grass dominated and ecotone states. Results from this study indicate that increased herbivore abundance in shrub dominated states did not constrain grass recovery potential.

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457. ECOLOGICAL AND CATTLE PRODUCTION IMPACTS OF AN INVADING NATIVE SHRUB (SHEPHERDIA ARGENTEA) IN A MIXED PRAIRIE LANDSCAPE. Regina Dahl*¹, Edward W. Bork²; ¹University of Alberta, St. Albert, AB, ²University of Alberta, Edmonton, AB

ABSTRACT

Mixed prairie grasslands of southern Canada historically had little shrub cover. However, wetlands created for the purpose of increasing waterfowl habitat have, in some situations, led to a marked expansion in woody species. This is the case on a significant portion of the University of Alberta Mattheis Research Ranch in SE Alberta, where Shepherdia argentea (thorny buffaloberry) is thought to have expanded considerably after the introduction of irrigation overflow water more than half a century ago. In order to

track the spatial extent of shrub expansion coincident with water introduction, the expansion of Shepherdia argentea at the ranch was mapped using a series of archived aerial photographs from the early 1950's to 2012. Field data were collected in the summer of 2013 to assess the impact of shrub presence on grassland diversity and composition, forage production and cattle use, as well as soil properties. Ultimately, the spatial data were linked to production data to determine net changes in cattle carrying capacity due to shrub encroachment. These results have implications for identifying the risk of future shrub expansion across wetland affected landscapes, including the importance of woody control measures.

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458. GLCI FORUM:THE RANCHING SUSTAINABILITY SELF-ASSESSMENT: A WORKSHOP FOR RANCHERS AND LAND MANAGERS. Royce Larsen*¹, William Tietje², Chuck Pritchard³, Steve Sinton³, George Work³, Aaron Lazanoff⁴, Karl Striby⁵, Chad R. Ellis⁶; ¹UC Cooperative Extension, Templeton, CA, ²UC Cooperative Extension, San Luis Obispo, CA, ³Rancher, San Luis Obispo, CA, ⁴Cal Poly, San Luis Obispo, San Luis Obispo, CA, ⁵USDA-NRCS, Templeton, CA, ⁶Noble Foundation, Ardmore, OK

ABSTRACT

The Grazing Land Conservation Initiative Forum this year is about the Rangeland Sustainability Analysis System (RSA). Ranchers come under pressure and scrutiny from the public to demonstrate stewardship of the land they manage. The Rangeland Sustainability Analysis System (RSA) was developed to help guide proper stewardship. The RSA is a self-assessment process that guides the rancher through a series of questions that cover social, economic, and natural resource aspects of 11 ranch-management categories. Anonymous summary scores allow ranchers to compare the operation to their peers and to track sustainability progress over time. Essential components for the ongoing implementation of the RSA are the strong support of a committee of ranchers, cattlemen associations, and voluntary participation. There are 7 important reasons for ranchers to participate in the RSA:

1. Presents a fast and easy way to create your written record
2. Fosters communication among family, employees, and agencies
3. Demonstrates your dedication to stewardship
4. Stimulates creative thinking about good ranching practices
5. Acts as a non-regulatory tool that may help you with regulators
6. Provides a new way to measure your practices leading to additional profitability
7. Developed by ranchers who understand the needs of ranchers and land managers

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*Presenter

459. GROUNDBREAKING NONLETHAL STRATEGIES FOR MINIMIZING LIVESTOCK DEPREDATION. Nancy Gloman*¹, Charlotte Conley²; ¹Defenders of Wildlife, DC, WA, ²Defenders of Wildlife, DC, DC

ABSTRACT

This workshop would present a collaborative environment for a discussion on minimizing livestock depredation on rangelands using a variety of innovative tools and methods. Predators play a critical role in rangeland ecosystems (e.g., protecting riparian areas by stabilizing herbivore populations), but they can also impact ranchers' businesses when they predate on their livestock. Several strategies that minimize contact between predators and wildlife are being successfully applied across the US. In addition, innovative payment mechanisms to compensate landowners for the presence of predators are also being successfully implemented. Strategies for preventing and reducing depredation are constantly evolving. This workshop will help ranchers and land managers learn about the most current nonlethal methods of predator control and compensation mechanisms. The workshop will include presentations about the deployment of proven effective predator deterrents and practices. By featuring a wide range of practitioners, ranchers and other stakeholders, we hope to make participants feel comfortable discussing their experiences with livestock depredation and predators on rangelands, as well as any concerns they have with incorporating deterrents and new animal husbandry strategies into their practices. The workshop would also include periods for open discussion to generate ideas about how livestock producers can better protect their animals from predators and elicit questions and concerns from the range management, ranching, and conservation communities. Goals of the workshop are to share information about deterrents and husbandry strategies to reduce livestock depredation on the range to reduce conflict between livestock and predators. The workshop will also serve to build tolerance for native predators on rangelands and empower managers and ranchers to prevent livestock depredations. Finally, small group sessions will allow stakeholders to further discuss native predators and share experiences with the solutions discussed in the workshop.

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Author Index by Abstract Number

Abatzoglou, John T. 107
 Abdelkreim, Mohammed M. 378
 Abele, Susan 285
 Abran, Melelani..... 290, 369, 373
 Adams, Barry..... 80, 138, 204, 205, 206, 249
 Adams, Todd R. 279
 Adler, Peter B. 186, 187, 188, 192
 Aguilar-Soto, Victor Manuel..... 160
 Al-Chokhachy, Robert..... 348
 Al-hamdan, Osama Z. 225, 227, 228
 Alan, Alvarez-Holguin 52
 Albarran-Portillo, Benito..... 14
 Albeke, Shannon E..... 217
 Aldridge, Cameron L..... 88, 188
 Alexander, Mike 206, 249
 Allison, Lesli..... 130
 Allred, Brady 211, 427
 Althouse, LynneDee 7
 Alvarez, Pelayo..... 128
 Alvear, Carlos 376
 Anderson, Dean M..... 17
 Anderson, Sarah L..... 47
 Anderson, Wade S. 70
 Angerer, Jay 25, 286, 430
 Ansley, James 133, 396
 Archer, Eric K..... 348
 Archibald, Sally..... 425
 Arechiga-Carrillo, Maria B. 42
 Arredondo Moreno, J Tulio 90
 Arriaga-Jordan, Carlos M. 14
 Arterburn, Jack R..... 157
 Astroth, Kirk 335
 Augustine, David 94, 180, 243, 363, 397

*Presenter

Avendano-Arrazate, Carlos H.....	57	Bobo, Matthew R.	271, 343, 355, 356, 357, 359
Averett, Joshua.....	409	Boe, Arvid	53, 60, 212
Aviles-Nova, Francisca.....	14	Bohrer, Stefanie L.....	213
Ayala, Felix	10, 11	Boll, Jan.....	228
Badrakh, Turmandakh	48, 145	Bolzotti, Chris	274
Bailey, Derek W.	218, 296, 305, 374, 375, 379	Bongadzeem, Carine S.	276
Baival, Batkhisig	441	Booth, D. T.....	404
Baker, Barry B.	164	Borchers, Jeffrey	240
Balandran, Martha.....	201	Bork, Edward W.....	6, 9, 72, 79, 80, 174, 204, 205, 206, 207, 249, 457
Balgopal, Meena M.....	310, 314	Borman, Michael.....	38, 407
Ballard, Bart M.....	135	Boucher, Tina V.	351
Bamboye, Gilbert F.....	276	Bowen, Richard	270
Baney, Oliwia.....	273	Boyd, Chad S.	64, 86, 114, 143, 144, 145, 146, 147, 148
Barnes, Matt	100, 179, 222	Boyd, Robert.....	343
Barnes, William.....	408	Boydston, Kathy	135
Barrett, Reginald.....	121	Boyte, Stephen P.....	254
Barrios-Cardenas, Patricia L.	63	Bradford, John.....	189
Barry, Sheila	203, 390	Braithwaite, Hope	232
Barth, Cory J.....	324	Brandenburger, Carl	9
Bartolome, James W.	39, 168	Branson, David H.	69
Bastian, Henry	355	Brennan, Jameson R.....	300, 301, 302, 325, 327
Bateman, Tim	232	Brennan, Leonard A.....	135
Bates, Jonathan.....	76, 114, 142, 144, 158	Briske, David D.....	243, 360
Battur, Ankhtsetseg.....	92	Broadbent, Tanner	207
Bean, Brian.....	96, 103	Brock, John H.....	197
Beauchamp, Kimberly	320	Brown, Greg	88
Beaudette, Dylan.....	163	Brown, Joel R.	82, 108, 162, 224, 227, 389
Becchetti, Theresa A.	203, 338, 342, 390	Browning, Dawn M.	161, 428
Beck, Jeffrey L.....	177, 217	Brownsey, Philip	390
Belland, Kent	199, 246	Bruegger, Retta A.	88
Bennett, Joe R.....	261	Brungard, Colby.....	164
Bennington, Jim.....	199, 246	Brunson, Kyle	253
Berleman, Sasha A.....	20	Brunson, Mark	110, 385
Bernau, Christopher R.....	260, 286	Buckhouse, John.....	38
Bestelmeyer, Brandon T.	92, 95, 162, 431, 456	Budde, Peter.....	200
Bielski, Christine H.	27, 427	Bunting, Stephen C.	420
Birkmaier, Kelly.....	262	Burke, Shawn	323
Black, Todd	236	Burnett, Sarah	270
Black Elk, Linda S.....	317, 318	Burritt, Beth.....	281
Blank, Robert.....	28, 30, 71		
Blumenthal, Dana M.	150		

Burritt, Elizabeth A.	377, 392	Connell, Lauren	64
Bushman, Shaun	176	Conner, James R.	25
Butsic, Van	257	Conner, Lafe G.	190
Cabanillas, Tomas	51	Connors, Kevin J.	176
Campbell, Tyler A.	297	Contreras, Suzanne	135
Cardozo, Geronimo	308	Cool, Rod	446
Carlson, J.D.	27, 427	Coombs, Cody	84
Carlyle, Cameron N.	78, 80, 204, 205, 206, 249	Cooper, Kristin	237
Carr, Craig	24, 380	Coppock, David L.	111, 319
Cary, Cheryl	273	Corrales-Lerma, Raúl	52, 55
Chambers, Jeanne	450	Cortner, Owen G.	8, 13
Chang, Scott X.	80, 204, 205	Cote, Steve	220, 221
Chapin, F.S. (Terry)	438	Courtwright, Jennifer	347
Chepulic, Brian J.	283	Cox, Robert D.	253, 408
Chesus, Kelly	150	Cox, Samuel	357
Childer, Rod	262	Crabb, Benjamin	184
Chowanski, Kurt	403	Creque, Jeff	202
Christensen, William	154	Crigler, Wink	265
Christoffersen, Nils	262	Crimmins, Mike	260
Chrisy, John A.	398	Cristina, Velez-Sanchez-Verin	252
Chuan, Xiaozhu	80, 205	Dahl, Regina	9, 457
Church, Matt	65	Dahlgren, David K.	184
Cibils, Andres F.	17, 375	Daigh, Aaron L.	5
Claassen, Vic P.	36	Dalke, Amber	26, 281
Clark, Clint	329	DAndrea, Rob	266
Clay, David	209, 261	Danvir, Rick	130
Clay, Sharon	209, 261	Dart, Jason	7
Clayton, Megan K.	195	Davies, Kirk W.	76, 114, 142, 143, 144, 145, 147, 158
Clements, Charlie D.	30, 46, 58, 59, 251, 255, 395	Davis, Benjamin	236
Clifton Ramirez, Kathryn	277	Davy, Josh	203, 390
Cline, Nathan L.	154, 274, 450	Day, Michelle A.	119
Coca, Mark T.	349	Day, Stephanie S.	47
Cochran, Jim	438	Debinski, Diane	299
Coe, Kent	409	Deboodt, Tim	38
Coelho, Aaron J.	406	Decker, Travis W.	21
Cole, Chris J.	357	DeCrappeo, Nicole	454
Collum, Kenneth R.	352	Deenik, Jonathan	368
Compagnoni, Aldo	186	DeKeyser, Edward S.	283
Conley, Charlotte	458	Delgado, Bruce C.	451
Conley, Zachariah	234	DeLint, Brian	178
		DeMaere, Craig	206, 249

Demoney, Kim	339	FADLALLA, Babo M.	378
Dencker, Camie M.	34	Faller, Timothy	317
Denesiuk, Dan R.	298	Fernandez-Gimenez, Maria.....	68, 88, 94, 208, 243, 316, 365, 441, 442
Denogean B., Francisco G.	10, 11, 18, 63	Fick, Walter H.	449
Densambuu, Bulgamaa	92	Ficke-Beaton, Stephanie J.	264
Derner, Justin D.....	81, 94, 180, 243, 293, 363, 366, 388, 397	Field, Aaron	151, 326
Despain, Del W.....	267	Fimbres-Preciado, Jesus.....	18
Diaz, Gisou	294, 376	Finzel, Julie.....	435
Diaz, Jose M.....	17	Fisher, Michael	38
DiBenedetto, Jeff	431	Fonda, Heather.....	270
Dickard, Melissa D.....	270, 343	Forbes, James T.	185
Dickey, Christopher P.	68, 88	Ford, Dustin	433
Dickson, Brett G.	266	Forero, Larry C.	383, 390
Do Carmo, Martin	308	Foulke, Thomas K.	125
Dobrowolski, James P.	364, 387	Fowers, Beth	171, 215
Doran, Morgan P.....	203, 390	Fraser, Lauch.....	136, 298
Duchardt, Courtney	299	Frasier, Gary.....	401
Ducheneaux, Kelsey R.....	43	Frederick, Stacey S.	29, 116
Duncan, Kimuyu	399	Frediani, Adrian F.....	172
Duniway, Michael C.....	164	Fuhlendorf, Samuel	27, 115, 118, 210, 211, 389, 421, 427
Dunn, Bruce.....	262	Fukumoto, Glen.....	290, 369, 370, 373
DuToit, Johan.....	231	Fuller, Garth.....	64
Dyess, Judith.....	26	Fults, Gene A.....	268
Edinger-Marshall, Susan	172, 315	Galera, Ashley	280
Edwards, Thomas.....	186	Garcia-Martinez, Anastacio	14
Elkayed, Motasem	277	Garcia-Moya, Edmundo.....	139
Ellis, Chad R.....	241, 458	Gardali, Thomas	170
Elmore, Dwayne	115, 118, 334, 338, 341, 342, 421	Gardner, Wendy	136, 406
Elsingner, Mae.....	303	Garrett, James J.....	330
Endress, Bryan A.....	12, 159, 409	Garris, Heath	136
Engle, David M.	27, 299, 387, 427	Garza-Ortega, Rodolfo	62
Englehart, Joe	178	Gascoigne, Billy.....	202
Eskridge, Kent M.	73	Gates, Roger	53, 403
Espeland, Erin	56	Gaugler, Erin M.....	124
Espinoza-Hidalgo, Carlos	12	Gayton MSc., PAg., Don V.....	419
Essoudry, Esther	273	Gearhart, Amanda	422
Estell, Rick E.	17, 305	Geaumont, Ben A.	166, 328, 433
Evans, Dave	163	George, Melvin R.....	289
Evans, Kenneth S.....	73, 291	Gerlach-Barrera, Luis Ernesto.....	11
Eviner, Valerie.....	167, 194	Germino, Matthew J.	54

Geupel, Geoff	437	Hardegree, Stuart P.	107
Gibble, Katherine T.	22, 191	Hardesty, Linda H.	446
Gil, Humberto I.	139	Harmon, Dan	30, 46, 58, 59, 251, 255, 395
Gil-Vega, Katia.....	57	Harmoney, Keith	292
Gilgert, Wendell C.	437	Harper, John M.	289, 390
Gill, Richard A.	190	Harr, Ryan	299
Gillan, Jeffrey K.	280	Harris, Richard.....	446
Gloman, Nancy.....	459	Harris, Thomas R.	126
Glosson, Guy.....	223	Hassan, S. "Iris".....	277
Gonzalez, Alfredo	17	Hatfield, Patrick	380
Goodman, Laura E.	375	Haufler, Jon	173
Gornish, Elise	106	Hauk, Brennan.....	200
Goslee, Sarah.....	269	Haukos, David	182
Gourley, Blayr B.....	334	Hauptman, Benjamin	327
Gracas Gomes, Maria	15	Heinse, Laura M.	446
Granberry, Todd.....	258	Helms, Emily R.	209
greene, david.....	256	Helzer, Chris.....	250
Gresham, Anna.....	237	Hemenway, Joshua	287
Griffin, Christine.....	339	Hendrickson, John R.	151, 248, 259, 302, 317, 324, 325, 326, 400
Griffith, Callie D.	426	Henneman, Carlene	170
Groseta, Andy.....	260	Heraty, Joanne	167
Gruell, George.....	156	Herbst, Brian.....	126
Guerrero, Rafael.....	81	Hernandez, Mariano	225, 228
Gunnell, Kevin L.	452	Hernandez, Sisto	102
Gunther, Kristen E.	242	Hernandez-Quiroz, Nathalie Socorro	160
Guretzky, John A.	306	Herrick, Jeffrey	269, 358, 434
Gustafson, Jon	163, 168	Hewins, Daniel B.	80, 204, 205, 206, 207, 249
Gutierrez-Gutierrez, Obed	252	Hewitt, Anthony.....	47
Guyer, Scott.....	351	Hibbard, Tyrrell	288
Hadley, Brian	343, 357	Hibbard, Whit S.	223
Hagen, Christian A.....	182, 185	Hibbs, Willow	442
Haggerty, Julia.....	210, 211	Hickman, Gene.....	398
Haider, Allison.....	248	Hickman, Karen R.	312
Hall, Ashley L.....	267	Hidinger, Lori	3, 241, 384
Hall, Linda.....	6, 174	Higgins, Michael	435
Halvorson, Gary A.	321, 324	Hild, Ann L.	242, 313
Hamer, Russel.....	240	Hill, Barry	33
Hamilton, Robert G.....	421	Hohmann, Matthew	77
Hamilton, Wayne T.....	25	Holmstead, Jamilee E.....	445
Hammond, Michele R.	39	Holthuijzen, Maike	454
Handley, Joy	37		
Hanson, Austin J.....	53		

Homer, Collin.....	188, 356	Jorge, Palacios-Nunez	252
Horn, Christa M.	12	Joyce, Linda	81
Horn, Kevin J.....	190	Judkins, Matt J.....	291
Horney, Marc R.....	382, 432	Judson, Sarah	347, 350
Hovick, Torre J.....	118, 421	Jurado-Guerra, Pedro.....	57
Hrozencik, Robert A.....	120	Kachergis, Emily.....	266, 271, 272, 343, 344, 352, 354, 358, 359, 442
Hruska, Tracy	122, 448	Kaminski, Timmothy	178
Huber-Sannwald, Elisabeth.....	90	Kane, Stephanie	123
Huff, Chris.....	297	Karl, Jason W.	272, 280, 343, 358, 428, 429, 434
Hughes, Morgan.....	231	Karl, Michael "Sherm".....	343, 346
Hulet, April	143, 145, 147, 450	Kaufmann, Philip R.....	347
Huntsinger, Lynn.....	121, 122, 385, 448	Kealoha, Perry.....	370
Hutchinson, Barbara S.	281	Kearns, Faith R.....	4
Hyde, Gretchen	337	Keeseey, Timothy C.....	263
Ibarra-Flores, Fernando A.	10, 18, 42, 61, 62, 63	Keiffer, Ryan F.	289
Ibarra-Gil, Humberto.....	139	Kellar, Clint	383
Ibarra-Martin, Fernando A.	61, 62	Kempka, Dick	202
Igl, Lawrence D.....	283	Kennedy, Michael L.	410
Iles, Dave.....	187, 188	Kerby, Jay.....	64, 145, 146
Ingham, Mike N.	417	Kerns, Becky K.....	119
Inman, John.....	451	Kilian, Robert.....	56
Irwin, Preston.....	264	Kim, Yong-Soo.....	290, 369, 370
Iwaasa, Alan D.....	140, 307	Kincheloe, Janna J.	300, 327
J. Santos, Sierra-Tristan.....	52	Kinford, Bob.....	223, 381
Jackson, Robert B.	134	Kinzie, Jillian.....	309, 311
Jacques, Louise.....	37	Kirkman, Kevin P.	153, 425
Jaeger, John R.	292	Kirt, Walstad	431
James, Darren.....	272, 456	Kisko, Claire R.....	79
James, Jeremy J.	106, 203, 390	Klaustermeier, Aaron W.....	5
Jasny, Lorien	89	Kleinhesselink, Andrew R.....	186, 187, 188
Jester, Steve.....	129	Klempel, Lauren N.....	433
Jimenez, Justin.....	350	Knapp, Corrie N.....	438
Johnson, Andrew.....	285, 352	Kniss, Andrew.....	214
Johnson, Douglas A.....	176	Koch, Jonathan B.	186
Johnson, Dustin D.	114, 148	Kocher, Susan	29, 116
Johnson, Holly	400	Kofinas, Gary.....	438
Johnson, Patricia S.....	53, 301, 302, 325, 326	Kohler, Monica.....	78
Johnson, S L.....	333, 336, 338, 342	Krabacher, Paul.....	414
Johnson, W C.....	60, 212	Kraft, John	182
Jones, George.....	37	Kral, Katherine C.	422
Jones, Jason S.....	25		
Jones, Thomas A.....	176		

Kray, Julie	150	Lipinski, Amanda	328
Kreuter, Urs P.	112, 131	Lipka, Adrienne.....	379
Kronberg, Scott.....	400	Littlefield, Robert S.	320
Krueger, Erik S.	27, 427	Long, Lexine	186
Kuvlesky, William P.	135	Lopez-Toledo, Leonel	12
Laca, Emilio	50, 390	Louhaichi, Mounir	277
Lair, Ken	40, 401	Lourdes Herminio Oliveira, Maria .	15
Lamagna, Sarah F.	271, 343, 354, 359	Lubell, Mark N.	89
LaMalfa, Eric M.....	187, 188	Luna Luna, Miguel	90
Lamb, James B.....	296	Lunt, Steven	379
Lambert, Scott M.	411	Lyons, Robert K.....	195
Lambright, Jessica.....	64	Lyseng, Mark P.	80, 206, 249
Lancaster, Jane	138	MacAdam, Jennifer W.	176
Landolt, Kyle L.....	278	Macaulay, Luke T.....	121
Larsen, Randy	184	Macedo-Santana, Franceli	12
Larsen, Royce	7, 390, 432, 458	Mack, Richard N.....	105
Larson, Gary.....	282, 436	Mack, Wyatt.....	328
Larson-Praplan, Stephanie R.	257, 390	Macon, Dan	97
Lasko, Angelina	237	Maczko, Kristie	16, 241
Lauenroth, William.....	189	Madsen, Matthew D.....	48, 145, 146, 147
Launchbaugh, Karen	337	Maestas, Jeremy D.....	185
Lautenbach, Joseph	182	Major, Donald J.....	254
Lazanoff, Aaron	458, 169	Makhamreh, Zeyad.....	277
LeCain, Dan R.....	150	Malmstrom, Carolyn	167
Lee, Chin N.....	290, 369	Malmstrom, Carolyn M.	194
Leger, Elizabeth A.....	238, 284	Malouff, Enoch.....	260
Lessard, Veronica C.	345	Mamo, Martha	73, 291, 306
Levi, Matthew R.....	162	Mann, Rebecca K.....	175, 187, 188
Li, Sandra Y.	279	Manson, Jessamyn S.	78
Li, Wenjun.....	443	Many, Daren	287
Li, Yanbo.....	443	Manzanares, Angelica M.	139
Liebig, Mark A.....	248, 324, 400	Marlo, Clayton	235
Lieurance, Wade	258	Martin-Rivera, Martha H.	10, 18, 42, 61, 62, 63
Likins, J. C.	404	Martinez, Humberto	297
Lile, David.....	263	Martinez-Duran, Ana Bertha	11
Limb, Ryan	199	Martinez-Salvador, Martin.....	44, 57
Limb, Ryan F.....	5, 115, 213, 328, 422, 423	Martini, Juan P.....	70
Lind, Brianne N.....	16	Mata-Gonzalez, Ricardo.....	19, 201
Lindquist, Eric.....	22	Matney, Casey A.....	304
Lindsey, Torie W.	295	Mattocks, Michelle	161
Linney, Fritz	297	May, Joseph A.	367
		Mayagoitia, Piedad E.....	305

Maynard, Jonathan J.....	428	Morales-Nieto, Carlos R.	44, 52, 55, 57, 252
Mbih, Richard A.	276	Moreno-Medina, Salomon	10, 11, 18, 42, 62, 63
McAdoo, Kent.....	34, 156	Morgan, Tye A.	28, 30, 71
McCann, Melissa C.	199, 246	Morris, Christo	238
McConnell, Richard	219	Morris, Joseph.....	169
McCord, Sarah E.....	66, 266, 272, 343, 352, 354, 358, 429	Morris, Lesley	23, 238, 284, 402
McCormack, Jamie.....	262	Morrison, Michael	135
McCornack, Brian.....	32	Moseley Urbanik, Kendra	168
McGillivray, Susan E.....	138	Mueller, Kevin E.....	150, 397
McGowan, Kelly.....	394	Murphy, Melanie	313
McGranahan, Devan A.	47, 153, 425	Muscha, Jennifer M.	56, 74
McKay, Shawn.....	238, 284	Myers, Orrin.....	408
McMahon, Adam.....	33	Naeth, M. Anne.....	137
McNelis, John J.	278	Naka, Kozma.....	410
Meade, Daniel E.....	7	Narduzzi, Drew	234
Mealor, Brian A.	171, 196, 214, 215, 391, 393	Narem, Diane M.	245, 282, 436
Meehan, Miranda A.	405	Naugle, David.....	210, 211
Mehl, Carolyn	173	Naylor, Bridgett.....	159, 409
Meiman, Paul J.....	68, 200, 386	Ndzeidze, Stephen K.....	275, 276
Melgoza-Castillo, Alicia.....	44, 52, 55, 57, 160, 201	Nearing, Mark A.....	225, 227, 228
Menalled, Fabian.....	380	Neville, Bryan	124, 247
Mendenhall, Laura.....	181	Neville, Marilyn	138
Meredith, Christy	348	Newingham, Beth A.....	54
Messmer, Terry	184	Noelle, Sarah.....	265, 281
Metz, Loretta.....	430	Nolan, Craun	239
Michael, Eytchison.....	284	Norland, Jack.....	405, 433
Miller, Craig.....	101	Noseworthy, Cara E.....	391, 393
Miller, James R.....	95, 299	Nouwakpo, Sayjro K.....	229, 230, 279
Miller, Kevin H.....	266, 353	Novak-Echenique, Patti J.	83, 84, 85
Miller, Perry.....	380	Nyren, Anne C.	247
Miller, Richard.....	450	O Connor, Rory.....	190
Miller, Scott W.....	343, 347, 350	O Connor, Tim G.....	425
Miller, Zoe M.	354	Ocheltree, Troy W.....	150, 208
Millward, Michael F.	296	Ochoa, Carlos G.....	38, 407
Mitasova, Helena.....	77	Ochsner, Tyson.....	27, 427
Moisey, Darlene.....	206, 249	Odadi, Wilfred O.	399
Monaco, Thomas A.....	175, 284, 452	Ode, Dave	282, 436
Montemayor, Erasmo	195	Ohrman, Michelle	209
Moore, Dina.....	129	Olsen, Anthony R.....	347
Mora-Delgado, Jairo R.	294, 376	Olson, Denise N.	245
		Olson, Kenneth C.	300, 327, 329
		Oltjen, James W.	383

Orr, Rick.....	394	Prosser, Chadley	259
Ortega, Alfonso.....	297	Pyke, David	454
Ortega, Carlos	51	Pyle, Lysandra A.....	6, 79, 174
Ortega-Gutierrez, Juan Angel.....	52	Pypker, Tom.....	406
Overlin, Annie	35	Quero-Carrillo, Adrian R.	57
Owens, Breanna.....	437	Racich, Loren	287
Owensby, Lyndi	375	Ralston, Brad.....	178
Owings, Glenn C.	287	Ramirez, Guillermo H.	72
Pack, Samantha J.	23, 402	Ramsey, Heidi	285
Palmer, Brianne.....	233	Rashford, Ben.....	216
Park, Seong C.	133	Ratcliff, Felix.....	39
Parkhurst, Robert	202	Rau, Ben.....	450
Parks, Catherine.....	159	Ray, Grace L.....	38, 407
Parmenter, Robert	408	Redden, Miles D.....	295
Patrignani, Andres	27	Reed-Dustin, Claire	19
Patton, Bob D.	247	Reese, Kerry P.....	185
Paulsen, Steven G.....	347	Reeves, Justin.....	293
Payne, Jarrett	235	Reeves, Kent A.....	98, 169
Pearce, Robert A.	40, 401	Reid, Robin.....	365
Pekin, Burak	159	Renteria-Villalobos, Marusia.....	160
Pellant, Mike L.....	1, 191	Retes-Lopez, Rafael.....	42, 61
Perkins, Lora	43, 261	Rhodes, Aaron C.	67
Perry, Sean F.	66	Rhodes, Edward	25
Petersen, Luke	50	Rice, Kevin	167
Petersen, Mark K.....	56, 74	Richardson, Belinda	8, 13
Pfander, Jeanne	281	Richardson, James.....	126
Phung, Angela	78	Richarte-Delgado, Leobardo	31, 45
Pierce, Jennifer L.....	22, 191	Richie, Deborah.....	2
Pierson, Frederick B.....	225, 227, 228	Richman, Jennifer.....	206, 249
Pinedo-Alvarez, Carmelo.....	160, 201	Riginos, Corinna	399
Pineros-Varon, Roberto	294	Rimbey, N.	123, 125
Pitman, Jim.....	182	Rinkes, Tom.....	1
Pittarello, Marco.....	305, 374	Riojas, Gilly.....	297
Pontureri, Jodi	244	Ritten, John	125, 216, 442
Porensky, Lauren.....	397, 399	Robbins, Matthew D.	155
Porzig, Elizabeth.....	437	Roberts, Andy J.	74
Pratt, Seth.....	331	Roberts, Caleb P.....	408
Price, Katilyn J.....	250	Robinette, Jennifer	198
Prince, Stephen.....	286	Roche, Leslie M.....	89, 243, 366
Printz, Jeff.....	259, 405	Rogers, William E.	453
Pritchard, Chuck.....	458	Rojo-Rubio, Rolando	14
Pritchett, James.....	120, 442	Rollins, Kimberly S.	109

Romero-Manzanares, Angelica	139	Sheley, Roger	107, 149
Rose, William C.	214	Short, John	8, 13
Roselle, Lovina	337, 338, 340, 342	Silveira, Joe	172
Rosenstock, Steve	286	Silver, Whendee	202
Rossi, Cole H.	229, 230	Simonds, Gregg E.	165, 183, 424
Roundy, Bruce A.	48, 145, 154, 274, 450, 455	Sinton, Steve	458
Rowland, Mary	409	Sitzmann, Paul	353
Running, Steven	210, 211	Skagen, Susan	180
Russell, Tiffany M.	285	Skinner-Rosenberg, Dylan	237
Ruyle, George B.	26, 265	Smart, Alexander	209, 261
Ruzycki, Thomas	77	Smith, Alistair	420
Sales, Aldo	15	Smith, Brenda	64, 149
Sanderson, Matt A.	269, 400	Smith, William K.	210, 211
Sant, Eric D.	165, 183, 424	Snyder, Devon K.	86
Sayre, Nathan F.	93, 127, 362, 438	Soca, Pablo M.	308
Scasta, John D.	117, 177, 299	Spaak, Jordan	200
Schacht, Walter H.	73, 75, 157, 240, 295, 306, 426	Spaeth, Kenneth E.	225, 226, 227, 228
Schafer, Dave	260	Specht, Joshua A.	439
Schauer, Christopher S.	329	Spiegel, Sheri	39, 168
Schellenberg, Michael P.	41, 303	Spurrier, Carol	343
Scherbinbski, Scott	181	Squires, Victor R.	152, 440
Schick, Bradley D.	306	St. Clair, Sam	67
Schlaepfer, Daniel	189	Stackhouse, Art	383
Schoderbek, Donald F.	72, 80, 204, 206	Stackhouse, Jeffery W.	166, 383
Schultz, Brad	394	Stanley, Chuck	388
Schumacher, Kyle	240	Starns, Heath D.	118
Schwartz, John S.	278	Staub, Jack E.	155
Schwartzman, Liya B.	113	Stauffer, Nelson G.	354
Scianna, Joe	56	Steinaker, Diego F.	70
Seal, Mindy	87	Stephens, Scott	20, 29
Seavy, Nathaniel E.	170	Stephenson, Mitch.	218, 374, 379
Sedivec, Kevin K.	5, 124, 151, 166, 199, 246, 302, 324, 325, 326, 328, 405, 422, 433	Steppuhn, Harold	307
Sedlacek, Teresa	108	Stettler, Jason M.	176
Seiden, EL, Zachariah T.	278	Stevenson, Matthew	290, 369, 371, 372, 373
Severson, John P.	185	Stone, Jim	104
Shane, Ryan	394	Strand, Eva K.	420
Shapero, Matthew W.	447	Striby, Karl	432, 458
Sharma, Sonisa	27	Stricklan, Dave	296
Shaul, Victor	413	Stringham, Tamzen K.	35, 83, 84, 86
Shaver, Pat L.	259, 361	Sturm, Ashton	78
		Suazo, Alex A.	54
		Suazo, Martina	408

Suding, Katharine.....	20	Tsevee, Altanzul.....	441
Summers, Danny.....	416, 452, 455	Tulganyam, Samdanjigmed.....	24
Summers, Paul.....	270	Tweedie, Craig.....	161
Sutton, Pamela J.	73	Twidwell, Dirac.....	27, 91, 118, 157, 210, 211, 426, 427, 453
Svejcar, Lauren.....	444, 456	Ulambayar, Budbaatar.....	92
Svejcar, Tony.....	64, 141, 142, 144, 145, 146, 149, 444	Unnasch, Robert S.	434
Svendsen, Niels.....	77	Valdez-Cepeda, Ricardo.....	44
Swanson, Sherman R.....	33, 34, 65, 394	Varelas, Leticia A.	216
Sweet, Karen.....	193	Vaughn, Robert.....	77
Sweitzer, Nikolai	203	Veblen, Kari E.....	175, 232, 399, 454
Talbot, Curtis.....	82, 224	Vernon, Jason L.....	416
Tanaka, John A.....	16, 125, 216, 241	Villalba, Juan J.	232, 377, 392
Tarr, Kayla M.....	75	Villalobos, Carlos.....	15, 31, 45
Tate, Kenneth W.	89, 243, 363, 366	Villarreal-Guerrero, Federico	44, 160
Tausch, Robin.....	450	Vogel, Garrett W.	49
Taylor, David T.	125	Volesky, Jerry	75, 295
Taylor, Kaitlyn L.	217	Volk, Jay	213
Taylor, Mary	354	Wagner, Karly B.....	33
Teoh, Kwan Hong	60, 212	Walker, John W.....	305
Thacker, Eric T.....	21, 118, 210, 211, 232	Wall, Ken	307
Theodori, Gene L.....	132	Wang, Tong.....	133
Thomas, Joseph W.....	423	Warnock, Cynthia	262
Thompson, Donald	303	Warren, Steven D.	77
Thomsen, Craig D.	36	Washington-Allen, Robert A.	277, 278
Thorne, Mark.....	290, 369, 371, 373	Waterman, Richard C.	74
Tierney, Katie R.	7	Wedin, David A.	157, 250
Tietje, William	458	Wei, Haiyan	225
Tilley, Derek.....	415	Weimer, Grant	240
Tilligkeit, Jacqueline E.	7	Weiner, Nathan I.....	420
Timerman, David	256	Weir, John.....	115
Tipton, Crystal Y.....	88, 208	Welch, Crystal	237
Toevs, Gordon R.....	343, 344	Wells, Smith L.....	234
Toledo, David.....	112, 259, 269, 400	Weltz, Mark A.	225, 227, 228, 229, 230, 279
Tolleson, Doug.....	260, 286, 332, 335, 338, 339, 342, 386	Weppner, Kerrie.....	191
Tomlinson, Hannah A.....	5	West, Jason B.	453
Torell, L. Allen	17, 108, 123, 125	Westbrook, Jasmine K.....	380
Torres-Perez, Juan	273	Whitcomb, Hilary	110
Tredennick, Andrew	187, 188	White, Michael D.	39, 168
Troelstrup, Nels Jr H.....	245	Whitted, Dennis L.	124, 199, 246
Trooien, Todd.....	261	Wiggam, Shelly.....	32

Wilkins, Neal.....297

Williams, C. Jason.....225, 227, 228

Williams, Ilana V.115

Williams, Jimmy.....430

Williams, John262

Williams, Tina219

Williamson, Jeb C.....431

Williamson, Matt286

Willoughby, Mike.....206, 249

Wilmer, Hailey.....243

Wilson, Dereck272, 352

Wingeyer, Ana B.....73, 291

Wirngo, Harry M.276

Wirth, Troy454

Wisdom, Michael159, 409

Wise, Cindy M.244

Wolf, Kristina M.382

Wolstenholme, Rachel.....181

Wong, Carolyn.....264

Wonkka, Carissa L.112, 210, 211, 453

Worcester, Suzanne451

Work, George458

Workman, Julia M.....196

Wu, Yongbo410

Wulster-Radcliffe, Meghan332

Wylie, Bruce K.254

Xu, Lan53, 245, 282, 301, 302,
325, 326, 436

Yeats, Scott173

Yellow Luger, Lisa J.....322

Young, Stanford.....412

Young, Stephen250

Young, Truman399

Zaranek, Hilary99

Zilverberg, Cody J.60, 212, 430

Zolnerowich, Gregory32

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