POSTER PRESENTATIONS: 2016 SRM Annual Meeting Corpus Christi, Texas

1.

MONITORING HYDROLOGIC RESPONSE TO RANGELAND RESTORATION PRACTICES IN ARID LANDSCAPES OF NORTHERN MEXICO.

Carlos G. Ochoa*[1], Carlos Ortega[2]

[1]Oregon State University, Corvallis, OR, [2]Universidad Autonoma de Chihuahua, Chihuahua, Mexico

Managing degraded rangelands to bring them to a more productive state requires a good understanding of the impacts that conservation efforts may have on local biotic and abiotic conditions.Properly conducted soil and water conservation practices can be beneficial to capture precipitation and store moisture for longer periods. In turn, this increase in moisture availability, can be beneficial for plant production, it can help recharge the soil profile, and in some cases, it can contribute to subsurface flow and groundwater recharge.Since 2012, a series of conservation practices including land imprinting, grade control structures, small basins, and planting of native shrubland species (*Atriplex canescens*) and (*Prosopis glandulosa*) have been conducted in a 500 ha watershed in a rangeland location in the Chihuahuan Desert, in northern Mexico. In March of 2014, we began our collaborative research work to investigate plant-soil-water relationships following these restoration efforts.We have instrumented the site to monitor rainfall, soil moisture, soil temperature, and shallow groundwater fluctuations. Also, vegetation variables such as canopy cover, species frequency, and planted shrubas response are being evaluated.Preliminary results show that average annual precipitation at the study site was 293 mm. Results provided valuable information regarding precipitation effects on soil moisture response at shallow (20 cm) and deeper (50 and 80 cm) depths. A greater soil moisture response, and variability, was observed in sensors located at 20 cm depth when compared to deeper probes. Shallow probes responded relatively rapid to specific precipitation events, particularly during the monsoon season. An increase in soil moisture level observed during the winter season in all probes was attributed to decreased plant water uptake during dormancy. Study results provide valuable information towards understanding ecohydrologic response following land conservation practices in arid environments.

2.

LOOK AT US! CHECK OUT THE RANGELANDS PARTNERSHIP&RSQUO;S RADICALLY REDESIGNED WEBSITES.

Barbara Hutchinson*, Jeanne Pfander, Amber Dalke, Sarah Noelle, Sheila Merrigan, Matt Rahr, Kelly Arizmindi

University of Arizona, Tucson, AZ

The Rangelands Partnership has relaunched its information and education websites Global Rangelands (http://globalrangelands.org) and Rangelands West (http://rangelandswest.org) based on input from stakeholders and members with financial support from several NIFA grants. Included in the redesign are improved Partner state-specific sites such as Arizona Rangelands (http://globalrangelands.org/arizona), Hawaii Rangelands (http://globalrangelands.org/Hawaii), and South Dakota Rangelands

(http://globalrangelands.org/southdakota). Besides improved navigation and mobile-friendly applications, topical content has been added along with accompanying videos as well as expanded "collections" of resources including journal articles, reports, fact sheets, and multimedia. While retaining a focus on integrating and providing easy access to more than 18,000 resources to serve research, education, and extension needs, new features include: (1) new/expanded collections from: the SRM annual meeting presentation and poster abstracts archive, multiple sub-collections from the Grassland Society for Southern Africa (GSSA) including complete editions of the *African Journal of Range and Forage Science*, full-text documents from the Food and Agriculture Organization of the United Nations, the Iranian *Journal of Rangeland Science*, and the California Range and Pasture Article Datastore; (2) comprehensive sections on "Trending Topics" such as wolf reintroduction in the southwest, wild horses and burros, and sage grouse; and (3) enhanced educational resources including "Careers and Education", "Range Education at a Distance" and "Rangeland Teaching Clearinghouse". The Partnership's social media outlets have also expanded and include Facebook (www.facebook.com/RangelandsWest), Twitter (twitter.com/RangelandsPartn), YouTube channel (www.youtube.com/user/GlobalRangelands/playlists), Pinterest (www.pinterest.com/RanglndsPartnrs/) LinkedIn, and ScoopIt news service.

3.

ENHANCING SUSTAINABILITY AND FODDER PRODUCTION OF LOWLAND PASTURES IN ARID AGROPASTORAL ECOSYSTEMS.

Mounir Louhaichi*[1], Raed Al Tabini[2]

[1]CGIAR, Amman, Jordan, [2]Hashemite Fund for the Development of Jordan Badia, Amman, Jordan

Lowland depressions have the potential to play an important role in the intensification and diversification of pastoral production and provide a favorable environment for biodiversity conservation. This is primarily due to their specific ability to accumulate soil, seeds, and nutrient deposits throughout the soil profile. But despite this potential, the current sustainable use of lowlands in the arid and semi-arid rangeland areas of West Asia and North Africa (WANA) is still limited. In fact, these landscape depressions are suffering from the encroachment of recurrent cultivations. Cultivated soils gradually lose their inherent fertility and are subject to erosion due to over-exploitation and inappropriate management practices. As a result, the grazing area is shrinking, the available biomass is reduced, and species biodiversity is being eroded. The reduction in vegetative biomass seriously impacts livestock production, natural resource conservation, and the well-being of the agro-pastoral communities. The objective of this research study is to enhance the productivity of lowland pastures in arid agropastoral ecosystems to provide additional fodder, while conserving the environment and biodiversity. Plant community characteristics were assessed between well managed lowland depressions and sites where continuous barley cultivation and/or grazing represent the routine practice in WANA region. Preliminary findings shows significant increase in productivity for the managed sites compared to farmer's practice. These results suggest that plant community structure will be impacted positively from sustainable management of lowland pastures. We conclude that carefully planned grazing management along with adapted forage legumes, such as common vetch in rotation with cereals should result in improved soil fertility and higher productivity.

4.

BREEDING SEASON IN BEEF-CATTLE IN THE NORTHWEST OF SONORA, MEXICO.

Francisco G. Denogean-Ballesteros*[1], Felix Ayala-A.[1], Salomon Moreno-Medina[1], Fernando A. Ibarra-Flores[2]

[1]Universidad de Sonora, Santa Ana, Mexico, [2]University of Sonora, Hermosillo, Mexico

In Sonora, Mexico, extensive cattle production is conducted in 15.4 million hectares, of which 5.5 (36%) are semi-arid areas including grasslands that present production rates with very marked differences which can increase cattle production levels on the rangeland with the application of available technologies. Data from 2006-2014 was collected and analyzed, including the month of birth of calves, monthly precipitation, annual inventories and herd composition and stocking rates from a ranch located in north-central Sonora in the municipality of Cananea with a surface of 707-10-21 ha and the capacity to hold 66 Animal Units. Using descriptive statistics we found that 58.5% (± 7.7) of calving occur in mid-April to July 31. During the period, the average annual precipitation was 454.5 mm, and the data showed that from total, 326.3 mm were grouped in the months of July, August and September, which represents 76.9%. The annual average calving percentage is 70.1% with fluctuations of 32% in 2012 to 97% in 2011. The annual inventory showed a stock of 88 heads of which 44 (49.9% were cows) had an average calving percentage of 70.1% with fluctuations of 32% in 2012 to 97% in 2011. The average stocking rate was 75.58 A.U. and the recommended rate is 66 Animal Units showing an overstock of 9.58 A.U. which represents 14.5%. It's possible the application of reproductive techniques to optimize cattle production in semiarid rangelands. We conclude that it is feasible to implement a breeding season of three months from July to September to coincide with the natural breeding season reported, reduce supplementation costs, and increase the calving rate to 80%, depending on climatic conditions and the management of the rangeland.

5.

EARLY INTENSIVE GRAZING OF KENTUCKY BLUEGRASS: PLANT COMMUNITY RESPONSES AND ANIMAL PERFORMANCE.

Bob D. Patton[1], Fara A. Brummer*[1], Ryan F. Limb[2]

[1]North Dakota State University, Streeter, ND, [2]North Dakota State University, Fargo, ND

Kentucky bluegrass (*Poa pratensis* L.) is a perennial, cool-season invasive grass throughout the northern Great Plains. It can provide adequate early spring grazing, but forage quality declines quickly with maturity. Timed grazing can impact plant species and can shift plant communities to a more desired state. Higher animal densities may be necessary to affect target species. However, animal performance and overall economic benefit to the livestock producer need to be considered. A five year timed grazing study at the Central Grassland Research Extension Center, North Dakota, compared early-intensive grazing with season-long grazing on Kentucky bluegrass foliar cover. Beef heifers, moderately stocked on both treatments, were removed from the early-intensive treatment when thirty percent of native

vegetation had received some grazing. Stocking rate was similar across both treatments, but stocking density was over three times higher on the early-intensive treatment. Forage production was not significantly different (*P*<0.05) between early intensive and season-long grazing treatments in any of the five years. However, Kentucky bluegrass foliar cover was less on the early intensive treatment (23.5±6.42 vs. 53.46±1.75 *P*=0.001). Heifers gained more (*P*<= 0.05) in season-long pastures, with a corresponding weight loss on the early intensive treatment (0.37 vs -1.04 lbs/day, respectively). However, early spring forage production in 2015 was less than in prior years of this study due to a dry winter. While early intensive grazing appears to be an effective long-term management strategy to reduce Kentucky bluegrass, animal performance should also be considered, especially in the case of pre-breeding females with higher nutritional needs. Grazing animal age and stage should be matched accordingly on a yearly basis.

6.

EVALUATING THE USE OF THRESHOLDS CONCEPTS FOR IMPROVING HABITAT THROUGH CHEATGRASS MANAGEMENT.

Clay W. Wood*[1], Brian A. Mealor[2]

[1]University of Wyoming, Laramie, WY, [2]University of Wyoming, Sheridan, WY

Invasive species have ever-increasing impacts on ecological and economic functions of ecosystems. Cheatgrass (*Bromus tectorum* L.) is an invasive annual grass that is widely distributed throughout most of the western United States. Cheatgrass produces high amounts of fine fuels which can increase fire frequency and severity, altering vegetation composition and structure. Although cheatgrass can be used as early spring forage by livestock and wildlife, it may not be preferred, so its suitability as a forage species is questionable. We hypothesize that there is a direct, predictable relationship between pre-treatment vegetation condition and post-treatment forage response that may be defined at lower levels of cheatgrass by minimal post-treatment grass response and in more severe infestations by more pronounced increase in perennial forage following treatment. By identifying these treatment-response thresholds, we hope to aid land managers in prioritizing where their treatments will provide a high level of benefit. In summer 2015, we sampled locations representing a gradient of cheatgrass to perennial grass biomass and canopy cover ratios prior to herbicide application across multiple sites. At each intensively sampled location we employed four different sampling methods to determine the ratio of cheatgrass to perennial grass using both biomass and cover measurements. Comparisons will be made among sampling methods to determine if each method yields similar results in perennial grass response to herbicide treatment. We aerially applied two imazapic formulations during fall 2015. Post-treatment data will be collected in 2016 to evaluate the response of cheatgrass and associated vegetation following herbicide application for cheatgrass control. With a better understanding of cheatgrass and perennial grass response following herbicide treatment and various cheatgrass infestation thresholds within an ecosystem, we aim to provide valuable information which land managers can use to refine landscape-scale management strategies.

7.

INTERACTIONS BETWEEN *VENTENATA DUBIA* AND FIRE IN THE PACIFIC NORTHWEST BUNCHGRASS PRAIRIE.

JoAnna Perren*[1], Lesley Morris[1], Bryan A. Endress[1], Robert V. Taylor[2], Josh Averett[1], Bridgett Naylor[3]

[1]Oregon State University, La Grande, OR, [2]The Nature Conservancy, Enterprise, OR, [3]USDA Forest Service, La Grande, OR

Ventenata dubia is a relatively new invasive annual grass to the Intermountain West that has spread rapidly across seven western states (CA, OR, ID, WY, WA, UT, MT). Fire has a well-documented connection to the spread and increase of other annual species, such as cheatgrass, but the invasion dynamics between *V. dubia* and fire are unstudied. Our overall objective in this study was to examine the relationship of fire with the spread of *V. dubia* in the Pacific Northwest Bunchgrass Prairie. Given the influence of fire on the spread and increase of other annual grasses in the region (e.g., cheatgrass), we expected that fire would also assist *V. dubia* in similar ways. To test this idea, we resurveyed 77 plots across the Zumwalt Prairie Preserve where frequency and cover of *V. dubia* had been recorded in 2008. Twelve of these plots were known to have burned in the last 15 years. We then asked if *V. dubia* had increased across all sites between 2008 and 2015, if it had increased more in sites that had burned versus unburned sites over the 7 years, and if there was more *V. dubia* on burned or unburned sites in 2008 or 2015. We found that frequency of *V. dubia* had doubled and cover had also significantly increased across all of our plots over the 7 years regardless of whether or not they had burned. Likewise, fire did not significantly effect frequency or cover of *V. dubia* between burned and unburned plots within the same year. Our findings suggest that fire is not a driving factor in the spread and increase of *V. dubia* in this region and that it can continue to invade in the absence of wildfire as a disturbance.

8.

NUTRITIONAL VALUE OF THE DIET CONSUMED BY CATTLE GRAZING AN AREA INVADED BY NATALGRASS [*MELINIS REPENS* (WILLD.) ZIZKA] IN THE STATE OF CHIHUAHUA.

Obed G. GutiÃ©rrez*[1], Carlos R. Morales[2], Oscar Ruiz[2], Juan A. Ortega-Gutiérrez[2], Federico Villarreal-Guerrero[2]

[1]Universidad AutÃ³noma de Chihuahua, Chihuahua, Mexico, [2]Universidad Autónoma de Chihuahua, Chihuahua, Mexico

Natal grass (*Melinis repens*) is an invasive species which displaces native grasses. Such invasion is extended to the center-south region of the state of Chihuahua. The objective of this study was to evaluate forage production natal grass and nutritional value for cattle. The experiments were conducted on the 'Salinas' Ranch, located in the municipality of 'Satevó', Chihuahua, in a brush grassland with an 87.5 % invasion of natal grass. Forage production was determined quadrant of 0.25 m2. Botanical composition of the area was determined by the line-point intercept method. Sampling was conducted from August 2013 to February 2014. Two esophageal fistulated cross Hereford-Angus animals (350 ± 5 kg) were used to collect samples to determine nutritional value. Variables measured were: crude protein (CP), non-digestible nitrogen (ADIN), organic matter (OM), *in vitro* digestibility of organic matter (D*IV*MO), digestive (NDF) and non-digestive fiber (ADF). Average forage production (DM) was 1279

kg/ha-1. The highest levels of CP were reached during the regrowth (July 2013;13.23 ± 1.10%), and flowering (10.71 ± 1.10%) stages. Digestibility (July 2013-February 2014) ranged from 36.56±1.86% to 43.06±1.86%.

9.

USING THE POPULAR PRESS TO PROMOTE THE USE OF IPM TECHNIQUES FOR THE 25 WEEDS OF GREATEST CONCERN IN NEVADA.

Brad Schultz*[1], Jason Davison[2]

[1]Humboldt County Extension Educator, Winnemucca, NV, [2]University of Nevada Cooperative Extension, Fallon, NV

A formal needs assessment survey related to the Integrated Pest Management Program in Nevada identified two critical needs: 1) the identification of the highest priority weeds in each county, and 2) the need for knowledge regarding effective control methods for these weeds. The first need was met using a program titled "Weeds to Watch" in which the highest priority weeds for each of Nevada's 17 counties were identified and publicized using various media. This program is part of the current effort to meet the second need. In this three year program, which began in 2013, one of the 25 weeds of highest concern is featured in a monthly article published in the top two agriculture magazines in Nevada. Each article includes a series of color photographs of the target weed, a paragraph on the typical habitat where the plant is found, a section discussing plant biology, and an extensive discussion of recommended control approaches including cultural, mechanical, biological and herbicidal methods when appropriate. Each article was distributed in 9,000 print copies and potentially viewed by approximately 30,000 electronic hits each month. This program represents a partnership between University of Nevada Reno Cooperative Extension (UNCE) and two private media companies with UNCE obtaining widespread distribution of educational materials and the media companies providing their readers desired articles at no cost. A formal evaluation effort is planned following the conclusion of this program to determine the educational impact and contribution to advancing the goals of the IPM program in Nevada.

10.

BUFFELGRASS SPREAD TAKES FORM OF SATELLITE DISPERSAL, PRESENTS OPPORTUNITY FOR TARGETED REMOVAL.

Jaron Weston*, Jeff Fehmi

University of Arizona, Tucson, AZ

Penniselum ciliare, buffelgrass, has spread rapidly in the Sonoran desert of Southwest AZ and has proved difficult to control with severe impacts on native ecosystems. Targeted removal of satellite populations of invasive species has been shown via modeling to be an effective control. Because buffelgrass dispersal pattern has received little to no attention in literature, I investigated the pattern of buffelgrass dispersal along Highway 85 in the Barry M. Goldwater Range. Density of buffelgrass was collected for all

buffelgrass 6 meters from the west side of the aforementioned highway. A Ripley's K analysis, conducted in ArcGIS, showed that buffelgrass dispersal is clustered depending on the scale of investigation. Further research should explore buffelgrass dispersal patterns at larger scales and the effectiveness of land management techniques on buffelgrass that utilize strategies of targeted removal of clusters.

11.

USING VERY SMALL HERBIVORES AND HIGH SCHOOL STUDENTS TO CONTROL NOXIOUS WEEDS IN RANGELAND PASTURES.

Linden K. Greenhalgh*

Utah State University, Tooele, UT

Local high school students combined with weed, insect, and rangeland specialists to initiate a program to control noxious weeds in Tooele County, Utah. Thirty-three students at Tooele High School learned about controlling weeds with insects from weed bio-control specialists. The program consisted of in-class instruction about noxious weeds including why they matter, what weeds are a problem in the local area, methods of control including bio-control.Additionally, the project included field days with hands on collection, analysis, insectary construction, monitoring protocol and release of insects. Global positioning system (GPS) navigation and way point marking were also taught. Utah State University graduate students conducting ongoing related studies were involved in the program with the high school students.

12.

A METHOD FOR TESTING LAND RESOURCE AREA CONCEPTS.

Shawn W. Salley*[1], Curtis Talbot[2], Joel Brown[3]

[1]USDA-ARS, Las Cruces, NM, [2]USDA NRCS, Las Cruces, NM, [3]NRCS, Las Cruces, NM

Land Resource Units (LRUs) are defined by the National Soil Survey Handbook as aggregations of soil map units and subunits of Major Land Resource Areas (MLRAs). In the USDA NRCS Land Resource Hierarchy, LRUs are defined as the level between MLRAs and STATSGO and are mapped at 1:1 million scale. They also function as an important framework for the development of Ecological Site (ES) concepts. While the art and science of resource area mapping has advanced significantly in the past several decades, NRCS LRU regionalizations have typically lacked suitable scientific foundations in defining resource area concepts. With the recently adopted Provisional Ecological Site initiative (intended to complete initial inventory of ES in the contiguous U.S. by 2020), a pressing need has risen to stratify ES concepts by a practical and functional LRA. Because resource areas, such as Major Land Resource Areas (MLRA), are rarely discrete physical entitiesâ€•often being conceptualizations reflecting perceived biases from the mapperâ€•it is important that resource areas implement rule-based procedures to test LRU concepts and geography. Here we present a methodology suitable for testing resource area boundary concepts and provide examples across the Continental U.S.

13.

RECOMMENDATIONS FROM A WRITER: RESULTS FROM A WORKSHOP ON COMMUNICATING RESEARCH.

Retta A. Bruegger*

Colorado State University, Grand Juntion, CO

While rangeland management is both an "art and a science," as a rangeland professional most of my training is not in art. Storytelling is an art form that can serve to engage people in material in which they would not otherwise have an interest. Effectively communicating the relevance of rangeland science requires new strategies in an increasingly urbanized society in which potential "consumers" may not have a personal relationship with rangelands. I sought professional help in making our research more engaging to a non-scientific audiences as part of a Center for Collaborative Conservation Fellowship. This poster details improvements to our website and how I made them through a workshop with a poet and teacher of creative writing and digital storytelling, Cameron Scott. The goals of this effort were 1) to improve the website for our outreach and demonstration project, Learning from the Land, and in so doing, 2) learn skills that I could apply to other outreach materials related to the communication of research. Our methodology was to first examine Learning from the Land's website, after which Mr. Scott led me in a series of activities and discussions. We then generated ideas for revising how I told the "story" of the research, and applied strategies to decrease the abstract character of the writing. This process ultimately improved the presentation of material on our website. It forced me to think with greater clarity about our research as I explained what we do to someone unfamiliar with the field and terminology. Learning from the Land is a project that works closely with stakeholders, so communicating in clear, relevant, and interesting ways is critical to our goals. However, this poster details specific recommendations that may benefit others when communicating rangeland research to new audiences.

14.

USING CO-DEVELOPMENT TO IMPROVE LIVESTOCK MANAGEMENT DURING DROUGHT ON NATIONAL FORESTS.

Kelsey L. Hawkes*[1], Mitchel P. McClaran[1], Julie Brugger[1], Michael A. Crimmins[1], Larry D. Howery[2], George B. Ruyle[1], Jim Sprinkle[3], Douglas R. Tolleson[1]

[1]University of Arizona, Tucson, AZ, [2]Univesity of Arizona, Tucson, AZ, [3]Nancy M. Cummings Research Extension & Education Center, Carmen, ID

Decisions regarding the management of livestock grazing on public lands (e.g. national forests) are complex because multiple parties are involved: the responsible agency and the livestock grazing permittee. Making those decisions during drought is even more difficult because 1) the approval process for changing management practices on public lands can be very slow and 2) drought is both spatially and temporally variable and difficult to predict. Therefore, increasing preparation for drought should include 1) identifying practices that can reduce exposure to future drought as well as those that can be applied during a drought, and 2) starting the approval process early so that it is completed before the next

drought. We used a co-development process, where permittees and Forest Service managers worked together to identify 1) useful practices and 2) the process and duration of the associated approval. We used a scenario-based approach to solicit the co-developed suggestions, where realistic, probability-based drought conditions were applied to a hypothetical, yet representative grazing allotment in the Tonto National Forest, AZ. The co-developed solutions to the drought scenarios included altering herd rotation sequences, herd size and structure, developing temporary and permanent drinking waters, providing supplemental feeding on private land, or combination of solutions. The approval process ranged from low difficulty with no permissions needed, to intermediate difficulty where line officer approval is needed for updates to Annual Operating Instructions, to high difficulty where approval is required through National Environmental Policy Act (NEPA) analysis. Based on evaluations from the participants, the co-development process fostered constructive dialogue and cooperation between the parties; and the scenario activities stimulated participants to begin identifying new practices for specific allotments and initiating the approval process to put them in place before the next drought.

15.

WHO&RSQUO;S AFRAID OF ALLAN SAVORY? A BIBLIOMETRIC STUDY OF THE SCHOLARSHIP OF HOLISTIC MANAGEMENT.

Carlisle Kent, Kate Sherren*

Dalhousie University, Halifax, NS

Allan Savory is the founder of Holistic Management (HM), a systems-thinking, adaptive management approach to grazing livestock that is based on goal-setting and careful monitoring, and is often characterized by native rangelands and high-intensity, short-duration rotational grazing. Authors citing his work discuss diverse subjects and perceive his work very differently – he is clearly a polarizing figure. We use a scientometric approach to examine the impact Savory has had on scholarship by performing a detailed analysis on 337 records citing Savory from 1980-2015 found in Web of Science. Scientometrics is a practice aimed at measuring scientific influence. We examine patterns on spatio-temporal scales, subject matter using a custom classification scheme, and perceptions of HM, as well as research tendencies using bibliometric network visualizations. Savory's work has different meanings to different disciplines, often being cited as an example of more general 'adaptive management practices' by a wide range of fields outside the grazing community. Over time environmental and social science articles gradually increased in number among those citing Savory, while production and agriculture remained fairly stable after a peak in 1986-1990. Authors discussing Savory in the context of HM, as opposed to citing Savory for his general adaptive management principles, increasingly make a positive assessment of the practice over time. This occurs in conjunction with a similar increase over time in environmentally-inclined agriculture and social sciences records, which are those most likely to have a positive outlook on HM (unlike production-focussed agriculture, which is more likely to have a neutral or negative outlook). Maps of similarity in reference lists show polarization between management/social sciences and agriculture (i.e. they cite different work), while production, environmental and natural science papers are spread throughout the citation network suggesting more diverse citation patterns.

16.

APPROACHES FOR COMMUNICATING RANGELAND SCIENCE: RESULTS FROM STATEWIDE AND NATIONAL SURVEYS.

Kristen E. Gunther*, Ann Hild, Stephen L. Bieber, Jacqueline J. Shinker

University of Wyoming, Laramie, WY

Scientists must understand how to make information relevant to a variety of audiences in order to ensure that best available science is applied to real world management. However, scientists often struggle to communicate their science to effect public acceptance and application. We present findings from surveys distributed first among Wyoming stakeholders, and then to national audiences. Our research records whether value loaded ("positive" or "negative") language influences reader response to technical information. We asked survey respondents to rate "how true" they found a series of statements on the topic of "ecosystem uncertainty." Participants were surveyed before and after reading introductory text on the subject, and again one month after this initial intervention. Introductory texts (primers) contained either "positive" or "negative" language. The control group received a "neutrally" written text without a value-loaded language primer. Survey results suggest that value-loaded language influences reader's reception of the same technical information by driving their opinions away from neutrality. This effect was visible immediately after reading of the text, and in some cases persisted a month after initial intervention. The impact of primers on reader response also varied with reader background (e.g. agricultural production experience caused readers to remain more neutral after reading the texts). These findings suggest that "neutral" presentations of scientific knowledge are not the most efficient method for enhancing engagement with science and transfer of technology. Successful communication depends upon priming language and knowledge of the receiving audience.

17.

ENGAGING STAKEHOLDERS TO CREATE USABLE SCIENCE ON WORKING RANGELANDS.

Leslie M. Roche*[1], Tracy K. Schohr[1], Daniel K. Macon[2], Justin D. Derner[3], Kenneth W. Tate[1]

[1]University of California, Davis, Davis, CA, [2]Colorado State University, Auburn, CA, [3]USDA-ARS, Cheyenne, WY

Rangeland ecosystems encompass diverse land resources, representing complex coupled human and natural systems in which conservation goals must be balanced with the economic realities of agricultural production. In California, rangelands cover approximately 60% of the state, and are often at the nexus of wildland, agricultural, and urban landscapes. As a result, these working landscapes are at the frontier of increasing social pressures to define sustainable management. Ranchers have unique knowledge and experiences that influence their individual decision-making and management strategies. They are also the actors expected to participate in policy partnerships and comply with regulations, so it is crucial to understand how they view the policy and regulatory landscape. Via a multi-partner collaboration, we have developed an integrated social survey and field research approach to better 1) connect research and policy with how decisions get made on the ground, and 2) understand on-ranch impacts, management, and planning horizons following severe drought. To date, survey analyses of 509 ranchers

and in-depth interviews with102 ranchers have revealed structural, social, and attitudinal diversity across California ranches. Survey analysis also revealed rancher experience and knowledge positively influenced ranch goal setting and the management toolbox, which had direct positive effects on drought adaptation strategies. We are continuing to work with rangeland stakeholders to quantify economic and ecological impacts of severe drought via follow-up surveys and on-ranch assessments. From this work, it is clear that novel, large-scale, participatory research and extension approaches are required to address modern, complex issues on working landscapes.

18.

NEEDS ASSESSMENTS HELP DIRECT RESEARCH AND EXTENSION FOCUS FOR TWO NEW LIVESTOCK ADVISORS.

Fadzayi E. Mashiri*[1], Devii Rao[2]

[1]University of California, Mariposa, CA, [2]University of California, Hollister, CA

Success for a Cooperative Extension professional strongly depends on the ability to develop an extension program that addresses issues and priorities relevant to the local community they serve. This requires the professional to understand the community's socio-economic dynamics, knowledge gaps and vision by conducting a needs assessment. A needs assessment is conducted to identify interests and attitudes (McCawley 2009) of a particular group. They can be implemented as formal or informal interviews, surveys, focus groups or working groups. Information acquired from needs assessments is invaluable in helping new extension professionals focus their research and extension programs on real issues. As two new Livestock and Natural Resources Advisors, we are conducting needs assessments with livestock producers in California's Central Valley (Mariposa, Merced, Madera counties) and on California's Central Coast (San Benito, Monterey, Santa Cruz counties). Although we are using different survey methods, we are finding valuable information about the local ecosystems, production systems, past research and extension programs and issues producers need addressed. Preliminary results from both areas indicate that ranchers have a strong interest in issues related to weed management, predator-livestock conflict, livestock health and nutrition, rangeland management and laws and regulations. In the Central Coast, ranchers are also interested in issues related to water quantity and quality, soil health and educating the public about livestock production. In the Central valley producers are also interested in niche marketing of livestock and drought management. These results begin to capture the complexity of issues that producers deal with and that advisors need to address if they want to attract the interest of the producer. Knowing the issues also enable the advisors to anticipate and identify important collaborators needed to effectively address the diverse issues, some of them outside their area of specialization.

19.

WHAT EXPLAINS POSITIVE SOCIAL OUTCOMES OF COMMUNITY-BASED RANGELAND MANAGEMENT IN MONGOLIA?

Tungalag Ulambayar*[1], Maria Fernandez-Gimenez[2]

[1]The Institute of Geography and Geo-Ecology, Mongolian Academia of Sciences, Ulaanbaatar, Mongolia, [2]Colorado State University, Fort Collins, CO

In the early 2000, different donor programs supported formation of over 2000 community groups in Mongolia. However, results of donors' efforts have not been consistently successful, yet little is known about the factors that influence success or lack thereof. This research examined causal relationships of variables that influenced socio-economic outcomes of community groups. We studied 142 pastoral groups in 36 soums (counties) of 12 Mongolian provinces, where 77 of them were donor supported groups. We examined how the effect of formal organization on social outcomes was mediated by four intermediate variables, namely, information diversity, leadership, knowledge exchange and agreed rules given four different ecological regions. Using a serial-multiple mediation model, we hypothesized that these four intermediate outcomes taken together will mediate the ultimate social outcomes of beneficiary groups. We found that traditional and innovative rangeland management practices, proactiveness and social networks were significantly mediated by the intermediate outcomes as anticipated, while the same mediators did not influence levels of trust, norms of reciprocity and assets. Moreover, among these four interdependent mutually-enforcing mediators, information diversity had a triggering effect on other three variables creating a causal chain of information diversityàleadershipà knowledge exchangeàrules. The study also revealed importance of ecological zone in achieving better social outcomes such as traditional and innovative rangeland practices, social capital and assets. However, a negative effect of rules on trust and norms of reciprocity as well as assets was a contradictory finding to the prevailing understanding in the field of the commons.

20.

PROFESIONALS PERCEPCION OF NORTHERN MEXICO GRASSLAND CONDITION AND INSTITUTIONAL RESPONSIBILITY.

SANDRA RODRIGUEZ*[1], Reyes Gerardo[2], Otilia Rivero[1], Alicia Melgoza[3]

[1]UNIVERSIDAD AUTONOMA DE CHICHUAHUA, CHIHUAHUA, Mexico, [2]UNIVERSIDAD AUTONOMA DE CHIHUAHUA, CHIHUAHUA, Mexico, [3]Universidad Autónoma de Chihuahua, Chihuahua, Mexico

Grassland of Northern Mexico covers around 48% of the total inland cover. Those areas provide several benefits and services to thousands of inhabitants of Mexico. Grassland sustainable management remains challenging due to some economic, ecological, and social reasons. These variety of reasons occupy different position in the list of priorities of each group of stakeholders. In this sense, it is important to heard stakeholders to identify their concerns and opinions about grassland management. This is a transversal and exploratory study that aimed to assess professional perceptions of grassland in Northern Mexico. A semi-structural survey was designed to accomplish the goal. Data was collected in 2006 and 2014 during two international grassland symposiums held in Mexico; 147 and 76 people participated in the study respectively. In general perceptions towards the condition of the grassland in Mexico has not change during the years, a large number of participants considered that grassland areas are heavily deteriorated. In terms of institutional responsibility, there is a tendency to delegate conservation to federal authorities. Participants considered that cattle ranching and conservation are not opposed. In addition there is a lack of knowledge on some other products different from cattle that

can be obtain from the grassland (i.e. ornamental plants). An effective strategy to formulate managing and to implement programs is to understand stakeholders 'perceptions of grassland.

21.

USING FIBER OPTIC TECHNOLOGY TO CHARACTERIZE RANGELAND FIRE BEHAVIOR.

Doug Cram*[1], Carlos G. Ochoa[2], Christine Hatch[3], Scott Tyler[4]

[1]New Mexico State University, Las Cruces, NM, [2]Oregon State University, Corvallis, OR, [3]University of Massachusetts, Amherst, MA, [4]University of Nevada - Reno, Reno, NV

We evaluated the potential of a fiber optic cable connected to distributed temperature sensing (DTS) technology to characterize rangeland fire behavior in real time. We used a 'fire cable' containing three optic fibers coated with three different materials designed to protect the fiber. The 150-m long cable was deployed in grasslands and burned in three prescribed fires. The cable was arranged to allow comparison between head, back and flank fire conditions. Thermocouples were placed at selected locations along the cable for temperature comparison against DTS measurements. Results indicated the fire cable when used with DTS technology can quantify temperature, heat duration, and potentially rate of spread. A similar temperature response curve between fire cable and thermocouple was observed during the rising limb, but the metal armoring of the fire cable remained hot longer than the thermocouples after the flames had passed. This technology allowed for continuous fire temperature distribution mapping, a phenomenon that is difficult to otherwise quantify without this technology. These results add understanding of DTS and fire cable technology as a new method for characterizing and mapping real-time rangeland fire behavior conditions.

22.

TARGETED GRAZING TO REDUCE WILDFIRE SPREAD IN SAGEBRUSH STEPPE ECOSYSTEMS.

Christopher L. Schachtschneider*[1], Eva K. Strand[1], Karen L. Launchbaugh[1], Scott K. Jensen[2]

[1]University of Idaho, Moscow, ID, [2]University of Idaho, Marsing, ID

Wildfire is a major threat to the greater sage-grouse (*Centrocercus urophasianus*) severely impacting key habitat every year. Although fire is a natural ecological process in these habitats, the presence of annual grasses has increased the continuity of fuels and has aided in shortening the fire return interval. Many studies have observed how fire affects plant communities at different grazing usage, but few have looked at how livestock grazing alters fire behavior in sagebrush ecosystems. Even without scientific studies, livestock grazing has been suggested as a tool to reduce fine fuel biomass and fuel continuity. This study bridges a gap in our knowledge of how livestock grazing can be used to reduce fire behavior. We created 30 paddocks (30 x 30 meters) in mountain and Wyoming big sagebrush (*Artimisia tridentata)* ecosystems. Cattle were used to graze at low and moderate utilization levels, 30-40% and 55-65% respectively, in the summer (June-July) and fall (September). Utilization was 60% and 31% in the Wyoming big sagebrush and 55% and 33% in the Mountain big sagebrush summer treatment paddocks. A prescribed burn was conducted across control and grazed plots in late September of 2015 and flame

height, rate of spread, burn characteristics were observed.   The interaction between grazing treatment, fuel loads, and fire behavior will be discussed.

23.

IMPACTS OF ANNUAL SPRING FIRE OR MOWING ON SMOOTH BROMEGRASS BUD BANK.

Cady M. Olson*, Alexander J. Smart, Lan Xu

South Dakota State University, Brookings, SD

Annual defoliation targeted at introduced cool-season grasses, which use similar resources as native grasses, could substantially reduce their competitiveness and improve the quality of the northern tallgrass prairie. The objective of this study was to evaluate annual spring fire or clipping on smooth bromegrass bud bank in tallgrass prairie vegetation. The site consisted of native tallgrass prairie vegetation in east central South Dakota. Treatments consisted of annual spring fire or clipping since 2009 and an undefoliated control. Fire was applied in mid-May and clipping was applied weekly in May to simulate heavy grazing. Each treatment had 4 replications. At the end of the 2015 growing season, tiller density of smooth bromegrass within two 0.1m2 subplots was recorded for each treatment. Three tillers were randomly selected from each treatment subplot and excavated to determine the number of crown positions and buds, and bud viability. Smooth bromegrass tiller density, bud density, and bud viability will be analyzed by treatment. This study will elucidate the underlying mechanisms of vegetative propagation of smooth bromegrass invasion in northern tallgrass prairies. In addition, it will increase our ecological understanding of management techniques aimed at reducing invasive cool-season grasses.

24.

GRAZING BEHAVIOR OF CATTLE AND NILGAI ANTELOPE IN BURNED COASTAL CORDGRASS IN TEXAS, USA.

Victoria L. Haynes*[1], Adam Toomey[2], Sandra Rideout-Hanzak[2], J. ALFONSO ORTEGA-S.[3], Timothy E. Fulbright[4], David B. Wester[2], Humberto L. Perotto-Baldivieso[5], Tyler A. Campbell[6], Alfonso Ortega-S. Jr.[6]

[1]Caesar Kleberg Wildlife Research Institute, Victoria, TX, [2]Caesar Kleberg Wildlife Research Institute, Kingsville, TX, [3]CAESAR KLEBERG WILDLIFE RESEARCH INSTITUTE, KINGSVILLE, TX, [4]Texas A&M University-Kingsville, Kingsville, TX, [5]Texas A&M University - Kingsville, Kingsville, TX, [6]East Foundation, San Antonio, TX

Gulf and marshhay cordgrasses (*Spartina* spp.) are native perennial grass species that are prevalent along the Texas Coastal Prairies. When cordgrass remains undisturbed and matures its nutritional value declines, creating unpalatable and degraded forage. In this study, we will apply prescribed fire to large cordgrass areas to remove old growth, and monitor the spatial and temporal movements of cattle (*Bos* spp) and nilgai antelope (*Boselaphus tragocamelus*) within and around burned and non-burned areas. Our objectives are to (1) determine differences in cattle and nilgai distribution and forage usage in burning cordgrass communities during different seasons; (2) determine the length of site preference of

burned areas in different seasons; and (3) develop prescribed burning recommendations to maximize consumption of cordgrass for cattle and nilgai along the Gulf Coast Prairie on a sustainable basis. Our study is being conducted on the East Foundation's El Sauz property in Willacy County, Texas, USA. The study site consists of 10 plots (roughly 500 acres each); two independent plots will be burned each fall and spring for a total of 8 treatment plots and 2 control plots. Forty cattle and 30 nilgai antelopes will be tracked using Lotek's LifeCycle® GPS collars. Forage samples will be analyzed to compare nutritional variation between non-burned sites and those burned during spring or fall. We will also record nutritional fluctuations in cordgrass forage for several weeks following each burn and compare results with GPS locations of cattle and nilgai to determine possible reasons for site preferences.

25.

THE SOUTHWEST FIRE SCIENCE CONSORTIUM: AN OPPORTUNITY IN FIRE SCIENCE AND MANAGEMENT.

Barbara Satink Wolfson*[1], Andrea E. Thode[2], Anne Bradley[3], Doug Cram[4], Alexander Evans[5], Donald A. Falk[6], Peter Z. Fule[2], David Huffman[2], Jose S. Iniguez[7]

[1]Southwest Fire Science Consortium, Flagstaff, AZ, [2]Northern Arizona University, Flagstaff, AZ, [3]The Nature Conservancy, Santa Fe, NM, [4]New Mexico State University, Las Cruces, NM, [5]Forest Guild, Santa Fe, NM, [6]University of Arizona, Tucson, AZ, [7]USFS Rocky Mountain Research Station, Flagstaff, AZ

The Southwest is one of the most fire-dominated regions of the US. Currently, the Southwest Fire Science Consortium (SWFSC) is working to bring together localized efforts to develop and disseminate fire science in a practical manner, with thoughtful interaction among projects. Managers and scientists are often not aware of each other or of the external resources available. We developed the SWFSC to be more efficient and inclusive, allowing future fire science issues to be addressed from a broader perspective with more information, more partners, and more resources. With support from the Joint Fire Science Program (JFSP), the SWFSC promotes communication and strives to meet the fire knowledge needs of scientists and managers. We organized the SWFSC around six guiding principles: 1) be inclusive, making sure all relevant partners have the opportunity to be involved; 2) serve as neutral science partners; 3) be customer driven, both in how we are structured and how we function; 4) operate collaboratively, fostering joint management and science communication; 5) be innovative, pursuing new and creative ways to disseminate knowledge; 6) facilitate the flow in fire science. We provide opportunities for land managers, scientists, and policy makers to interact and share knowledge in ways that can effectively move new information to management practices and facilitate new research based on management needs.

26.

RECONSIDERING THE PRESCRIBED TWO YEAR REST PERIOD FOLLOWING FIRE.

Emily A. Gates*[1], Lance T. Vermeire[2], Clayton B. Marlow[1]

[1]Montana State University, Bozeman, MT, [2]USDA-ARS, Miles City, MT, MT

Current policy recommends that rangelands be rested from grazing for two growing seasons following fire to allow for proper recovery, despite the lack of empirical literature supporting this recommendation. We aim to determine if grazing the first growing season following a spring wildfire alters later productivity and species composition of northern mixed grass prairie. Following the April 2013 Pautre wildfire in northwestern South Dakota, exclosures were erected in three burned pastures to simulate two growing seasons of rest. Grazing exclosures were paired with sites grazed both the first and second growing seasons following the fire and replicated across loamy and sandy ecological sites. Prior to grazing the second growing season, five 2 m² cages were placed at each grazed site to assess first-year grazing effects. Following the second growing season, productivity and species composition were determined for exclosures and cages. Current-year productivity differed between ecological sites as loamy sites were more productive (Loamy= 2764 kg/ha, Sandy = 2356 kg/ha; P=0.0271), but was similar between grazing treatments (Rested= 2556 kg/ha, Grazed= 2564 kg/ha; P=0.9550). Ecological site strongly determined species composition. Loamy sites consistently contained more *Pascopyrum smithii*, *Bouteloua gracilis* and *Carex duriuscula* than sandy sites (30 v 0%, 18 v 8%, 4 v 1%; P= 0.0004, 0.0457 and 0.0382 respectively). The effects of grazing exclusion manifested in only *Hesperostipa comata* and *Agropyron cristatum*. *H. comata* was more prevalent on rested sites (22 v 15%, P=0.0096). *A. cristatum* experienced a grazing treatment by ecological site interaction as it was reduced by grazing on loamy sites, but was not affected on sandy sites (P=0.0226). Our results do not support the notion that a two growing season rest period following fire is necessary and indicate that grazing may resume the first growing season following spring wildfire with no negative effects.

27.

LONG-TERM EFFECTS OF BURN SEVERITY ON NON-NATIVE PLANT COVER.

Martha Schmidt*[1], Darcy H. Hammond[1], Andrew T. Hudak[2], Beth A. Newingham[3], Eva K. Strand[1], Penelope Morgan[1]

[1]University of Idaho, Moscow, ID, [2]USDA Forest Service, Rocky Mountain Research Station, Moscow, ID, [3]Great Basin Rangelands Research, USDA-ARS, Reno, NV

Effects of burn severity on post-fire non-native plant invasion is of great concern to managers and researchers, especially given predicted increases in large, high severity fires. However, fewer studies have focused on long-term (>10 year) non-native plant establishment and persistence. We analyzed non-native plant cover 12-13 years post-fire to determine the effect of burn severity on non-native plants. We compared percent cover of non-native plant species between wildfires in southern California chaparral (Old and Simi Fires of 2003) and dry ponderosa pine forests in central Colorado (Hayman Fire of 2002). Preliminary analysis of the 12- or 13-year post-fire data show significantly higher non-native plant cover in the high severity burn (TukeyHSD, p=0.02) in dry ponderosa, but no significant differences between burn severity classes for chaparral (p=0.15) where non-native species were more abundant regardless of burn severity. Non-native species of the California fires include *Bromus tectorum*, *Poa pratensis* and *Erodium cicutarium*. For the Colorado fire, non-native species include *Taraxacum officinale*, *Verbascum thapsus* and *Bromus tectorum*. While non-native species response to fire is clearly ecosystem specific, our data indicate that dry ponderosa forest types burned at high severity may be more susceptible to non-native plant invasion than those burned at lower severities. Therefore,

mitigation of high severity burns should be a high priority of managers in dry ponderosa pine ecosystems where invasive plant establishment is a concern.

28.

FIRE IN DESERT GRASSLAND REGION OF THE SOUTHWESTERN USA: WHERE AND WHY.

Matthew R. Levi*, Brandon T. Bestelmeyer

USDA-ARS Jornada Experimental Range, Las Cruces, NM

Fire is an important driver of ecological processes in semiarid systems and serves a vital role in shrub-grass interactions. In desert grasslands of the Southwestern US, the loss of fire has been implicated as a primary cause of shrub encroachment. Where fires can currently be re-introduced and managed given past state changes and recent restoration actions, however, is unknown and controversial. Biophysical variables that influence fuel load and quality are commonly employed to model fire distributions; however, soil-landscape properties like those captured by ecological site descriptions are rarely employed to model fire probability. We characterized the spatial distribution of fire in the Chihuahuan Desert and Madrean Archipelago ecoregions and investigated the influence of soil properties and ecological site groups compared to other commonly used biophysical variables using multi-model inference techniques. Soil-landscape properties significantly influenced the spatial distribution of fire ignitions. Bottomland ecological sites (i.e., soil-landscape classes) experienced more fires than expected in contrast to ecological sites with coarse soil textures and high fragment content that experienced fewer fire ignitions than expected. Influences of mean annual precipitation, distance to road/rail, soil available water holding capacity (AWHC) and topographic variables varied between ecoregions and by political jurisdictions and differed for peak and nonpeak fire seasons. AWHC explained more variability of fire ignitions in the Madrean Archipelago compared to the Chihuahuan Desert. Understanding the spatiotemporal distribution of recent fires in desert grasslands is needed to manage fire and predict responses to climate change. While climate variables have proven useful for predicting fire patterns in most systems, the use of landscape units such as ecological sites presents an opportunity to improve predictions at management scales. The application of soil property information readily available in soil survey is an important addition to the toolbox for predicting and managing fire.

29.

PLANT MATERIAL TESTS: CAN WE LEARN FROM SMALL PLOTS?

Daniel N. Harmon*[1], Charlie D. Clements[1], Mark Weltz[1], Jeff White[2]

[1]USDA, Reno, NV, [2]Newmont Mining, Elko, NV

Choosing appropriate plant materials for a rangeland rehabilitation project is critical for long-term success. The question is what species to seed? We find it is first necessary to define objectives and goals before debating plant material choices. For example, our objective is often to suppress cheatgrass and associated fuels. To meet this objective our goal is to establish 1 long-lived perennial grass/ft². That density may seem high but our experience has shown that density often decreases over time, so starting

at a near maximum is ideal. To test the ability to achieve this goal we seeded 7 degraded xeric Wyoming big sagebrush sites in northern Nevada from 2013-2015. The plots would be considered very small as we used a hand push seeder with each species seeded separately in a 50ft row (15lb/acre rate). The advantage of small plot tests is that we can test 30+ species at once and replicate that test at numerous sites with varying soils and precipitation zones. It would be difficult to achieve such tests and require large areas if we used standard rangeland drill applications. Our small plot tests can be done by a single person and we find the results do not drastically differ from our large plot plant material tests. Results found, averaging all sites and years, less than 5 species (4.9) achieved our goal of 1 plant/ft² out of the 30-40 grass species tested. Twelve native species achieved the goal at least once for all tests ran. For example squirreltail achieved the goal 18% of the time. Siberian wheatgrass experienced the best results, 47%, and 'Hycrest' crested wheatgrass followed with 42%. In conclusion we find that small plot tests can provide an understanding of species potential so that resource managers can improve rehabilitation efforts in xeric Wyoming big sagebrush critical wildlife habitats.

30.

PRESCRIBED FIRE MODELING: PREDICTING ECOLOGICAL EFFECTS AT A MANAGEMENT SCALE.

Phillip S. Steigerwald*[1], Merwyn M. Kothmann[2], William E. Grant[2]

[1]Texas A&M, Uvalde, TX, [2]Texas A&M University, College Station, TX

Fire is a major driver for rangeland vegetation communities. Current fire models can predict many fire physics questions such as fire duration, intensity, frequency, probability, and other physics bases question; however, these models do not answer questions about the ecological responses of vegetation needed for designing prescribed fire for rangeland management. To answer management questions a fire management model must operate at the management scale and relate to burning prescriptions. This model predicts woody vegetation canopy cover response to different prescribed fire management strategies at a management scale to achieve desired vegetation changes.

31.

WYOMING'S RANGELAND HEALTH ASSESSMENT PROGRAM.

Barton Stam*[1], Justin Caudill[2]

[1]University of Wyoming Extension, Thermopolis, WY, [2]Wyoming Department of Agriculture, Rock Springs, WY

Rangeland monitoring is an important component of the sustainable management of rangelands. Federal land management agencies and other range managers, often struggle to accomplish all necessary monitoring due to staffing, funding, and time constraints. Permittees are frequently asked to help monitor their grazing allotments in cooperation with local rangeland management specialists and other parties such as, university extension and state departments of agriculture. These joint monitoring efforts are frequently referred to as Cooperative Permittee Monitoring (CPM). In an effort to support CPM the Wyoming Legislature and Governor allocated funds for a Rangeland Health Assessment

Program (RHAP) in 2010. Since then over $700,000 in RHAP grant dollars have been provided by the State of Wyoming through the Wyoming Department of Agriculture. Over 4 million acres of federal, state, and private rangelands have been or are currently under rangeland monitoring, funded in part, through RHAP dollars on 37 different projects. Participants in the program, both professional range managers and permittees report positive experiences. The RHAP program is currently working toward ensuring monitoring programs are sustainable in the long term after RHAP funds are expended. The presenter of this poster has worked with 4 RHAP grants in four Wyoming counties (Big Horn, Hot Springs, Washakie, and Fremont). Lands included in these grants include USDA Forest Service, Bureau of Land Management, private, and state lands. This poster will share examples of how the RHAP program has positively influenced rangeland management and CPM. Previous RHAP experience also suggests potential areas of improvement and factors that contribute to a successful project.

32.

A SOIL CATENA APPROACH TO ECOLOGICAL SITE CONCEPT DEVELOPMENT IN MAINE.

Jamin Johanson*[1], Nicholas Butler[2], Carl Bickford[2]

[1]NRCS, Bangor, ME, [2]NRCS, Dover-Foxcroft, ME

The ecological site conceptual framework evolved over decades of field observations by soil scientists and rangeland specialists in the western United States. Today, ecological sites are being developed for all regions of the U.S. by the Natural Resources Conservation Service-Soil Survey Division and numerous partner agencies and groups. In the eastern U.S., relatively few soil and vegetation relationships have been identified using the ecological site framework compared to the semi-arid rangelands of the west, and the feasibility of ecological sites for natural resource management in temperate regions is yet to be convincingly tested. We present initial efforts to develop ecological site concepts on a broad scale for the frigid region of New England in the northeastern U.S. As a basis for ecological site concept development, we used existing soil catena concepts—which classify related soils based on pedogenic processes, lithology, soil texture, and drainage class—to target till soils on two catenas in Maine. We analyzed soils and vegetation data collected at over 200 plots in 2015 using a combination of summary statistics, multivariate analyses, and tacit knowledge. Our results suggest that patterns between soils and vegetation are not only apparent in the catenas studied, but highly predictable. Based on this initial work, we expect that the ecological site framework will be successfully applied to the frigid till soils of New England, and that upcoming efforts by the NRCS and partners to develop ecological sites in the eastern U.S. will produce ecological information comparable in value to the ecological site descriptions of western rangelands.

33.

SCIENTIFIC SUPPORT TOOLS FOR ECOLOGICAL SITE DEVELOPMENT AND VALIDATION.

Ken Spaeth*

Natural Resources Conservation Service, Reno, NV

Rangeland landscapes are a complex mosaic 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. Ecological site development requires a variety of organizational and analysis skills in order to provide a science based approach. A variety of data sources and analysis tools exist for ESD development: 1) historical and current field data; 2) National Resource Inventory (NRI) data (2013-15); 3) Rangeland Health model and matrix concepts; 4) use of Rangeland Hydrology and Erosion Model (RHEM) for exploring hydrology and erosion dynamics and risks; and multivariate software (PCORD) to investigate data patterns and correlations to develop and validate S&T dynamics.

34.

HISTORICAL RANGE MONITORING UTILIZING THE PARKER 3-STEP METHOD AND VERTICAL PHOTO POINTS.

Katie J. Bonogofsky*[1], Jessica Dhaemers[2]

[1]USFS, Dillon, MT, [2]USFS, Wisdom, MT

The Beaverhead-Deerlodge National Forest designed a monitoring initiative during the 2015 season to re-read historic Parker 3-step monitoring sites. The purpose was to preserve the historical sites while looking at range condition and apparent trends on grazing allotments across all districts on the forest. Additional seasonal employees were hired to help with the monitoring efforts. The Forest chose to collect the data the same way it was historically collected with the idea that the data could be compared and analyzed directly. The majority of transects across the Forest were installed and read as Parker 3-step transects in the 1950's and 1960's. Some districts had transects installed as Vertical Photo Points (VPP's), which are a slight variation of the Parkers. Both types of transects provide the same information and gave a good baseline for what the range looked like at the time. Each district on the Forest was equipped with tools to locate and re-read the transects as originally done. Some transects had been re-read multiple times, while others had never been looked at since installation. Examples of each type of transect along with the apparent trend calls can be seen on this poster. Comparing the historic photos to current photos proved to be just as useful as the data itself. This data set will only become more useful as we move forward. Looking back in time at our rangelands helps us understand what condition they were in over 60 years ago, the changes that have taken place, and it will help us guide management for the future. We hope the monitoring effort will continue for more generations to come.

35.

COMPARING FIVE COMMON VEGETATION ATTRIBUTES AND INDICATORS IN THREE ECOSYSTEM TYPES.

Amber Dalke*[1], George B. Ruyle[1], Judith Dyess[2]

[1]University of Arizona, Tucson, AZ, [2]U.S. Forest Service, Albuquerque, NM

Determining which vegetation sampling strategies to employ is dependent on project objectives, and understanding how different indicators and attributes compare allows decision-makers to select the most appropriate and cost-effective choice. We looked at four indicators (basal cover, aerial cover, plant rank by dry weight (DWR), plant frequency) and one attribute (species composition) to determine whether the ranked order of perennial graminoid species varied between these five sampling strategies and which strategies identified the most comprehensive graminoid list. In 2013, macroplots were measured in high elevation mountain meadows (n=9, Apache-Sitgreaves National Forests, eastern Arizona) and in desert grasslands (n=4) and Madrean evergreen woodlands (n=4) in the Coronado National Forest (southeastern Arizona). A Kendall's tau-b correlation was performed to determine the relationship between the five strategies across the three ecosystems. All tests had a strong, positive correlation between strategies, suggesting that within each ecosystem the ranked order of species does not differ between indicators and the attribute. Each strategy identified a different number of species. In meadows, frequency identified the most graminoid species, suggesting frequency is sufficient to establish a comprehensive graminoid list. In desert grasslands, frequency detected the most graminoid species, but species composition, aerial cover, and DWR found similar numbers of species. In woodlands, species composition/aerial cover identified the most graminoid species, suggesting these strategies can detect rare species. On most macroplots, basal cover was unable to detect rare/less-common graminoid species compared with other strategies. Preliminary findings suggest frequency identified the most species in ecosystems with a relatively simple (one layer) vegetation structure (mountain meadows/desert grasslands). Species composition/aerial cover detected the most species in rangelands with more complex structures (oak woodlands). Vegetation structure may dictate which sampling strategies are most appropriate. Frequency combined with another attribute or indicator likely provides the most comprehensive understanding of the perennial graminoid community.

36.

A COMPARISON OF TWO METHODS FOR SAMPLING HERBACEOUS COVER: A RICH COUNTY, UT CASE STUDY.

Katherine Thomas*[1], Kristin Hulvey[2], Eric Thacker[2], Robert Coleman[1]

[1]Brigham Young University - Idaho, Rexburg, ID, [2]Utah State University, Logan, UT

Rangelands in the intermountain west provide multiple ecosystem services including sustainable forage for livestock and habitat for sage grouse. Livestock grazing systems that alter the timing and distribution of cattle across the landscape have the potential to affect such services by altering the abundance and composition of rangeland vegetation. One common way to asses such changes is by monitoring herbaceous species cover, although the method used can greatly affect the quality of the data collected and the ability of researchers to answer their identified research questions. In an effort to better understand the relationship between grazing and ecosystem services, we investigated the effects of season long grazing versus rotational grazing systems on the herbaceous vegetation in our study sites. To do this, we evaluated herbaceous species cover along 50 transects using two different methods: Daubenmire and Sample Point photo analysis. While Daubenmire estimates are calculated in the field, Sample Point analysis is performed via computer, by manually identifying species intersected by a one hundred pixel-grid on photos taken along transects. Preliminary data analysis suggests that Daubenmire

and Sample Point differ in their ability to accurately assess herbaceous cover in the presence of shrubs. The Daubenmire method allowed us to avoid shrubs since herbaceous evaluation could be assessed beneath the shrub canopy. The photos used for Sample Point, however, were taken above shrub height, and shrub cover obstructs a portion of herbaceous cover during photo analysis. Our findings will enable us to evaluate which method is appropriate for future herbaceous sampling at our Rich County project. More broadly, our results emphasize the need to select cover sampling methods that are appropriate for a site's vegetative community.

37.

COMMUNICATION TOOLS TO MOVE THE BLM'S ASSESSMENT, INVENTORY AND MONITORING (AIM) STRATEGY FORWARD.

Tyler Morrison*

Western State Colorado University, Gunnison, CO

As an intern at the BLM's National Operations Center, I assissted the Assessment, Inventory and Monitoring (AIM) team with developing a plan to drive communication of the AIM strategy to all levels of BLM employees and the agency's partners. Part of that plan involved creating an online database of previous AIM efforts. By showing why a BLM monitoring effort used the AIM strategy, how the project was implemented, the quality of the data gathered, and how that data is informing management decisions, we believe BLM staff and managers will better visualize AIM's concepts and understand the benefits of implementing the AIM strategy. During this poster session, I will showcase a few of the project factpages I created, as well as the online mapping system developed to house them. I look forward to presenting tangible examples of how AIM is giving BLM managers the tools they need to make more informed, defensible decisions.

38.

DEVELOPING SOIL ERODIBILITY PREDICTION EQUATIONS FOR THE RANGELAND HYDROLOGY AND EROSION MODEL (RHEM).

Osama Z. Al-hamdan*[1], Fred B. Pierson[2], Mark A. Nearing[3], Christopher J. Williams[2], Mariano Hernandez[3], Jan Boll[4], Sayjro K. Nouwakpo[5], Mark Weltz[6], Ken Spaeth[7]

[1]Texas A&M University-Kingsville, Boise, TX, [2]USDA-ARS, Boise, ID, [3]USDA-ARS, Tucson, AZ, [4]Washington State University, Pullman, WA, [5]University of Nevada Reno, Reno, NV, [6]USDA, Reno, NV, [7]Natural Resources Conservation Service, Reno, NV

Soil erodibility is a key factor for estimating soil erosion using physically based models. In this study, a new parameterization approach for estimating erodibility was developed for the Rangeland Hydrology and Erosion Model (RHEM). The approach uses empirical equations that were developed by applying piecewise regression analysis to predict the variability of erodibility before and after disturbance (i.e., wildfire, prescribed-fire and tree encroachment) and across a wide range of soil textures as a function of vegetation cover and surface slope angle. The approach combines rain splash, sheet flow and

concentrated flow erodibilities into a single parameter for modeling erodibility in most cases. The new approach was evaluated for sites representing different degrees of disturbance associated with burning and tree-encroachment. Our evaluation of the new erodibility approach in RHEM found the method predicts erosion at the plot scale with a satisfactory range of error in all cases. The new approach for estimating erodibility for RHEM has several advantages. First, the results of this study indicate that in most cases the model will be dependent on only one erodibility factor. Second, the approach addresses the phenomenon that erosion rates become larger at a specific threshold point. Third, the equations use readily available data for estimating erodibility values. Fourth, the approach covers continuously a wide range of ground cover and foliar cover.

39.

UTILIZING PATCH BURN GRAZING AND FLORISTIC QUALITY ASSESSMENT IN THE TEXAS BLACKLAND PRAIRIE.

Timothy M. Siegmund*[1], Jay Whiteside[2], Jason R. Singhurst[3]

[1]TX Parks and Wildlife Department, College Station, TX, [2]TX Parks and Wildlife Department, Purdon, TX, [3]TX Parks and Wildlife Department, Austin, TX

In February of 2015 first entry prescribed burns were conducted on approximately 70 acres of each of two, 230 acre pastures in Navarro County, TX. These two pastures are classified entirely as Blackland Ecological Sites in which a tallgrass prairie is the reference climax plant community for all represented soil types. Each is managed under a cow-calf one pasture continuous grazing regime for at least the past 15 years.   Important to our goals were whether or not introducing frequent fire back to the landscape and beginning a patch burn grazing management system could increase the abundance of climax tall grass species and perennial forbs. Although each pasture contained similar characteristics of soils, vegetation and management, the variable we expected to affect plant community response to patch burn grazing is the differing cattle stocking rates between the two, 10.45 ac/AUE and 7.67 ac/AUE. In order to measure shifts in the plant community composition over time, as well as differences between burned and un-burned portions of the pastures, we used a Floristic Quality Assessment (FQA) methodology based on Swink and Wilhelm's (1979,1994) work in the Chicago region and modified for use in the Platte River prairies of Nebraska (Helzer 2012). This methodology uses a plot-wise FQA in which we sampled 100- 1m2 plots in each pasture. Within each plot we recorded all identifiable species within the plot and assigned each species a conservatism score from 0-10. Sampling in this manner can eliminate the subjectivity of vegetative cover scores and estimates. Furthermore, we can assess the frequency of occurrence of various species between plots, years, and pasture as the study continues. July of 2015 was our first sampling season, and we plan to continue sampling in subsequent years. Our first set of data is currently under evaluation.

40.

TRANSPLANTATION SUCCESS FOR THE ENDANGERED PIMA PINEAPPLE CACTUS (CORYPHANTHA SCHEERI VAR. ROBUSTISPINA) USING VARIABLE METHODS.

Gerald M. Berthelette*, Jeff Fehmi

University of Arizona, Tucson, AZ

There has been little research on and little success transplanting the endangered Pima pineapple cactus (*Coryphantha scheeri* var. *robustispina*). Transplants have low-levels of survival and the determinate variables and practices remain largely unknown. As a result, the U.S. Fish and Wildlife Service (USFWS) does not consider transplanting as a viable conservation measure. This study evaluates transplanting in two parts. First, we monitor 84 individual Pima pineapple cactus (PPC) transplanted southwest of Tucson, Arizona in 2014 with and without soil (bare roots) as well as with and without water added at the time of the transplant. Second, we followed up on additional transplant experiments with which we could compare biotic and abiotic variables that seem to be associated with transplant success. This post-transplant monitoring and analysis of varying transplant methodology and abiotic variables associated with each site forms a framework for determining the best practices to maximize PPC transplant successes. Precipitation within the period after transplanting greatly increases transplant success while other factors have strong interactions.

41.

SIMULATION MODELLING TO ANALYZE LIVESTOCK SPECIES RESILIENCE DURING MONGOLIAN WINTER DISASTERS.

Weiqian Gao*[1], Jay P. Angerer[2], James R. Conner[1], William E. Grant[1]

[1]Texas A&M University, College Station, TX, [2]Texas A&M AgriLife Research, Temple, TX

Mongolia is a large pastoral landlocked country; livestock production is considered the key component in the Mongolian economy. However, droughts followed by extremely cold winter conditions (dzud), can lead to livestock massive losses that affect pastoralists' livelihoods. In order to examine some of the conditions that can lead to dzud livestock losses, we built a simulation model that included climate factors, forage availability, and livestock life cycles to analyze livestock species resilience across three ecological zones of Mongolia. We conducted 24 year simulations based on historical forage and climate data. By using the single control variable method of simulation, we analyzed resilience of sheep and cattle within three major ecological zones (forest-steppe, steppe and desert-steppe). Livestock forage demand was estimated by forage intake based on each livestock species seasonal forage intake amount. Forage availability was acquired from PHYGROW simulation model outputs reported by the Mongolia Livestock Early Warning System. To define climatic conditions of dzud in the simulations, we defined dzud as periods having average minimum temperature ≤-30°C and monthly average of snow depth ≥20cm. Mortality greater than 10% was considered a dzud disaster. Our modeling analyses results indicated that the months of February, March and April had the highest susceptibility to dzud loses. The most frequent dzud occurring month at forest-steppe is in February, steppe is March and desert-steppe is April. Cattle dzud mortality was generally less than sheep. Comparing the model results with district livestock numbers, the model performed well in estimating livestock losses with climatic conditions like that of the 1999-2002 dzud. Models such as this may be useful for providing near-term estimates of livestock losses based on forecast climate and forage conditions. This, in turn, can assist herders and policy makers in contingency planning for dzud prior to the onset of winter.

42.

TILLER DYNAMICS UNDER DIFFERENT LIVESTOCK AND WILDLIFE HERBIVORY IN A MIXED GRASS PRAIRIE.

John R. Hendrickson*[1], Patricia S. Johnson[2], Lan Xu[3], Kevin K. Sedivec[4], Mark A. Liebig[1], James Garrett[5], Igathinathane Cannayen[6]

[1]USDA-ARS, Mandan, ND, [2]South Dakota State University, Rapid City, SD, [3]South Dakota State University, Brookings, SD, [4]North Dakota State University, Fargo, ND, [5]Sitting Bull College, Fort Yates, ND, [6]North Dakota State University, Mandan, ND

Wildlife and livestock herbivory as well as ecological site can influence plant community composition. Population ecology can provide insight into how these dynamics influence plant communities. We selected two different ecological sites, thin claypan and loamy, at a research site near Mahto, South Dakota, that had areas with and without prairie dogs. Within each main plot (30x30m), four subplots (15 x 15cm) were randomly located. All tillers of western wheatgrass [*Pascopyrum smithii* (Rydb.) Á. Löve] within subplots in each main plot was marked with a colored wire in June 2014. We focused on western wheatgrass because it occurred in all sites. Non-livestock grazed treatments were fenced two years prior to starting the study. Treatments without prairie dog herbivory were located off of prairie dog colonies. Following initial marking in June 2014, plots were visited in September 2014 and June 2015. At each visit, live, dead and new tillers were recorded and new tillers were marked with a different colored wire. Tiller per tiller recruitment was determined by counting the number of new tillers and dividing by number of live tillers present at the previous sampling. In September 2014, thin claypan sites produced 1.16 new tillers per live tiller but on loamy sites it was only 0.88 (P=0.0020). In June 2015, tiller per tiller production on loamy sites was higher than thin claypan but the ratio at both sites was less than 1. In September 2014, treatments without prairie dogs averaged 1.26 tillers per tiller compared to 0.79 for treatments with prairie dogs (P<0.0001); however, in 2015 treatments without prairie dog only produced 0.31 tillers per tiller compared to 0.51 for treatments with prairie dogs (P=0.0281). These preliminary findings suggest both ecological site and type of herbivory influence population dynamics but more data is needed to fully evaluate these influences.

43.

NEVADA (USA) RANGE MANAGEMENT SCHOOL &NDASH; ADAPTING AN AMERICAN, GRAZING MANAGEMENT CURRICULUM TO OTHER CONTINENTS.

Brad Schultz*[1], Kent McAdoo[2], Barry Perryman[3], Steve Foster[4], Jason Davison[5]

[1]Humboldt County Extension Educator, Winnemucca, NV, [2]University of Nevada Cooperative Extension, Elko, NV, [3]University of Nevada Reno, Reno, NV, [4]University of Nevada Cooperative Extension, Lovelock, NV, [5]University of Nevada Cooperative Extension, Fallon, NV

The University of Nevada Cooperative Extension created the Nevada Range Management School (NRMS) in 2005 to improve the sustainability of grazed rangelands. In Nevada, USA, over 670 individuals have attended two or more of NRMS modules. In 2011, the United States Forest Service International

Program (USFSIP) invited the NRMS cadre to help develop a similar curriculum for the Middle Atlas region of Morocco. Versions of this curriculum were also taught in 2014 to international participants in the USFSIP International Rangeland Seminar in 2014 and Agricultural Extension staff in the Republic of Georgia. The curriculum's foundation modules address plant growth, development, physiology and grazing, and the timing and duration of grazing, and routinely received high marks for clarifying important concepts and providing knowledge the recipients could use to improve grazing management. International participants also identified numerous approaches to apply this knowledge in their own countries. Observation and feedback from program participants in Morocco and the Republic of Georgia indicate that application of knowledge gains is difficult when there is little or no control of when livestock access to grazing lands.

44.

HYDROLOGIC DROUGHT, SOIL MOISTURE STORAGE, ROOT DEPTH AND, LIVESTOCK MANAGEMENT DURING &LDQUO;DROUGHT&RDQUO;.

Brad Schultz*

Humboldt County Extension Educator, Winnemucca, NV

Drought in the Great Basin must be separated into at least two types: hydrologic or surface water drought and soil moisture drought during the spring to early summer growing season. Hydrologic drought typically occurs when snow pack is low and/or diminishes before the typical spring runoff period. Soil moisture drought affects vegetation growth, not surface flow, and is primarily a function of inadequate or poorly distributed precipitation during the spring growing season. Insufficient moisture in the root zone, in the spring, when soil and air temperatures are warm enough to support plant growth, results in decreased forage production, much more than total precipitation during the dormant winter season. Perennial herbaceous forage plants typically have 80% or more of their root biomass in the top 16 to 20 inches (41 to 61-cm) of the soil, and as much as 60% in the soil's top 8 inches (20-cm), where most nutrients needed for growth occurs. The water holding capacity of the soil layers inhabited by most of the root biomass is less, and sometimes much less, than the mean precipitation during both the dormant winter months (October-March) and the spring (April-June) growing season. Depending upon the size and frequency of discrete precipitation events once growth begins, the root zone can often be refilled with soil moisture when precipitation is less than average. This includes water years that are classified as moderate to severe drought. Photo documentation of plants in areas of northern Nevada classified as extreme or exceptional drought show that little if any adverse effect of the drought on plant growth and health. This can be explained, at least in part, by the amount and timing of precipitation and the soil's water holding capacity, with respect to the location of most of the root biomass of the forage plants.

45.

LIMITATIONS OF THE DROUGHT MONITORING INDEX FOR PREDICTING FORAGE PRODUCTION AND ADJUSTING LIVESTOCK NUMBERS.

Barry Perryman[1], Brad Schultz*[2], Tamzen Stringham[1]

[1]University of Nevada Reno, Reno, NV, [2]Humboldt County Extension Educator, Winnemucca, NV

The Nevada BLM Drought Response Plans disclose the environmental impacts of implementing Drought Response Actions (DRA). We reviewed the usefulness and validity of the drought prediction tools and the DRAs. They have limited ability to serve as accurate and precise indicators of annual herbage production. Declaring drought based largely on Drought Monitor data misses the ecological principle that shallow rooted forage plants (grasses) do not depend on the amount of precipitation prior to the effective growing season, but rather the amount and periodicity of precipitation during the thermal growing season. When the drought monitor indicates drought in January, February or even March of the current year, that categorization may be totally irrelevant with regards to the effective moisture available during the growing season and total plant growth. The critical moisture variable for herbaceous forage production is the amount of soil moisture in the root zone when active growth begins, and for the subsequent 2-3 months. The timing and amount of precipitation that occurs in discrete precipitation events immediately before and during the growing season, not total precipitation, are critical factors for plant growth. Hydrologic drought, which largely reflects surface water supplies (i.e., the Drought Monitor) must be separated from growing season soil moisture drought, which largely influences forage production. Most (80%+) root biomass for perennial herbaceous species occurs in the top 16 to 20 inches of the soil. The water holding capacity in this depth zone for many soils is much less than the average winter and/or spring precipitation. One or two substantial precipitation events, correctly timed, can provide adequate soil moisture for abundant plant growth. We propose use of the Evaporative Demand Drought Index (EDDI) and similar tools in addition to current assessment methods to better capture wet and dry periods at both long and short time scales.

46.

EVALUATION OF NEW CICER MILKVETCH CULTIVARS FOR FALL PASTURE.

Paul G. Jefferson*[1], Surya N. Acharya[2], Bruce E. Coulman[3]

[1]Western Beef Development Centre, Humboldt, SK, [2]Agriculture and Agri-Food Canada, Lethbridge, AB, [3]University of Saskatchewan, Saskatoon, SK

New cicer milkvetch (*Astragalus cicer*) cultivars were evaluated for forage yield and quality in stockpiled harvests (fall harvest only) compared to simulated pasture or hay plus stockpiled regrowth harvest systems in 2013 and 2014 growing seasons at Lanigan Saskatchewan, Saskatoon Saskatchewan and Lethbridge Alberta. Cultivars Veldt and Oxley II were compared to Oxley (check) cicer milkvetch and AC Grazeland alfalfa (*Medicago sativa*) (check) in mixture with Knowles hybrid bromegrass (*Bromus inermis* x B. *riparius*). The Alberta location was included because both cultivars were selected at that location. Stockpiled forage yield of Veldt and Oxley II was similar to checks at Lethbridge and Lanigan, but the yield at Lanigan was 70% lower than Lethbridge. Stockpiled forage quality at Lanigan was similar among the cicer milkvetch cultivars and better than that of alfalfa. Producers can use any of the cicer milkvetch cultivars for stockpiled forage grazing in the fall. The Hay plus stockpiled regrowth harvest management system produced superior forage quality and good forage yield compared to stockpiled season-long Stockpiled (fall harvest only) management.

47.

INFLUENCE OF SELF-FED VS. TRADITIONAL SUPPLEMENT FEEDING IN WINTER ON ACTIVITY PATTERNS OF RANGELAND HEIFERS.

F. Guadalupe Continanza*[1], Jennifer M. Muscha[2], Andrew J. Roberts[2], Mark K. Petersen[3], Andres Cibils[1]

[1]New Mexico State University, Las Cruces, NM, [2]USDA-ARS, Miles City, MT, [3]USDA-ARS Fort Keogh LARRL, Miles City, MT

We investigated the influence of two types of winter supplementation on activity patterns of heifers on northern Great Plains rangeland. The experiment was conducted at the USDA-ARS Fort Keogh LARRL in Miles City, MT during 18 days in January 2015. One group of 68 heifers was fed 1.82 kg of a 20% crude protein cake supplement/day/heifer (CAKE) delivered daily at approximately 10:00 AM, while another group of 66 heifers was provided a self-fed high protein plus mineral supplement designed to be consumed at 0.11 to 0.45 kg/heifer/day (SELF). Lotek 3300 GPS collars were fitted on five heifers per treatment to monitor movement at 5 min. intervals. The influence of supplementation treatment on daytime (7:00AM – 7:00 PM) activity patterns was explored by classifying points on the basis of movement velocity (m/min). Chi square tests were used to analyze the influence of treatment on daytime frequency of resting (< 1 m/min), traveling (>=20 m/min) and grazing (between 1-20m/min) events. Daytime activity patterns were significantly associated with supplementation treatment (Chi sq. 121.13, P<0.01). Lower daytime grazing events were recorded for CAKE vs. SELF heifers (62.1 vs.73.0%). CAKE heifers exhibited higher frequency of resting (29.1%) and travel (8.8%) events compared to their SELF counterparts (23% and 4%, respectively). A self-fed supplement such as that used in this study might provide a better means of feeding supplemental protein to stimulate use of dormant forage resources on rangeland.

48.

VEGETATION SELECTION BY ANGUS CROSSBRED VS. RARAMURI CRIOLLO COWS GRAZING CHIHUAUAN DESERT RANGELAND IN SUMMER.

Shelemia Nyamuryekunge*[1], Andres Cibils[1], Richard Estell[2], Alfredo Gonzalez[2]

[1]New Mexico State University, Las Cruces, NM, [2]USDA-ARS Jornada Exp. Range, Las Cruces, NM

We examined vegetation selection patterns of nursing Angus X Hereford crossbred (AH) and Raramuri Criollo (RC) cows grazing Chihuahuan Desert vegetation during the growing season. Eleven cows of each group grazed separately in two large pastures (1190ha, 1165ha) from mid-July until mid-August 2015 (28 days). GPS coordinates were recorded at 10 min intervals on five cows of each group. Vegetation in the pastures included honey mesquite (*Prosopis glandulosa*) intermixed with perennial grasses on sandy soils or tobosa (*Pleuraphis mutica*) and burrograss (*Schleropogon brevifolius*) in lower areas with clayey soils. GPS data were overlaid on a vegetation map of the pastures in ArcGIS. Mapped vegetation types were: bare ground, burrograss, mesquite, mesquite dunes, other shrubs, *Sporobolus* spp., and tobosa. Ivlev's electivity index (E) for each vegetation type was calculated for all collared cows (n=10). A *t-test*

revealed statistical differences in E between groups for all seven vegetation types. Compared to AH cows, RC showed higher preference for bare ground areas presumably dominated by annuals (ERC = 0.34; EAH = -1.00; P<0.01) and burrograss areas (ERC = 0.19; EAH = -0.25; P<0.01), lower preference for mesquite (ERC = 0.03; EAH = 0.13; P = 0.02), mesquite dunes (ERC = -0.08; EAH = 0.02; P<0.01), and tobosa grasslands (ERC = -0.11; EAH = 0.12; P<0.01), and lower avoidance of other shrubs (ERC = -0.26; EAH = -0.70; P= 0.04) and *Sporobolus* areas (ERC = -0.42; EAH = -0.88; P<0.01). Our preliminary results suggest that RC cows employ foraging strategies during the growing season that differ significantly from AH cows which are commonly used in our region

49.

GRASS HEIGHT &NDASH; A NEW LOOK AT AN OLD TOPIC IN SAGEBRUSH STEPPE ECOSYSTEMS.

Janessa C. Julson*, Karen L. Launchbaugh

University of Idaho, Moscow, ID

Rangeland managers have long measured grass height to assess biomass, utilization levels, and cover for wildlife. Growing interest in populations of ground nesting birds, like sharp-tailed grouse and greater sage-grouse, have raised interest in how livestock grazing may reduce grass height and compromise cover for grouse. We examined perennial bunchgrass height in four grazing allotments in sagebrush steppe ecosystems in Idaho to examine variation in grass height: 1) among locations and years, 2) among major grass species, and 3) whether plants were under or between shrubs. We also compared height of grasses around sage-grouse nests with respect to the fate of nests as successful or failed. The major grasses we examined were: Bottlebrush Squirreltail (*Elymus elymoides*), Bluebunch Wheatgrass (*Pseudoroegneria spicata*), Crested Wheatgrass (*Agropyron spciatum*), Needlegrasses (*Stipa* and *Oryzopis*), and Sandberg Bluegrass (*Poa secunda*). We found that utilization by livestock or wildlife does indeed reduce grass height, but that the specific level of utilization is very difficult for field technicians to assign. Grass heights varied about 39% depending on site. Grasses between shrubs were 1.5 to 3 times more likely to be grazed than plants under a shrub canopy. Grasses that grew under shrub canopies were 20% taller than those that grew in between shrub canopies because they experienced less removal of height from grazing. The average heights of grasses within one meter of a sage-grouse nest were similar regardless of whether the nest was successful or not; 35.9 cm average droop height around failed nests compared to 35.1 cm around hatched nests. Results related to nest success in grazed and ungrazed areas of pastures will also be presented.

50.

UTILIZING OUTREACH AND GRAZING TO IMPROVE CONSERVATION AND SOIL HEALTH.

Chad Ellis[1], Pat Pfeil*[2]

[1]National Grazing Lands Coalition, Ardmore, OK, [2]National Grazing Lands Coalition, Arcadia, FL

The National Grazing Lands Coalition (NatGLC) was awarded a Conservation and Innovation Grant with the USDA NRCS in 2014 to conduct outreach/education/demonstration on how prescribed grazing

impacts pasture and range productivity, conservation and soil health. The cornerstone of this project is the use of an on-farm demonstration of rainfall simulators to facilitate technology transfer to producer-lead community-based organizations of underserved, limited resource and socially disadvantaged groups on a nationwide scope. Hands-on workshops held by our project partners in Texas, Louisiana, South Dakota, South Carolina and New York accompany these demonstrations to enhance assimilation and adoption of grazing land management practices.Our poster will showcase these demonstrations with pictures and technical information for conference attendees. Dates and locations of future demonstrations will be listed.

51.

SEEDED FORAGES FOR CALIFORNIA ANNUAL RANGELAND.

Josh Davy*[1], Elise S. Gornish[2]

[1]University of California, Red Bluff, CA, [2]University of California, Division of Agriculture and Natural Resources, Davis, CA

Achieving multiple management goals is a priority for working grassland landscapes in California. Rangeland managers are particularly interested in identifying plant species and varieties that provide high forage value while also resisting invasion from noxious, unpalatable species and demonstrating robustness to the effects of drought. We initiated a four year study to investigate the initial value of 24 annual and perennial forages to provide adequate ground cover, forage production and resilience to the presence of weedy species and grazing. We found that the most successful varieties in the short term ('Blando' brome, 'Grouse' chicory and 'Rush' intermediate wheatgrass) declined precipitously through time and were dissimilar to the most successful species in the long term (harding grasses 'Perla', 'Holdfast', and 'Advanced AT'). Soil type affected cover of varieties in idiosyncratic ways, and weed cover generally negatively affected most varieties, with the exception of 'Tonic' plantain, 'Paiute' and 'Kara' orchardgrass, 'Winfred' brassica, 'Gala' brome and 'Grouse' chicory.

52.

ON-RANCH GRAZING STRATEGIES: CONTEXT FOR THE ROTATIONAL GRAZING DILEMMA.

Leslie M. Roche[1], Justin D. Derner[2], Bethany B. Cutts[3], Mark N. Lubell[1], Kenneth W. Tate*[1]

[1]University of California, Davis, Davis, CA, [2]USDA-ARS, Cheyenne, WY, [3]University of Illinois at Urbana-Champaign, Champaign, IL

Considerable debate remains over the efficacy of rotational grazing systems to enhance conservation and agricultural production goals on rangelands. We analyzed responses to grazing management questions in the Rangeland Decision Making Surveys of 765 California and Wyoming ranchers in order to characterize on-ranch grazing strategies and identify variables influencing strategy adoption. Two-thirds of respondents practice on-ranch rotational grazing strategies, indicating ranchers do experience benefits from rotation which have not been documented in experimental comparisons of rotational and continuous grazing systems. Limited on-ranch adoption of intensive rotational strategies (5% of

respondents) indicates potential agreement between research and management perceptions about the success of this particular strategy for achieving primary livestock production goals. Over 93% of all rotational grazer respondents were characterized as using *extensive* intragrowing season rotation with moderate (few wk to mo) grazing period durations, moderate (2.4–8 ha·animal unit) livestock densities, and growing season rest periods. Variables associated with ranchers' grazing preferences included a mixture of human dimensions (goal setting, views on experiment and risk tolerance, information networks), ranch characteristics (total number of livestock, land types comprising ranch), and ecoregions. We also found that the majority of grazing systems research has largely been conducted at spatial and temporal scales that are orders of magnitude finer than conditions under which on-ranch adaptive grazing management strategies have been developed. Resolving the discrepancies between the grazing systems research and management knowledge base will require substantive communication and novel approaches to participatory research between scientists and managers.

53.

ANIMAL BEHAVIOR, BODY CORE TEMPERATURE, AND PRODUCTION EFFICIENCY OF GRASS-FINISHED CATTLE.

Mark Thorne*[1], Melelani A. Abran[2], Chin N. Lee[3], Glen Fukumoto[4]

[1]University of Hawaii - Manoa, Kamuela, HI, [2]University of Hawaii at Manoa, Kamuela, HI, [3]University of Hawaii at Manoa, Honolulu, HI, [4]University of Hawaii at Manoa, Kailua-Kona, HI

Ruminant production efficiency is affected by the voluntary intake of forages and forage quality. Increasing foraging activity increases energy requirements of animals. Frame size and physiological status also influence energy requirements. Forage quality changes with daily and seasonal fluctuations in temperature and light intensity. Production efficiency of grass-finished cattle may be influenced by these factors. Previous studies show that high quality grass-finished beef can be grown on Hawaii pastures. However, the nutritional quality of consumed forages, such as C4 grasses, has not been evaluated as it pertains to grass-finished beef production. There is a need to identify factors that influence the efficiency of grass-finished beef production   A two-year study was conducted on 24 grass-finished cattle at the University of Hawaii, Mealani Agricultural Experiment Station. Animal behavior, BCT (body core temperature), weather variables, and forage quality were assessed during three daily periods (am, noon, pm) over three seasons. Cattle grazing activity was highest during the morning and evening periods compared to the midday for all seasons. Cattle spent the least amount of time laying down; a time when their BCT was highest. Standing and chewing and standing activity were higher during the midday in all seasons but highest in summer. Forage quality varied seasonally and was highest in summer than in fall. Diurnal differences were observed in the carbohydrate values which were highest in the evening through all seasons. Average Daily Gain (ADG) was not significantly greater between the 2012 cohort (0.86 kg/d) and 2013 cohort (0.84 kg/d). All animals were slaughtered at an average of 20 months and a live body weight of 531 kg. Eighty-percent of carcasses graded choice or better. Results from this study provide insight into the influence of forage quality and BCT on grazing behavior and production efficiency and may lead to improved management practices for grass-finished cattle.

54.

SELECTING THE OPTIMUM STOCKING RATE: A 26-YEAR-LONG STUDY IN SOUTH CENTRAL NORTH DAKOTA.

Bob D. Patton*[1], Anne C. Nyren[2]

[1]North Dakota State University, Streeter, ND, [2]North Dakota State University, Garrison, ND

The effects of grazing intensity on cattle performance, profitability and the sustainability of forage production have been monitored on mixed-grass season-long pastures at the NDSU - Central Grasslands Research Extension Center northwest of Streeter since 1989. Three replicates of five treatments were included: no grazing, light, moderate, heavy and extreme grazing. Our goal was to stock the pastures each year so when the cattle were removed in the fall, 65, 50, 35 and 20 percent of the forage produced in an average year remained on the light, moderate, heavy and extreme treatments, respectively. Average daily gain and body condition score decreased with increasing grazing intensity. This effect was significant ($P \leq 0.05$) in most but not all years. Regression of gain/ton (total weight gain of all animals/ton of available forage) and stocking rate showed that gain initially increases with stocking rate, but then decreases at higher stocking rates.Regression analysis shows that the constant stocking rate with the greatest average gain/ton of forage from 1991 to 2014 was 2.57 animal unit months (AUMs)/ton of forage, and the average gain/ton would have been 78.8 pounds/ton. If cattle prices were constant from spring to fall, then return/ton (dollars returned to the enterprise/ton of forage) would peak at a stocking rate somewhere below maximum gain/ton, with the exact point depending on carrying costs. The stocking rate with the maximum return/ton during the last 24 years would have been 2.53 AUMs/ton, with an average annual return of $54.01/ton. Although the most profit would have been made at 2.53 AUM/ton, forage production would be reduced and plant species composition would be altered. Based on vegetation response to stocking rates, the best compromise between profitability and sustainability appears to fall between a moderate stocking rate (0.69 AUM/ton) and a heavy stocking rate (1.32 AUM/ton).

55.

THE IMPACT OF BALE GRAZING ON FORAGE RESOURCES.

Darren Bruhjell*[1], Tony Cowen[2], Sharon Reedyk[2]

[1]Agriculture and Agri-Food Canada, Beaumont, AB, [2]Agriculture and Agri-Food Canada, Edmonton, AB

The purpose of this project is to increase our understanding of extensive winter grazing management systems. This knowledge is required due to the spatial variability of soil nutrients and corresponding forage productivity following bale grazing. This variability originates from the non-uniform deposition of bale residue, manure and urine and may result in a site having excess nutrients near where bales were placed (resulting in increased forage production, environmental risk and nutrient loss) and insufficient nutrients between bales (resulting lower forage production). With the exception of 2015, forage production has been significantly greater (P<0.05) since 2013 on areas directly impacted by the bale

when compared to the areas between the bales. While forage production was higher on all sites the year following bale grazing, it was only significantly higher on the early Caroline bale site. By 2015, while production was still higher on bale impacted sites, it was no longer significant (P>0.05). The impact of bale grazing on forage quality varied depending on site. Relative feed value (RFV) at the Caroline site was greater on both bales in 2013 and 2014 at the late season bale location. It was however significantly lower in 2014 at the early bale grazed location. Relative forage quality (RFQ) and crude protein was also variable, RFQ was significantly higher at the late grazed location in 2013 and significantly lower at both bales in 2014. Crude protein (CP) was only significantly different (higher) at the early grazed location in 2014. At the Vermilion site, RFV was only significantly higher at the late grazed bale location in 2014 while RFQ was significantly lower at the early bale location in both 2013 and 2014. CP was significantly higher at both bale locations in 2014.

56.

ENVIRONMENTAL VIABILITY OF INCREASED FIELD USE FREQUENCY FOR IN-FIELD WINTER FEEDING.

Darren Bruhjell*[1], Tony Cowen[2], Sharon Reedyk[2]

[1]Agriculture and Agri-Food Canada, Beaumont, AB, [2]Agriculture and Agri-Food Canada, Edmonton, AB

This project was initiated in the summer of 2015 to assess the viability of increased field use frequency for in-field winter feeding on two soil types. The purpose of this project is to: a) Determine the effects of a two-in-three year bale grazing rotation and associated nutrient loading (including carbon capture) on soil, forage yield and forage quality of two Alberta pastures; b) Determine the effects of a two-in-three year bale grazing rotation on nutrient migration into a local shallow groundwater system; c) Monitor and compare soil moisture and temperature regimes of winter bale grazed sites and non-winter grazed sites; and d) Assess potential for optical sensors (drone and quad-mounted sensors) to estimate forage biomass and carbon capture Beef producers put significant time and money into winter feeding. Because the animals do most of the work (traveling to the bales; spreading the manure), in-field feeding reduces costs associated with feeding thus increasing farm profitability. It also increases the amount of nutrients that remain on the land, reducing the need for synthetic fertilizers. The innovation of in-field feeding can continue to expand with the development of best management practices which allow greater feeding site frequency rates and potentially higher stocking rates if the practice is backed by science that shows increased farm profitability and sustainability without increased negative environmental effects. This project will help characterize the in-field components of the nutrient cycle and the hydrologic cycle and how they respond to increased nutrient and residue loading that exceeds AAFC and provincial recommendations. An increase in nutrients combined with the other benefits of in-field winter feeding will improve pasture health through increased nutrient cycling, soil building, soil moisture retention and lower soil temperatures. The latter two parameters combined with plant residue and surface microsite creation through pugging have direct positive impacts on the hydrologic cycle.

57.

USING ANNUAL MONITORING TO IMPROVE GRAZINGLANDS IN JUDITH BASIN COUNTY, MONTANA.

Rick Caquelin*

NRCS, Stanford, MT

In central Montana's Judith Basin County, there are over 20 producers who have been doing annual photo monitoring and adjusting their grazing strategies on their grazing lands since as early as 1997. Judith Basin County largely falls in Major Land Resource Area 46, Foothills and Mountains with about a 16 inch average annual precipitation. The monitoring sites are predominantly on loamy, clayey and overflow ecological sites. Photos are generally taken in August each year and the photos, grazing records and utilization information are compared to past years' information. The land manager and NRCS range conservationist develop grazing plans based on trends revealed through the annual monitoring during the winter prior to the next year's grazing season. This poster illustrates how collaboration between land managers and range management professionals results in grazing improvements when monitoring is used consistently to modify grazing plans to meet landscape goals.

58.

CATTLE GRAZING TIME ON AND OFF PRAIRIE DOG TOWNS.

Andrea Collins*[1], Jameson R. Brennan[2], Kenneth Olson[2], Janna Kincheloe[2], Patricia S. Johnson[2]

[1]South Dakota State University, Brookings, SD, [2]South Dakota State University, Rapid City, SD

Prairie dog occupation of rangelands often poses a difficult problem to land managers. Prairie dogs alter plant communities by consuming and clipping vegetation leading to changes in species composition to favor short grasses and annual forbs, and potentially reducing cattle weight gains. Previous research has looked at impacts of prairie dog colonization on cattle weight gains, and overall time spent on prairie dog colonies. Few studies have evaluated the percentage of grazing time allocated to prairie dog towns and how this is influenced by percentage of pasture occupied by prairie dog towns. A study was conducted near McLaughlin, South Dakota in a mixed grass prairie ecosystem to determine time spent grazing on prairie dog towns versus off-town. Four 202 ha pastures were fenced with varying percentages of prairie dog occupation (0%, 18%, 40%, and 75%). Pastures were stocked with yearling steers from June until October. Stocking rate was calculated to achieve 50% utilization based on a 50% reduction of forage availability on prairie dog occupied area. A subset of steers within each pasture were outfitted with Lotek 3300LR GPS collars equipped with motion sensors to aid in classifying graze versus non-graze behaviors. GPS data were loaded into an ArcGIS layer and analyzed to determine percentage of grazing time spent on prairie dog colonies versus off. Understanding cattle-prairie dog interactions, and degree to which cattle utilize prairie dog towns for grazing will aid land managers decisions to improve cattle performance on prairie dog occupied pastures.

59.

MANAGING NATIVE FORAGES FOR DOMESTIC LIVESTOCK GRAZING AND GRASSLAND BIRDS HABITAT.

Jill Epley*

USDA, Irmo, SC

The purpose of this project is threefold. To restore approximately four hundred acres of introduced pasture in Union County, South Carolina back to native grasses and forbs, to provide outreach and education on native ecosystems, and to discuss and demonstrate methods of managing the grazing of domestic livestock while creating and maintaining habitat for grassland birds. Outreach and education will be provided during the preparation and establishment of native grasses on the site. There will also be opportunities for demonstration workshops. These workshops will deal with prescribed burning, silvopasture practices, prescribed grazing, and wildlife habitat management.The US Forest Service will demonstrate prescribed burning techniques and discuss and provide chemical site preparation.The USDA-NRCS has approved an agreement for the SC Department of Natural Resources, Clemson Extension and the National Wild Turkey Federation to develop and implement a conservation plan. They will also monitor the planting and establishment of the native grasses and forbs at the site. Duke Energy has provided an agreement that will assist with purchasing the native grass and forb seeds.Hands-on workshops will be held both during and after the native prairie restoration for groups that include farmers, ranchers, and the general public. These workshops will enhance the assimilation and adoption of grazing land and wildlife habitat management.

60.

HOW DOES CATTLE GRAZING AFFECT IMPORTANT PLANTS FOR WHITE-TAILED DEER IN SOUTH TEXAS?

Ramon Saenz III*[1], J. ALFONSO ORTEGA-S.[2], Timothy E. Fulbright[3], David G. Hewitt[2], Tyler A. Campbell[4], Alfonso Ortega-S. Jr.[4]

[1]Caesar Kleberg Wildlife Research Institute, TAMUK, Kingsville, TX, [2]CAESAR KLEBERG WILDLIFE RESEARCH INSTITUTE, KINGSVILLE, TX, [3]Caesar Kleberg Wildlife Research Institute, Kingsville, TX, [4]East Foundation, San Antonio, TX

Increasing economic value of hunting has heightened landowners' interest in enhancing habitat for wildlife. Aldo Leopold, in his book *Game Management,* considered cattle as one of the tools to use in improvement of habitat. He also warned that improper management of herbivory can damage wildlife habitat. Our objectives were to 1) determine how intensity of herbivory affects species richness and standing crop of grasses and forbs, and 2) determine effects of autumn cattle grazing on spring forb standing crop. We randomly allocated fifty 1.5 m x 1.5 m vegetation enclosures on each of six 2 500 ha study sites placed on four East Foundation ranches which are located all throughout south Texas. Every autumn and spring from 2015–2017, plant species composition and standing crop within each enclosure will be compared to a paired grazed plot. Vegetation will be separated into grasses, forbs preferred by white-tailed deer, and non-preferred forbs. In the first season of data collection, in three out of the six locations with the increase in grazing utilization, standing crop of preferred forbs had decreased. In the remaining three locations grazing utilization had no effect. All six study sites, non-preferred forbs were not affected by grazing utilization. Further study and data collection will assist in gaining a better understanding the effects of cattle grazing to manipulate habitat and optimize cattle and white-tailed deer performance in South Texas.

61.

USING GPS COLLARS AND PEDOMETERS TO TRACK CATTLE BEHAVIOUR UNDER OPEN-RANGE GRAZING.

Carly A. Moore*[1], Nicky Lansink[1], John Basarab[2], Carolyn Fitzsimmons[3], Scott Nielsen[4], Graham Plastow[5], Edward Bork[1]

[1]University of Alberta, EDMONTON, AB, [2]Alberta Government, Lacombe, AB, [3]Agriculture and Agri-Food Canada, Edmonton, AB, [4]University of Alberta, Edmonton, AB, [5]Livestock Gentec, Edmonton, AB

Studies linking animal genetics to performance on pasture require an understanding of livestock behaviour, which can be complex under open-range conditions. Here we describe a novel approach to linking the use of GPS collars and leg mounted pedometers in an attempt to determine if there are relationships between free-ranging cattle habitat selection and use and associated molecular breeding values for residual feed intake (RFI), an important measure of cattle feed efficiency. Relationships between these cattle and their activity budgets will also be studied. This work was conducted at the University of Alberta Mattheis Research Ranch, just north of Brooks, Alberta in the Mixedgrass Prairie. An identified subset of commercial cows with distinctly divergent (high and low) molecular breeding values for residual feed intake were fitted with Lotek 3300LR GPS collars and AfiAct II pedometers to track their movements while rotationally grazing a series of large pastures for five months. Behavioural data for each animal and treatment group will eventually be used to develop resource selection functions (RSFs) for beef cattle with divergent RFI scores. Methods of data collection throughout the summer and a review of the efficacy of the AfiAct II pedometers and Lotek collars will be discussed in the poster.

62.

EFFECT OF INCREASED NATIVE SPECIES DIVERSITY ON PASTURE BIOMASS PRODUCTION OVER TEN PRODUCTION YEARS.

Alan D. Iwaasa*, Edward Birkedal, Edmund T. Sottie

Agriculture and Agri-Food Canada, Swift Current, SK

Several ecological research studies have indicated that increased plant biodiversity benefits primary production. However, it is not clear whether the results and concepts of basic ecological biodiversity studies apply to manage temperate grazed pastures. An Agriculture and Agri-Food Canada - SPARC study was started in 2001, in which class 3-4 crop land was seeded to two different native mixtures: a simple (S) mix with six different wheatgrasses and one forb and a complex (C) mix containing eleven grasses (warm and cool season species), one forb and two shrubs. In 2005 four pastures (each pasture 2 ha), two S and two C, were grazed continuously at a utilization levels of 50% for the next ten years. Study objective was to determine if increased species diversity resulted in higher primary forage production. Available pasture biomass measurements were taken at the beginning of the grazing season which occurred at the beginning of July (AYD) and peak biomass measurements were taken at the end of July (CYD). Both AYD and CYD measurements were taken over all years (2005 – 2014) and were an average of 10 random quadrat samples per pasture. Results observed no interaction or primary biomass differences (P>0.10) between the S versus C mixtures for AYD or CYD. As expected there were

year effects (P<0.0001) for AYD or CYD. Although several drought or below normal moisture periods occurred over the ten years, the level and/or duration of environmental heterogeneity may not have been sufficient to show any primary production benefit with a higher forage diversity mixture and the lower-diversity mixture did just as well.

63.

LIVESTOCK AND WILD HORSE GRAZING IN GREATER SAGE-GROUSE LATE-BROOD MEADOW HABITAT.

Sabrina M. McCue*[1], Sara L. McBee[1], Sherman R. Swanson[2], Kent McAdoo[3], Brad Schultz[4]

[1]University of Nevada, Reno, Reno, NV, [2]College of Agriculture, Biotechnology, and Natural Resources, University of Nevada, Reno, Reno, NV, [3]University of Nevada Cooperative Extension, Elko, NV, [4]Humboldt County Extension Educator, Winnemucca, NV

Nevada's meadows provide juvenile sage-grouse with protein-rich forbs, especially during low precipitation years. Livestock and wild horses favor meadows over uplands during hot summer months for water, forage, and thermoregulation. Proper functioning condition of meadows ensures ground water availability to forbs and erosion resilience under grazing and high flow events. Overgrazing often leads to decreased meadow functioning condition. Light to moderate grazing can improve habitat conditions for sage-grouse, promoting young, nutrient rich, leader growth. Successful grazing management in riparian areas leverage tools that allow recovery after grazing. There are many tools in the livestock management toolbox. There are currently no effective tools for managing wild horses. This study will examine effects of horse and livestock grazing on vegetation and hydrologic response variables with regard to prevailing guidelines for sage-grouse late-brood rearing habitat in meadows. The goal is to identify grazing patterns leading to resilient or degraded lentic riparian habitats. Draft Inventory and Monitoring in combination with Designated Monitoring Area Methods for Lentic Wetland Areas will be modified and applied. Sage-grouse habitat indicators will be assessed using methods established in the Sage-grouse Habitat Assessment Framework. Horse and livestock grazing activity captured year-round by automatic cameras will document actual use. Such data are needed to move the wild horse management conversation beyond its current impasse and develop management concepts for livestock and wild horse use leading to successful management of lentic riparian resource values and habitat conditions for sage-grouse. To date, no systematic study of this type has occurred across Nevada's riparian meadows.

64.

PREDICTING ABOVEGROUND PLANT PRODUCTION FROM PRECIPITATION PATTERNS ON NEBRASKA SANDHILLS RANGELAND.

Jonathan Soper*[1], Walter Schacht[1], Jerry Volesky[2], Jessica Milby[1]

[1]University of Nebraska-Lincoln, Lincoln, NE, [2]University of Nebraska-Lincoln, North Platte, NE

Annual grazing plans and within year adaptations are commonly developed based on a combination of average annual precipitation and current year precipitation. Because inter- and intra-annual

precipitation patterns are variable, predicting aboveground plant production on grazinglands is challenging. However, there are reports of using within year precipitation records to predict current-year, aboveground plant production. We quantified aboveground plant biomass on warm-season grass dominated upland range (sands ecological site) at the Gudmundsen Sandhills Laboratory and the Barta Brothers Ranch in the Nebraska Sandhills. Aboveground biomass by plant functional group has been estimated by clipping standing vegetation at ground level in 30 to 60 quadrats (0.25 m2) in mid-June and mid-August (peak standing crop) from 1999 through 2015. The quadrats were in 1-m2 exclosures that were moved annually within rangeland pastures grazed at moderate stocking rates (1.5 to 1.9 AUM ha2). Precipitation and temperature data were collected from on-site weather stations. Preliminary analysis suggests that May and June precipitation is a good predictor of peak standing crop in August, although April and May precipitation also is a good indicator of August plant biomass. Dependable predictions of annual plant production based on early season precipitation is a valuable tool for livestock producers on grazinglands.

65.

RESEARCH ON VEGETATION AND STREAM WATER TEMPERATURE IN SEMIARID RIPARIAN SYSTEMS.

Jaycee A. Leonard*, Carlos G. Ochoa

Oregon State University, Corvallis, OR

With a changing global climate and growing demand for water throughout the world, responsible and sustainable land and water resource management practices are becoming increasingly important. The overall goal of this project is to determine a holistic representation of the effects land management practices have in stream temperature and riparian vegetation conditions within a semiarid stream in North Central Oregon. Often land managers are asked to make changes to riparian areas and modify management practices to benefit stream quality. This study was initiated to help analyze the many interactions affecting water temperature changes and whether these suggestions are successful. The study site located on a stream with current and historic high stream temperatures provides a critical platform for studying management of water temperature in semiarid environments. Extensive vegetation inventories were accomplished utilizing riparian channel transects, greenline inventory protocol and randomized comprehensive vegetation record plots. These large vegetation surveys helped understand the influences of red alder water uptake and possible influences on streamflow input and temperature. These vegetation surveys assessed species richness, density, frequency and height of all dominate species present. Onsite ongoing data collection and analysis include transpiration rates, streamflow and meteorological data including; temperature, relative humidity, barometer, rainfall, wind direction and speed data. Stream and ambient thermal data has been collected in over 15 sensors and were further intensified by using Distributed Temperature Sensing Technology (DTS) for two months in the summer. This particular study is part of an overarching project focused on a systems based approach to analyzing climate-vegetation interactions and ecohydrologic processes in arid and semiarid landscapes. Results of this study provide insight on riparian vegetation water consumption in water scarce ecosystems and expected results from this study will enhance base knowledge regarding multiple ecohydrologic interactions that may affect the thermal regime of semiarid riparian corridors in the West.

66.

VEGETATION RECOVERY ON SOUTH DAKOTA MIXED GRASS PRAIRIE AFTER PRAIRIE DOG REMOVAL.

Jameson R. Brennan[1], Hector M. Menendez III*[2], Kurt Chowanski[3], Benjamin Turner[4], Mark Hendrix[5], Christina Koehler[6]

[1]South Dakota State University, Rapid City, SD, [2]South Dakota State University, Brookings, SD, [3]South Dakota State University, West River Ag Center, Rapid City, SD, [4]Texas A & M university, Kingsville, TX, [5]Custer State Park, Custer, SD, [6]USDA NRCS, Webster, SD

Prairie dog colonies can have a large impact on plant species composition and rangeland production through direct consumption and by clipping vegetation to increase predator detection. Vegetation within prairie dog towns is characterized by a reduction of mid-grass species, an increase in perennial shortgrass, an increase in annual forbs, and an increase in bare ground. Often identified as a keystone species of importance for conservation, prairie dog colonies are frequently seen as limiting to cattle production and control measures are often used to prevent colony expansion or eliminate colonies entirely. While many studies have looked at the impacts of prairie dog towns on plant communities, research is lacking on the rate of restoration of colonies following a control event. An assessment and monitoring program was established in western South Dakota on a mixed-grass prairie following the control of a prairie dog town. The Prairie dog town was controlled in the fall/winter of 2008/2009. Monitoring of biomass; species richness; western wheatgrass, bare ground, and vegetation cover; species frequency of prairie rose and big bluestem; and prairie rose density occurred in two year intervals from 2009 to 2015. Following control, overall grass species cover and biomass increased and bare ground cover decreased as did species richness. Restoration of prairie dog colonies occurred rather quickly, which can aid decisions about recovery time and grazing management strategies.

67.

MONTANA STATE UNIVERSITY EXTENSION RANGE MANAGEMENT INSTITUTE.

Tracy Mosley*[1], Dan Lucas[2], Jeff Mosley[3]

[1]Montana State University, Livingston, MT, [2]Montana State University, Philipsburg, MT, [3]Montana State University, Bozeman, MT

Rangeland comprises approximately 70% of the land area in Montana. Ranches with rangeland livestock production enterprises contribute significantly to Montana's economy and, when managed correctly, these landscapes can naturally maintain plant community health, soil integrity, water quality, and wildlife habitat. Therefore, it is important for Extension faculty to possess adequate knowledge to assist these individuals. This program, funded by Western SARE, was initiated to provide in-depth training for Montana Extension faculty on fundamental rangeland ecology and management principles. The focus of the program is to aid educators in more effectively assisting landowners who desire to manage the rangelands they rely upon for their livelihood efficiently and sustainably. Faculty attended three workshops that included classroom and field instruction. Topics included: 1) *Rangeland Ecology*

Principles, 2) *Rangeland Management Principles*, 3) *Management Tools to Improve Efficiency*, 4) *Rangeland Metrics and Monitoring*, and 5) *Current and Emerging Issues on Rangelands*. Pre- and post-tests indicated that participants increased knowledge significantly across all workshops. Personal contact with participants also demonstrated increased confidence by participants when working with ranchers and local working groups focusing on rangeland resources. In the future, project coordinators plan to lead the development of a strong mentoring program across Montana among field faculty who address rangeland resource clientele inquiries. Additionally, by participant request, project coordinators are developing a 'Level 2 Montana State University Extension Range Management Institute' workshop. Previous participants will be invited to attend this hands-on, field-oriented workshop designed to further elevate faculty knowledge of rangeland management tools and strategies.

68.

PREDICTING ECOSYSTEM FUNCTION CHANGES FOLLOWING SIMULATED PLANT SPECIES EXTINCTION SCENARIOS FOR SUSTAINABLE MONGOLIAN GRASSLAND USE.

yu yoshihara*

tohoku university, osaki, Japan

Understanding the relationships among biodiversity, ecosystem function, and ecosystem services is central to applied ecology. We examined plant productivity, litter decomposition rate, and soil respiration rate following removal of select plants to simulate extinction scenarios previously documented in Mongolian grasslands. Additionally we analyzed the relationships between plant trait (function) diversity and ecosystem functions. Plants in experimental plots were removed according to four extinction scenarios: 1) dominant species first; 2) rare species first; 3) combination of scenarios 1 and 2; and 4) random extinction. The first scenario occurred frequently in grassland ecosystems that were overgrazed. The second scenario was frequently associated with climate change. The relationship between species richness and soil respiration rate was moderately positive. However, the relationship varied among the four species removal scenarios. Although soil respiration rate was relatively unchanged by removal of dominant or rare species, it was vulnerable to random species removal. These results indicate that species loss will degrade multiple Mongolian grassland ecosystem functions.

69.

OIL-PRODUCED WATER THRESHOLDS ON RANGELAND PLANT&RSQUO;S SURVIVAL UNDER GREENHOUSE CONDITIONS.

Hannah A. Tomlinson*, Aaron W. Klaustermeier, Ryan F. Limb, Aaron L. Daigh, Kevin K. Sedivec, Thomas M. DeSutter

North Dakota State University, Fargo, ND

Oil and gas production activities in western North Dakota increased the presence of anthropogenic surface salinity in the Northern Mixed Grass Prairie (NMGP). Oil-produced water (i.e. brine) is a regulated waste product of oil and gas extraction that can have salt, mostly sodium chloride,

concentrations higher than natural saline seep formations. Accidental and deliberate discharges of brine can kill actively growing plants shortly after coming into contact with plant leaves and roots. Additionally, the loss of root structures and vegetative cover can leave soil susceptible to wind and water erosion. Salt tolerant plant species, i.e. halophytes, are capable of completing their life cycle in salt-rich environments and may be suitable candidates to revegetate brine spill sites or stabilize and minimize the expansion of brine plumes. The objective of this greenhouse study was to determine brine thresholds of nine plant species at five brine-derived soil electrical conductivities (EC) and two different growth stages. The experiment was conducted on nine plants species native to the NMGP, with the exception of Kentucky bluegrass (*Poa pratensis*). Brine was diluted with distilled water to create five (2, 4, 8, 16 and 32 dS m^-1) soil EC's, with no added brine as the control, and applied it to five pots per EC treatment in a loam soil. Plant survival was determined by examining visual indicators in plant leaves, which is essential to maintain plant structure and function. Thirty days after brine application, survival and biomass data was collected on greenhouse plants and analyzed with regression to examine EC thresholds. Data from the analysis will determine species thresholds on a brine contaminated gradient.

70.

PRAIRIE GROUSE BIOPHONY VS. ANTHROPHONY: &LDQUO;BOOMING GROUNDS&RDQUO; WITHIN A WIND ENERGY-RANGELAND MATRIX.

Edward J. Raynor*[1], Cara Whalen[1], Edward Walsh[2], JoAnn McGee[2], Mary Bomberger-Brown[1], Larkin Powell[1]

[1]University of Nebraska-Lincoln, Lincoln, NE, [2]Boystown National Research Hospital, Omaha, NE

The sounds of vocalizing animals (biophonic) and the non-biological sounds (geophonic) of running water and rustling wind emanate from natural landscapes. However, vast expanses of open range are experiencing establishment of large wind-energy facilities (anthrophonic). The noise emitted from these machines may interrupt the natural landscape and underlying biological processes. To develop decision support tools for siting wind developments in the Nebraska Sandhills, we have evaluated the effects of wind developments on Greater Prairie-chickens (*Tympanuchus cupido*). We identified potential for wind-turbine noise interference to effect breeding success of lekking prairie-chickens at local (lek) and landscape (wind project area) scales. We recorded vocalizations along gradients extending out from an existing wind turbine facility at Ainsworth, Nebraska during the lekking seasons (March - June) of 2013 and 2014. Preliminary analyses suggest "booms" were shorter in duration and lower in fundamental frequency near the wind farm, and "whoops" were higher in sound pressure level and fundamental frequency near the wind farm. The boom chorus is the combined sound of multiple males booming simultaneously at a lek. The low-frequency sound of the boom chorus has an average peak frequency of 297 Hertz and travels a long distance over the landscape to function as an advertiser to other prairie-chickens. We found that the level of the of the boom chorus at a given point on the landscape is affected by distance to the lek, numbers of male and female prairie chickens at the lek, ordinal day, time of day, temperature and wind speed. Our approach will allow land managers to optimize wind energy development in areas of concern for rangeland wildlife including prairie grouse, while aiding investors and policy makers to identify ideal locations for future wind energy projects.

71.

ENERGY IMPACTS ILLUSTRATED: FOCUS GROUPS AND PHOTOGRAPHY DOCUMENT LANDSCAPE INDUSTRIALIZATION IN THE BAKKEN OIL PATCH.

Devan A. McGranahan*, Meghan L. Kirkwood

North Dakota State University, Fargo, ND

Energy production in North Dakota has boomed over the last seven years, driven primarily by development of petroleum deposits in the Bakken shale formation. While oil production has long been a feature of the working landscapes and rural communities of western North Dakota, new technologies such as hydraulic fracturing and horizontal drilling have led to unprecedented landscape industrialization. Both the density and productive capacity of wells are greater than before, which has increased the footprint of energy development in almost every sense: more traffic; more land given to pads, pipelines, and novel infrastructure such as saltwater disposal; and large increases in local populations. All of these changes affect the natural and social resources of rural communities, but the nature and extent of these impacts have yet to be documented. We conducted focus groups with community and farm industry leaders in the top three oil-producing counties of North Dakota, and present responses in a usable science framework designed to allow residents to identify priority areas of research and policy concern. From an agricultural perspective, participants were most concerned about fugitive dust impacts on crops and livestock, disruptions to farm operations by both on-road traffic and off-road traffic (e.g., company employees leaving gates open or disturbing livestock), and restoring productivity following reclamation of pads, pipelines, and spills. From a business perspective, participants expressed concern about terms of easement contracts, ability to rent or lease land in high-impact areas, and adequate compensation for time spent managing development impacts. From a community perspective, participants expressed concern over limited resources for local services, stress on social networks, and demands of itinerant populations on schools and churches. Using Google Earth and landscape photography, we visually present aspects of energy development's footprint in the Bakken region.

72.

ALAMEDA AND CONTRA COSTA COUNTY WILDLIFE-FRIENDLY LIVESTOCK POND INITIATIVE.

Miao L. He*

USDA - Natural Resources Conservation Service, Livermore, CA

The survival and recovery of two California amphibians is dependent on the land stewardship of local cattle ranchers in the east San Francisco Bay Area. The California red-legged frog and California tiger salamander occur primarily on rangelands, where the dominant management activity is cattle grazing. Livestock ponds provide alternative, high-quality aquatic habitat for these species and have become vital features on the landscape as the amphibians' natural habitat is lost due to land development and conversion to cropland. Many of the stockponds in Alameda and Contra Costa counties were built 30-60

years ago and are now failing due to erosion and siltation. The Wildlife-Friendly Livestock Pond Initiative provides funds from the Natural Resources Conservation Service, with additional matching funds from California Rangeland Conservation Coalition signatories and other partners, to rehabilitate these ponds for habitat and to provide a reliable source of drinking water for livestock. Livestock pond restoration activities may include desedimentation, spillway and/or dam repair, establishment or management of above-pond vegetation, and development of alternative, off-pond water. Nine livestock ponds are being restored during the first year of implementation in 2015.

73.

MOVEMENTS AND HABITAT USE OF PRONGHORN IN THE PANHANDLE AND TRANS-PECOS ECOREGIONS OF TEXAS.

Caroline L. Ward*[1], Randy DeYoung[1], David G. Hewitt[1], Timothy E. Fulbright[1], Shawn S. Gray[2], Humberto L. Perotto-Baldivieso[3]

[1]Caesar Kleberg Wildlife Research Institute, Kingsville, TX, [2]Texas Parks & Wildlife Department, Alpine, TX, [3]Caesar Kleberg Wildlife Research Institute - Texas A&M University - Kingsville, Kingsville, TX

Pronghorn antelope (*Antilocapra americana*) have large home ranges and are capable of making long-distance movements. Fences and highways are known to influence pronghorn movements. However, little is known about seasonal movements or habitat use in the high plains. We are studying pronghorn habitat use and movements in a mosaic of irrigated agriculture, livestock production, and open shrub and grassland in the Panhandle and Trans-Pecos ecoregions of Texas. We captured and fitted 50 pronghorn in 2014 with Global Positioning System (GPS) collars at two sites in the Panhandle. Locations were recorded from April to September 2014, resulting in 103,334 locations total. Preliminary analysis of the Panhandle data revealed that major highways with high traffic volume, such as U.S. Highways 385 and 87 in Dalhart and Texas Highway 70 in Pampa, are barriers to movement. All Panhandle pronghorn crossed smaller, low traffic county and farm-to-market roads readily. Pronghorn habitat use in the Panhandle consisted of 76.3% grassland or pasture, 15.9% shrubland, 7.1% agriculture, and 0.7% developed space, on average. Fifteen out of 25 pronghorn in Dalhart and 8 out of 25 pronghorn in Pampa used agricultural fields. The agricultural fields used consisted of 53.3% winter wheat, 39.4% fallow fields, 4.2% sorghum, 1.7% corn, and 1.5% double crop of winter wheat and sorghum, on average. The mean home range size of male and female pronghorn in Dalhart was 1,343.8 ha and 1,097.4 ha, respectively. For Pampa, the mean home range size for male pronghorn was 1,231.6 ha and 1,260.8 ha for females. Collars were recently collected from the Trans-Pecos field season, and data will be downloaded, analyzed, and compared to the Panhandle data. This information can increase understanding of pronghorn habitat use and improve pronghorn management through delineation of herd units and placement of pronghorn-friendly fencing in Texas.

74.

NATIVE SUMMER MAST AVAILABILITY IN SOUTH TEXAS.

Emily H. Belser*[1], David Hewitt[2], Timothy E. Fulbright[3], Charles A. DeYoung[2], Kim Echols[4], Don A. Draeger[5]

[1]Texas A&M-Kingsville, Kingsville, TX, [2]Caesar Kleberg Wildlife Research Institute, Kingsville, TX, [3]Texas A&M University-Kingsville, Kingsville, TX, [4]Caesar Kleberg Wildlife Research Institute, Eagle Pass, TX, [5]Comanche Ranch, Carrizo Springs, TX

Summer diets of herbivores in South Texas consist heavily of mesquite beans and prickly pear mast when available. However, the importance of these mast species is often overlooked. To quantify the disappearance rate of mesquite beans and prickly pear mast, we monitored 5 mesquite trees and 5 prickly pear plants within each of 6, 80-ha white-tailed deer enclosures during summer 2014. Only prickly pear mast was monitored in 2015 because mesquite bean production was zero that year. We marked individual beans on each mesquite tree. Marked beans remaining on each mesquite and every fruit on each prickly pear were counted weekly to determine disappearance rates. We also measured canopy cover and counted the mast of 20 mesquites and 10 prickly pear plants randomly chosen in each enclosure to determine mast production in 2014 and 2015. Mesquite mast disappeared sooner than prickly pear mast in 2014. Mast took longer to disappear in enclosures with high mast production than in enclosures with low production in both years. Biomass of prickly pear and mesquite mast in each enclosure varied from 8 - 1489 kg/ha in 2014 and from 0 - 890 kg/ha in 2015, showing that mast production in South Texas can be highly variable among years. Despite this variability among years, these two native plants can account for a vast food resource for wildlife. These findings have implications for brush management. Managers should consider maintaining adequate mesquite and prickly pear in areas where managing for wildlife is a priority.

75.

ATTWATER'S PRAIRIE-CHICKEN USE OF BURNED AREAS.

Heath D. Starns*[1], Samuel D. Fuhlendorf[1], Dwayne Elmore[1], Mike E. Morrow[2], Rebecca E. Chester[2]

[1]Oklahoma State University, Stillwater, OK, [2]Department of the Interior, Eagle Lake, TX

The Attwater's prairie-chicken (APC) (*Tympanuchus cupido attwateri*) is one of the most imperiled bird species in North America, with fewer than 500 birds currently in the wild. The primary population is located at the Attwater's Prairie-Chicken National Wildlife Refuge (APCNWR), which consists of approximately 4,200 ha of native and restored coastal prairie managed solely for the benefit of the species. Management techniques focus on habitat maintenance and improvement. Patch-burning (a combination of prescribed fire and grazing) is one of the primary management practices at the refuge, and has been credited with increasing landscape heterogeneity in other areas of the Great Plains. As part of the refuge's standard protocol, Attwater's Prairie-Chicken hens were fitted with very high frequency (VHF) radio transmitters prior to the nesting season. These transmitters were then used to locate nests upon initiation, and again to track broods after hatch. We assessed two years of APC nest site selection and brood use relative to patch-burning on the refuge. Attwater's Prairie-Chicken broods were observed predominately in patches burned within the 16 months immediately prior to hatching.

76.

DROUGHT AND DENSITY EFFECTS ON PALATABLE FORB SPECIES FOR WHITE-TAILED DEER.

Ashley A. Wilson*[1], Lindsay D. Roberts[1], Timothy E. Fulbright[1], David B. Wester[1], David G. Hewitt[1], Charles A. DeYoung[1], Kim Echols[2], Don A. Draeger[3]

[1]Caesar Kleberg Wildlife Research Institute, Kingsville, TX, [2]Caesar Kleberg Wildlife Research Institute, Eagle Pass, TX, [3]Comanche Ranch, Carrizo Springs, TX

Forbs offer high quality nutrition in white-tailed deer (*Odocoileus virginianus*) diets when they are available, but their abundance is highly influenced by environmental resource pulses in semiarid environments. We hypothesized that variation in precipitation and temperature has a greater effect on presence or absence of 2 palatable perennial forb species than deer population density. The study was conducted on two ranches in southwest Texas. Our study sties on each ranch included 6 81-hectare enclosures with target deer populations of 0, 20, 40 or 60 and 1 feeder/water, one enclosure with 60 deer and 3 feeders/waters, and one enclosure with 80 deer and 4 feeders/waters. We permanently marked 20 individuals of low menodora (*Menodora heterophylla*) and blackfoot daisy (*Melampodium cinereum*) in each enclosure. During 2014-2015, we recorded presence or absence of marked plants and recorded whether they appeared senesced or browsed. We then compared the effects of monthly average precipitation, temperature, deer density, and deer:feeder ratios on the average percent of low menodora and blackfoot daisy that were present, senesced, and browsed. Preliminary results show that the presence of low mendora was unrelated to deer density, but presence varied over time ($P < 0.001$). In contrast, fewer blackfoot daisy individuals were present at higher deer densities ($P = 0.031$), and presence also varied substantially with time ($P < 0.001$). Managers making decisions about effects of deer density on habitat should take into account that forb abundance may reflect effects of variation in environmental factors more strongly than deer population density.

77.

INFLUENCE OF INITIAL NEST FATE ON BOBWHITE NEST PLACEMENT.

William L. Lutz*, J. Patrick Clark, Joshua D. Pearson, Fidel Hernandez, Eric D. Grahmann, Leonard A. Brennan

Caesar Kleberg Wildlife Research Institute, Kingsville, TX

Much is known about bobwhite nesting ecology; however, relatively little is understood regarding how nest predators influence bobwhite nest selection and re-nesting behavior. The objective of our research is to compare how the fate of an initial nest influences the placement of a bobwhite's subsequent nest(s). We predict that bobwhites will move greater distances for subsequent nesting attempts if the prior nesting attempt was a failure than if the prior nesting attempt was successful. Our study was conducted on 5 spatially independent study sites across South Texas, in Brooks (2000–2008), LaSalle (2009-2011) and Goliad, Real, and Zavala counties in 2014 - 2015. We located and collected information on nest fate through the use of radio-telemetry. Using ArcGIS, we will determine if there is a difference in distance moved between prior and subsequent nests based on success of the first nest. Data are currently being analyzed and the study will conclude in 2016.

78.

INFLUENCE OF WOODY COVER ON NORTHERN BOBWHITE SEASONAL SURVIVAL.

J. Patrick Clark*, William L. Lutz, Joshua D. Pearson, Eric D. Grahmann, Fidel Hernandez, Timothy E. Fulbright

Caesar Kleberg Wildlife Research Institute, Kingsville, TX

Northern bobwhites have relatively low survival rates across their geographic distribution. Predation is a primary cause of the high mortality in bobwhites, and the amount of brush available may have a local impact on bobwhite survival by providing escape cover and protection. Even though many researchers have attempted to determine the woody cover requirements for bobwhites, few have attempted to study how woody cover may influence bobwhite survival. The objective of this research is to determine if bobwhite seasonal survival (Mar–Aug) is correlated with the amount of woody cover used at both the individual location, home-range, and pasture scales. Data were collected during 2014-2015 on 5 private ranches in Goliad, Zavala, Real, and La Salle Counties. We will also use data from a long-term research project conducted in Brooks County. Radio-marked bobwhites were relocated three times per week to monitor survival and woody cover use. We measured woody cover at bobwhite locations and at paired, random points using the line intercept method. Points taken from bobwhites were uploaded into Arc GIS to determine woody cover within home-ranges and within the pastures that contained those points. We used regression analysis to determine if a relationship existed between woody cover use and seasonal survival for each of these scales.

79.

PRELIMINARY DENSITY AND OCCUPANCY ESTIMATES FOR GRASSLAND BUTTERFLIES IN THE NORTHERN GREAT PLAINS.

Katherine C. Kral*, Ryan F. Limb, Torre J. Hovick, Jason P. Harmon

North Dakota State University, Fargo, ND

Butterfly abundance and diversity continue to decline with habitat fragmentation, degradation, and loss. Since butterflies play an important role in pollination, maintain overall grassland biodiversity, and act as biological indicators, research in butterfly ecology is imperative to gain insights into how land cover and context affect butterfly diversity and abundance. Currently, most butterfly research in the Northern Great Plains is restricted to monitoring surveys that do not account for imperfect detection. Our objective is to determine density or occupancy of grassland butterflies throughout the Northern Great Plains to assist future research. We used line-transect distance sampling (LT) and visual encounter surveys (VES), methods that account for imperfect detection, three times in June and July to find densities for common species and occupancy for rarer species at 20 sites. Additionally, we collected plant community and structure data, flowering forb density, and weather conditions to better predict detection rates. After one season, we detected 20 species of butterflies. We observed common species like cabbage whites and clouded sulphurs throughout the season, while we only detected skippers

(*Hesperiidae*) early in the season and greater fritillaries (*Heliconiinae)* later in the season. We doubled the number of detections and observed twice as many species with the VES compared to the LT. Overall, we did not detect any different grassland-dependent species in one search method compared to the other. We will present detection rates and density for some common species and occupancy for some rare species. As conservation efforts increase, more background knowledge can aid and improve research objectives and design, leading to a greater understanding of grassland butterfly ecology and management strategies in the Northern Great Plains.

80.

EFFECTIVENESS OF ASH JUNIPER CLEARING FOR MONTEZUMA QUAIL HABITAT IN THE EDWARDS PLATEAU.

Zachary J. Pearson*[1], Eric D. Grahmann[1], Fidel Hernandez[1], Robert Perez[2], Leonard A. Brennan[3], Humberto L. Perotto-Baldivieso[3]

[1]Caesar Kleberg Wildlife Research Institute, Kingsville, TX, [2]TPWD, Austin, TX, [3]Texas A&M University - Kingsville, Kingsville, TX

Montezuma quail (*Cyrtonyx montezumae*) habitat in the Edwards Plateau has been reduced by over-grazing, brush encroachment and fire suppression over the last century. Properties where extensive ash juniper (*Juniperus ashei*) stands have been cleared and excess livestock have been removed have experienced recolonization of Montezuma quail, presumably because herbaceous plant communities have once again become suitable for use by these quail. Our study objective is to document the herbaceous vegetation response to ash juniper clearing for Montezuma quail. In 2015, we initiated a 2 year study to quantitatively identify habitat suitability bounds of Montezuma quail habitat in the Edwards Plateau. Sixty points were stratified across 9 ranches with Montezuma quail, where call-back surveys were implemented and vegetation was sampled. In addition, 60 vegetation transects were randomly established on 2 separate ranches where juniper was cleared 1, 3, and 5 years prior. Important vegetation variables such as percent bareground, herbaceous cover and height, and food plant and bunchgrass density are being measured. These vegetiation data are being compared between these cleared sites and call-back sites were Montezuma quail have been detected. Data analyses are currently ongoing. We will present preliminary information from this study.

81.

THE EFFECTS OF GRAZING MANAGEMENT PRACTICES ON BUTTERFLY AND BEE COMMUNITY COMPOSITION.

Cayla R. Bendel*, Torre J. Hovick, Ryan F. Limb, Jason P. Harmon

North Dakota State University, Fargo, ND

Grazing occurs on about 6 million acres of rangelands in the United States, but current grazing management practices aimed at limiting rangeland degradation promote uniform utilization. This is potentially harmful to pollinator populations because the landscape lacks the diverse floral resources

they rely on. With recent pollinator declines worldwide, it is important to understand how these grazing practices affect native bee and butterfly populations. We evaluated bee and butterfly abundance and diversity in the Sheyenne National Grasslands in eastern North Dakota in response to four different grazing management practices. We observed 727 butterflies from 25 different species and recorded 422 bee-flower interactions amongst 33 different flower species in 2015. Bee and butterfly diversity and abundance were similar across all grazing treatments. We attribute our initial results to the lack of contrast among vegetation structure and composition across treatments driven by an unusually wet spring, and the first of three years of treatment application. We expect contrast between treatments to increase over time and have a greater influence on bee and butterfly communities. Future results from our study will be useful in guiding rangeland management practices that promote pollinator populations and the ecological services they provide.

82.

MEASURING NORTHERN BOBWHITE RESPONSE TO POST-GRAZING HABITAT RECOVERY.

Rachel A. Smith*[1], Leonard A. Brennan[1], Fidel Hernandez[2], Humberto L. Perotto-Baldivieso[1], Andrea Bruno[1], Ross O. Couvillon[1], Fred C. Bryant[1]

[1]Texas A&M University - Kingsville, Kingsville, TX, [2]Caesar Kleberg Wildlife Research Institute, Kingsville, TX

Northern bobwhite (*Colinus virginianus*) require habitat structure with substantial grass cover for nesting, predator avoidance, and thermal refuge. During the past 2 decades, many land managers have reduced or completely eliminated livestock across South Texas rangelands with the goal of improving bobwhite habitat. How bobwhites respond to post-grazing habitat recovery is unknown. Our objective is to investigate how bobwhites respond to the vegetative changes following removal of grazing. Our study is being conducted on a private ranch in Jim Hogg County, Texas and involves 2 different categories of post-grazing recovery: 1 area at 15 years post-grazing at high intensity and habitat restoration, and 1 area of 2-3 years post-grazing at high intensity only. Bobwhites were trapped, radio-collared, and located from April to September 2015 on the 2 experimental units.   In 2015, there were 66 birds (27 females, 39 males) trapped on the 15 years post-grazing and restored site and 53 birds (16 females, 36 males) on the recently grazed site. Apparent nest success on the 15 years post-grazing area was 62% compared to 58% on the recently grazed area. We are also studying the vegetation structure preferred by bobwhites around nesting sites. Our findings will inform managers about bobwhite preferences in post-grazing landscapes and potentially provide ideas for future restoration or strategies.

83.

EFFECTS OF THERMAL ENVIRONMENT ON THE GROWTH AND HEALTH OF WHITE-TAILED DEER (ODOCOILEUS VIRGINIANUS) DURING SUMMER.

Nicole Alonso*[1], David Hewitt[1], Clayton Hilton[1], Randall DeYoung[1], Perry Barboza[2]

[1]Caesar Kleberg Wildlife Research Institute, Kingsville, TX, [2]University of Alaska Fairbanks, Fairbanks, AK

White-tailed deer (*Odocoileus virginianus*) like all mammals, must maintain body temperature. High summer temperatures in South Texas negatively influence the growth of deer, but the magnitude of those effects is largely unknown. The goal of this study is to quantify the effects of metabolic heat on growth rate and health of fawns. I hypothesize the individuals with access to the cooled areas will be able to dissipate digestive and metabolic heat more readily and therefore have higher intake rates, leading to higher growth rates and better health. This study will determine the effect of summer temperatures on growth and food consumption of fawn and yearling deer. To observe the impacts of summer heat, I will randomly assign fawns to either an ambient temperature treatment or a treatment in which they can access a cooler environment. I will record food intake, growth rate, behavior, and indices of health. The control group will be held in four 4.5- X 9.3-m pens in ambient temperature while the test group will be held in similar pens that have an area cooled by air conditioners. I will use video cameras to record the time and duration of feeding by each individual. Preliminary results indicate that there is no significant difference between the consumption or growth rate of individuals, however data are still being collected and analyzed.

84.

INFLUENCE OF GRAZING ON ABUNDANCE AND DIVERSITY OF GRASSLAND BIRDS IN THE NORTHERN TALLGRASS PRAIRIE.

Sabine M. Naber*[1], Torre J. Hovick[2], Ryan F. Limb[2]

[1]North Dakota State University, Hawley, MN, [2]North Dakota State University, Fargo, ND

Rangelands cover more than 60 % of the land surface of the United States and have the potential to support diverse native communities that sustain many ecological services. Therefore, understanding how management practices influence grassland biodiversity is of value to land managers and society as a whole. To address this, we compared patch-burn grazing, a management practice focused on restoring heterogeneity to rangelands, to grazing regimes commonly practiced in the northern tallgrass prairie region. We sought to determine grassland bird abundance and diversity across grazing regimes and to relate vegetation heterogeneity across space and time to bird communities. Our study sites were located within the Albert Ekre Grassland Preserve and the Sheyenne National Grasslands in southeastern North Dakota. Grazing treatments were 1) Rotational, 2) Rotational with summer mowing, 3) Season-long, and 4) Patch-burn grazing. We recorded 42 bird species, 11 of which were grassland obligates. The most commonly detected grassland-obligate species were bobolink, grasshopper sparrow, savannah sparrow, and western meadowlark. Detections of obligate grassland birds were similar in three of the treatments, but lower in the rotational treatment. Obligate diversity was lowest in the season-long treatment. Because this is the first year of our study, our results should be viewed as preliminary. We expect greater differences between treatments to emerge as plant community structure becomes more contrasting over time. Additionally, precipitation in the month of May was a record high for this region, likely limiting differences across treatments that would exist under conditions closer to the long-term average.

85.

ROOST-SITE SELECTION OF NORTHERN BOBWHITES IN THE EDWARDS PLATEAU.

Joshua D. Pearson*[1], Fidel Hernández[2], Eric D. Grahmann[1], Fidel Hernández[2], Timothy E. Fulbright[2], Chad A. Markert[3]

[1]Caesar Kleberg Wildlife Research Institute, Kingsville, TX, [2]Texas A&M University-Kingsville, Kingsville, TX, [3]Dietert Ranch, Mountain Home, TX

The roosting habits and ecology of Northern Bobwhite (*Colinus virginianus*) are not well documented. Previous researchers have reported that bobwhites roost in open grassland with herbaceous vegetation heights ranging from 30–90 cm. However, information from a pilot study on bobwhites conducted in the Edwards Plateau ecoregion of Texas revealed that the configuration of their roost sites may differ substantially from prior findings. As a result, we initiated a study in 2015 to quantify roost-site selection of bobwhites in the Edwards Plateau. Bobwhites were radio-marked and located an hour after dark once per week to locate roost sites during Januaryâ€'August. We sampled vegetation the following day at the roost site and at a paired random site. Unlike bobwhites in other portions of their range, >90% of bobwhite roost sites (*n* =70) were located in low growing woody cover instead of grassland. We are currently analyzing these data to develop resource-selection functions to determine preference-avoidance of vegetative attributes. Understanding roosting habits and ecology will aid in making important decisions regarding habitat management and restoration.

86.

COMPARISON OF WINTER HABITAT USE OF PRAIRIE GROUSE IN THE NEBRASKA SANDHILLS.

Julia P. Johnson*, Larkin Powell, Walter Schacht

University of Nebraska-Lincoln, Lincoln, NE

Greater prairie-chickens (*Tympanuchus cupido pinnata*) and sharp-tailed grouse (*Tympanuchus phasianellus*) are important game species throughout much of the Great Plains, and both are used as indicator species of grassland health. Both prairie grouse species coexist in the Sandhills of Nebraska, but little is known about their habitat use or movements in the winter. Our objective is to evaluate the effects of ecological sites within rangeland and irrigated crop fields on winter movements of sharp-tailed grouse and greater prairie-chickens in the Sandhills. In order to provide a range of different land uses and proximity to crop fields, we selected two study areas to trap and tag birds: Samuel R. McKelvie National Forest and Valentine National Wildlife Refuge. We trapped and attached radio-collars to 22 female sharp-tailed grouse, 6 male sharp-tailed grouse, and 5 female greater prairie-chickens on 10 leks from March to April 2015. Sixteen of the 33 birds survived until August 2015: 10 sharp-tailed grouse hens, 3 greater prairie chicken hens, and 3 male sharp-tailed grouse. We will use aerial telemetry to obtain locations every two weeks from October through February. We will quantify movement distances, and will use GIS layers of habitat use and land cover to conduct an analysis of resource selection to assess which macrohabitat variables influence habitat selection of prairie grouse in the winter. Our research will provide information to assist with predictions of grouse population trends under various scenarios of landscape use for grazing or row-crop agriculture.

87.

STATUS OF CYMOPTERUS WILLIAMSII (WILLIAMS' SPRINGPARSLEY), NORTH-CENTRAL WYOMING.

Joy Handley*

University of Wyoming, Laramie, WY

Cymopterus williamsii (Williams' springparsley) is a Bureau of Land Management (BLM) Sensitive Species, endemic to the southern Big Horn Mountains in north-central Wyoming. Surveys were conducted on BLM Worland Field Office administered lands in 2015 to address the lack of surveys on the west side of the Big Horn Mountains (in contrast with several surveys on the east side) and update species status information. The 2015 surveys resulted in the discovery of three new populations, slightly expanding the known range to the southwest, as well as providing more precise mapping of three populations previously located only to the square mile sections described on specimen labels. Data from the new surveys will be used to develop an updated potential distribution model and revise the current understanding of this rare species.

88.

DIGGING DEEPER: ANALYZING ROOT TRAITS TO CHARACTERIZE JUNIPER EXPANSION INTO RANGELANDS.

Kelly A. Chesus*[1], Troy W. Ocheltree[1], Louise Comas[2]

[1]Colorado State University, Fort Collins, CO, [2]USDA-ARS, Fort Collins, CO

Juniper expansion into sagebrush communities is a widespread phenomenon occurring across large regions of the western U.S. over the past century. The primary concerns of juniper encroachment are the decrease in forage for wildlife and livestock and potential changes in water quantity. Management of this phenomenon has therefore focused on the removal and reduction of juniper trees from areas of active encroachment. Fire suppression and increased grazing activity are commonly considered as the primary drivers of juniper expansion but they do not explain all instances of expansion. In order to develop a complete explanation for the success of juniper we investigated the competitive abilities of juniper and sagebrush based on root traits. Given the water-limited systems that juniper and sagebrush commonly inhabit, analyzing the spatial pattern of water-use between these species may provide a better understanding of juniper encroachment at the ecosystem level. Because encroachment relies upon the successful establishment and survival of juniper seedlings to maturity, we designed our study to include measurements from different age classes (seedling, saplings, and adults). Five randomly selected pairs of juniper and a neighboring sage were selected for each age class. To assess their ability to access water we collected 3 soil cores from each pair to quantify depth-resolved differences in root traits. We also extracted stem and soil water from these pairs in June – August for water isotope analysis to quantify the vertical profile of soil water uptake. We will discuss species differences in specific root length, number of root tips, and isotopic signatures and their implications for the juniper encroachment phenomenon.

89.

COMPARATIVE BIOMASS PRODUCTION OF NATIVE AND NON-NATIVE GRASSES USED IN SOUTH TEXAS RANGE SEEDING.

Thomas M. Murr*[1], Keith A. Pawelek[2], Anthony D. Falk[2], Forrest S. Smith[1]

[1]Caesar Kleberg Wildlife Research Institute, Kingsville, TX, [2]South Texas Natives, Kingsville, TX

Biomass production is often an important factor land mangers take into consideration when selecting grasses to use for rangeland restoration where livestock forage production is the primary land management goal. Non-native species such as Kleberg bluestem and Buffelgrass are generally thought to have higher biomass production than native grasses, but native species are widely regarded as a superior option for wildlife habitat. However, little information is available on the biomass production of many native grasses that are available for range seeding in South Texas. We compared biomass production of native grass germplasm seed releases with the common non-native grasses used in range seeding in southern Texas. We collected plants of native and non-native grasses at peak standing crop from the South Texas Natives Farm in Kingsville, TX. For each we sampled five randomly selected plants from established stands, clipped each to ground level, and placed collected material into a drying room until completely dried. We will present biomass production potential of each species, and comparative data on biomass production of native and non-native grasses to inform managers in selection of grasses for range seeding in South Texas.

90.

CHLOROPHYLL CONCENTRATION INDEX, LEAF AREA AND BIOMASS PRODUCTION OF SIDEOATS GRAMA [BOUTELOUA CURTIPENDULA (MICH.) TORR.] GENOTYPES.

Alan Alvarez*[1], Carlos R. Morales[2], Obed G. Gutiérrez[1], Raúl Corrales-Lerma[3], Federico Villarreal-Guerrero[3]

[1]Universidad Autónoma de Chihuahua, Chihuahua, Mexico, [2]Universidad Autónoma de Chihauhua, Chihuahua, Mexico, [3]Universidad Autónoma de Chihauhua, Chihuahua, Mexico

The chlorophyll concentration is an indicator of the sunlight and nutrients assimilator system efficiency. Thus, it can be used to estimate a plant forage potential. Nowadays, there are portable devices to estimate differences on chlorophyll concentration between genotypes of the same species easily. The aim of this study was to evaluate the correlation between the chlorophyll concentration index (CCI) and the biomass production (BP) and the leaf area (LA) of the following sideoats grama grass genotypes: Vaughn, Niner, El Reno, E-689 and E-592. Measurements of CCI, BP and LA were performed weekly during 77 days on five samples from each genotype at each measurement event. Data were analyzed through the GLM and PROC CORR procedures of the statics program SAS. There were differences on LA ($P<0.01$), BP ($P<0.05$) and CCI ($P<0.001$), where the genotype E-689 presented the highest values. BP and LA were correlated whit CCI (R=0.65 and 0.82, respectively). The coefficient of determination (R^2) ranged from 0.64 to 0.96 on PB and CCI, while for LA and CCI R^2 ranged from 0.70 to 0.97. Based on the results of BP, LA and CCI, it is inferred that the genotype E-689 has the highest forage and quality potential. The differences found for BP and LA appear to be determined by CCI. Given that, the CCI could

be considered in future studies to select sideoats grama grass genotypes with a high forage and quality potential.

91.

IMPACT OF WATER SUPPLEMENTATION ON ROUGH FESCUE SEED AND BIOMASS YIELDS.

Michael P. Schellenberg*[1], Isabelle Piche[2]

[1]Semiarid Prairie Agricultural Research Centre - Agriculture and Agri-Food Canada, Swift Current, SK, [2]Semiarid Prairie Agricultural Research Centre - Agriculture and Agri-Foof Canada, Swift Current, SK

Recent literature has identified a correlation between fall moisture and seed production in a key grass species, plains rough fescue (*Festuca hallii*), of the Northern Great Plains. A field experiment was established at the Semiarid Prairie Agricultural Research Centre, Swift Current, Saskatchewan, Canada to examine this possible correlation. The results (biomass and seed yield) reported here are from 2014, first year of the study of 10 populations of 2 year old plants that were irrigated and not. The populations originate from across the Canadian Prairies. Populations responded quite differently, from no difference to some preferring no irrigation to others responding to irrigation, although not statistically significant ($\alpha=0.05$). The differences were more striking for seed yield compared to biomass yield. These results are only a single year's results and need additional years to verify if there is an actual difference. But this initial dataset does indicate varying response to environmental conditions possibly as an indicator of originating site adaptation. Thus further complicating development of general agronomic practices for improved seed and biomass yield improvement for this species.

92.

USE OF DRONES FOR AGRICULTURAL REMOTE SENSING.

Darren Bruhjell*[1], Tony Cowen[2], Denis Belisle[2]

[1]Agriculture and Agri-Food Canada, Beaumont, AB, [2]Agriculture and Agri-Food Canada, Edmonton, AB

What is a UAV? A UAV is an unmanned aerial vehicle , commonly known as a drone. It is also referred to as a remotely piloted aircraft (RPA) by the International Civil Aviation Organization (ICAO), an aircraft without a human pilot aboard. What Can They Do? UAVs are used in agriculture primarily for aerial photography. However, the type of payload (camera or sensor) can vary depending on the specific application. Sensor types include Visual, Multispectral, Thermal, Lidar, and Hyperspectral (see far right for descriptions). Sensor Descriptions and Typical Agricultural Applications: Visual (High resolution camera: For aerial mapping and imaging); Multispectral (Multiple spectral bands: For plant health measurement (NDVI)); Thermal (Thermal Infrared (TIR) Sensor: For heat signature detection (ie livestock)); Lidar (Short range LASER rangefinder: For 3D digital surface modeling (topography)); Hyperspectral (Full spectral sensing: For small UAV applications (NDVI, water quality assessment)). Potential Considerations: Although prices are constantly decreasing, UAV purchase can be costly ($10k+); Transport Canada regulation compliance; Required operator training; Site limitations

93.

GREENSEEKER NDVI &NDASH; A TOOL FOR PASTURE HEALTH ASSESSMENT.

Darren Bruhjell*[1], Denis Belisle[2], Tony Cowen[2]

[1]Agriculture and Agri-Food Canada, Beaumont, AB, [2]Agriculture and Agri-Food Canada, Edmonton, AB

What is NDVI? Normalized Difference Vegetation Index, or NDVI, is a color-coded representation of relative crop health in a field. How It Works: The GreenSeeker system creates NDVI data using optical sensors to measure and quantify crop health—or vigor. The sensor emits brief bursts of red and infrared light, and measures the amount and type of light that is reflected back from the plant. The strength of the detected light is a direct indicator of the health of the crop; the higher the reading, the healthier the plant. The quad-mounted sensor scan setting along with the spacing of quad passes creates about a 2.5 meter grid across the field. That is a lot of sample points and should be very representative of the area, picking up most variability. The sensor can be mounted on farm implements, ATV, or even carried by hand for more precision on smaller areas. Potential Uses of NDVI Data: Yield Estimation, Determine level of Chlorophyll, Plant health and stress level, Optimal fertilizer use, Nitrogen Management, Identify insects and pest in crop, Analyze plant disease, Plant or weed identification, Cultivation planning, Harvest planning according to vigor

94.

SEVENTY-SEVEN YEARS OF WOODY PLANT COVER CHANGE ON A WATERSHED-SCALE IN THE LIMESTONE CUT PLAINS, TEXAS.

Edward C. Rhodes*, Jay P. Angerer, William E. Fox, Jason McAlister

Texas A&M AgriLife Research, Temple, TX

Woody plant encroachment into the grassland ecosystems of North America has been a long-documented phenomenon of ecological and economical significance. Due to anthropogenic manipulation, simply monitoring percent woody cover over time does not fully show the dynamics of woody cover growth and decline. Woody plant removal on one property may be offset by encroachment on another. In this study, we spatially analyzed aerial imagery over a 77-year period in five watersheds located in the Limestone Cut Plains ecoregion of central Texas. Common woody species include deciduous oak, live oak, juniper, mesquite, and elm species. Imagery was collected for 1937/40, 1958, 1974/75, 1980/82, 1995, 2004, 2008, 2010, 2012, and 2014. Using the ENVI GIS system, all imagery was classified into shrub and non-shrub categories using an object-based classification model. Classified imagery was then used to calculate the total woody cover, woody cover growth and loss from one temporal period to the next, and total attrition of the 1937 woody plant cover. Four watersheds experienced a drastic decrease in woody cover from 1937 to 1958. Over the next 56 years, each watershed had varying amounts of shrub cover increase and decline, with the exception of one watershed having relatively equal amounts of addition and loss for each time period. However, only two of the watersheds had a total net increase of woody cover over from 1937 to 2014. Attrition of the

1937 woody cover was quite substantive for the entire dataset. Less than 10% of the 1937 woody cover remained. Even in periods of increasing woody plant cover, attrition of the 1937 cover was occurring. Our analysis underscores the importance of accounting for human dimensions in evaluating woody plant encroachment and changes in woody plant cover over time.

95.

SPATIAL BEHAVIOR OF THE MEAN ANNUAL TEMPERATURE OF CHIHUAHUA BY THREE INTERPOLATION METHODS.

Maria C. Morales*[1], Jesús A. Prieto-Amparan[2], Federico Villarreal-Guerrero[1], Alfredo Pinedo-Alvarez[2], Carmelo Pinedo-Alvarez[2]

[1]Universidad Autónoma de Chihuahua, Chihuahua, Mexico, [2]Universidad Autonoma de Chihuahua, Chihuahua, Mexico

Grasslands support a wide variety of species and provide environmental services such as water capture, atmospheric carbon sequestration, soil maintenance, among others. The effects of the global environmental change on grassland regions may jeopardize the benefits provided by these ecosystems. The weather monitoring throughout the grassland regions of the Mexican state of Chihuahua is recorded by a group of weather stations; however, their non-homogeneous distribution represents a limitation for the climate analysis. The aim of this study was to assess and compare the precision of three interpolation methods on the estimation of the spatial behavior of the mean annual temperature for the state of Chihuahua. Data from 57 weather stations located in the state were used and analyzed in a Geographic Information System. Data from 90% of the stations were used for the estimation of the interpolated temperature while the rest of them were utilized for validation. The interpolation techniques used consisted of two deterministic (IDW and Spline- Radial Base) and one geostatistic (Kriging) techniques. Results from the root mean square error (RMSE), the estimated effectiveness of prediction (E), and the coefficient of determination (R2) showed that the highest precision was reached by the IDW method with values of 0.885, 1.49 and 85.0, respectively. The Kriging method reached values of 0.79, 2.2 and 67.36 and the Spline method reached values of 0.86, 1.93 and 74.95 for R2, RMSE and E, respectively. The study showed the advantages of the IDW method as a tool in the analysis of the spatial behavior of the mean annual temperature in the state of Chihuahua, especially in large areas of grassland in the state where the coverage of weather stations is poor. It was also observed that the precision of the Kriging method gets compromised when the density of weather stations is low.

96.

RANGELAND MONITORING USING REMOTE SENSING: COMPARING FIELD-BASED SAMPLING AND IMAGE ANALYSIS TECHNIQUES.

Ammon Boswell[1], Steven L. Petersen*[2], Bruce A. Roundy[2], Ryan R. Jensen[2]

[1]NRCS, Montecello, UT, [2]Brigham Young University, Provo, UT

Managers benefit from improved monitoring techniques that provide rapid, accurate, cost effective and robust measures of rangeland health and ecological trend. Remote sensing can be an effective tool for assessing rangelands efficiently and accurately. The purpose of this study is to evaluate and compare vegetation and bare-ground cover between high-resolution remotely sensed images with data collected from the field using common sampling practices. In 2011, high resolution (5cm) color and color-infrared images were taken of plots located throughout central and northern Utah using a UltraCam X (UCX) camera. Simultaneous to the aerial flights, field data (vegetation, rock and bare-ground cover) was collected by the Utah DWR Range Trend Program. Remotely sensed images were classified using a supervised classification in ERDAS Imagine software to generate vegetation classes and surface cover values. The reliability of these classifications were assessed using an Accuracy Assessment coupled with a generated Kappa Statistic value. Results indicate that total classification accuracy was 91% with a Kappa of 0.88. Total shrub cover measured using remote sensing was only 1% different than field based samples. Herbaceous vegetation differed by 5.6%. Differences in surface cover (rock, bare-grouse) between both methods was higher (26.8%). Remote sensing can be used by managers effectively quantify, monitor, and evaluate rangelands across temporal and spatial gradients.

97.

MAPPING SRUCTURAL DIVERSITY OF TREES IN THE SOUTHWEST JEMEZ MOUNTAINS (NEW MEXICO) USING LANDSAT 8 DATA.

Kamal Humagain*[1], Carlos Portillo[1], Robert Cox[1], James W. Cain III[2]

[1]Texas Tech University, Lubbock, TX, [2]New Mexico State University, Las Cruces, NM

Tree density has been increasing due to the exclusion of fires over years in the American Southwest and ecological restoration treatments are aimed to reduce such increasing fuel for extreme fire events and to increase understory biodiversity. This study provides an overview of remote sensing techniques to estimate tree density in the Collaborative Forest Landscape Restoration Project (CFLRP) area of Jemez Mountains, New Mexico. We used reflectance values from individual Landsat 8 bands (bands 4, 5, 6, and 7) and vegetation indices (NDVI- Normalized Difference Vegetation Index, DVI- Difference Vegetation Index, SR- Simple Ratio, and ND57- Normalized Difference bands 5 and 7) to estimate the density of trees. Models including multiple predictor variables derived from remote sensing data performed best (R^2 = 0.46 – 0.95) for each vegetation types rather than using a single model for the entire project area. The area dominated by non-conifer tree species (aspen) showed the highest value of R^2. The combined tree density map shows most of the grasslands without trees and recent wildfire areas with less (1-100 trees/hectare) to no trees. About 50% of the study area is distributed with medium density of trees (101-1000 trees/hectare). A small fraction of the areas covered by spruce-fir, pinyon-juniper, and ponderosa pine is distributed with high density of trees (>1000 trees/hectare). Test of accuracy of the models shows 77% of estimated density values are in the same density classes as the observed values and demonstrates the effective use of reflectance values from satellite images while predicting tree density in the areas dominated by coniferous forest and complex topography. Project managers could use this baseline info to identify the areas in need of restoration treatments.

98.

A TWENTY-FIRST CENTURY TOOLSET: REMOTE SENSING AND GIS FOR RANGELAND DROUGHT MONITORING.

Ryan M. Shofner, Jack Alexander*, Sara A. Shofner

Synergy Resource Solutions, Inc., Belgrade, MT

Drought is one of the most costly impacts on rangelands, both monetarily and environmentally. Effective detection and monitoring can help mitigate negative impacts of drought. The USGS VegDRI drought monitor, which uses remote sensing data combined with other weather and climate information to determine drought conditions weekly, is processed using ESRI ArcGIS and Python to translate the dataset to a more useful product for land managers. The process reduces the geographic extent to an area of interest, such as a ranch. The overall drought condition of the area of interest is then calculated using a weighted method. The drought score is standardized and matches the scoring of VegDRI, which facilitates communication between agencies, landowners, and managers, and can assist in drought mitigation and management decisions.

99.

MAPPING THE SPATIAL DISTRIBUTION OF TANGLEHEAD (HETEROPOGON CONTORTUS) ON SOUTH TEXAS RANGELANDS.

Jose M. Mata*[1], Humberto L. Perotto-Baldivieso[2], Fidel Hernandez[3], Eric D. Grahmann[3], Sandra Rideout-Hanzak[3]

[1]Texas A&M University- Kingsville, kyle, TX, [2]Texas A&M University - Kingsville, Kingsville, TX, [3]Caesar Kleberg Wildlife Research Institute, Kingsville, TX

Tanglehead (*Heteropogon contortus* [(L.) P. Beauv. ex Roem & Schult]) is a native grass in southwestern US rangelands; however, its prevalence as an invasive on South Texas rangelands has grown. In the last decade, large areas of tanglehead monocultures have emerged, simplifying native vegetative communities in Jim Hogg, Brooks and Kleberg counties. The dominance of this species in sandy soils is a cause for concern for many ranchers as it may have negative impacts on wildlife resources. Unfortunately, little is known regarding the spatial extent of this invasion and its impact. The goal of this project is to determine the extent and spatial distribution of tanglehead in critical areas of South Texas. To address this goal, specific tanglehead dominated areas have been identified using high-resolution aerial photography, field verification, ranch information, and data collected from previous research. This information is being cross-referenced with recent aerial photography and satellite imagery to develop a spectral signature exclusive to tanglehead in order to classify and generate maps of tanglehead at local and county scales. Historical aerial photography and satellite imagery (2004-2014) will be used to assess the spatial and temporal distribution of tanglehead and quantify its rate of increase over the last decade. Landscape metrics that describe the spatial structure and distribution of tanglehead will be used to assess its expansion in the last decade across the study area.

100.

LAND USE AND LAND CHANGE GRASSLAND AREAS IN CHIHUAHUA, MEXICO.

Carmelo Pinedo-Alvarez*, Alfredo Pinedo-Alvarez, Marusia Renteria-Villalobos

Universidad Autonoma de Chihuahua, Chihuahua, Mexico

Land-change and land-use (LCLU) changes and the urban growth were quantified during a period of 25 years in Chihuahua City and its surroundings. Four scenes of Landsat 5 and 8 satellite from the years 1989, 1999, 2009, and 2014 were used. The LCLU was predicted using the methodologies of Markov chains and cellular automata. The following seven classes of LCLU were identified: crop land, urban land, shrub land, grassland, forest land, water bodies, and riparian vegetation. The KAPPA index was used to evaluate the accuracy of the LCLU classification. The shrub land area decreased from 55% in 1989 to 48% in 2014. Likewise, the grassland area showed reductions from 23% to 16% during the period 2009-2014. Conversely, urban land increased its area in about 15% from 1989 to 2014. Results from predicted scenarios show that for 2019 and 2024 areas currently occupied grassland and shrubland may be replaced by urban land cover. The data from this study can be extrapolated to other areas where urban land will increase its area on the surrounding natural ecosystems.

101.

HEADCUT EROSION IN WYOMING&RSQUO;S SWEETWATER SUBBASIN.

Samuel E. Cox[1], D. Terrance Booth*[2], John C. Likins[3]

[1]USDI-BLM, Cheyenne, WY, [2]USDA-ARS (Retired), Cheyenne, WY, [3]USDI-BLM (Retired), Lander, WY

A warming climate and chronically-diminished snowpacks are straining water resources in the western United States. Properly functioning riparian systems slow runoff, store water, regulate extreme flows, and in the case of losing streams they recharge aquifers; however, riparian areas across the west are degraded with a majority of BLM-managed riparian systems not in proper functioning condition. Widespread catastrophic erosion of water-storing peat and organic soils has destroyed many kilometers of linear water-storage capacity leaving gravel-bottom ditches that speed watershed outflow causing flooding in areas downstream. Headcuts are the leading edge of catastrophic channel erosion. We used aerial imagery (1.4 to 2.6-cm pixel) to locate 163 headcuts in riparian areas in the Sweetwater subbasin of central Wyoming. Structure-from-Motion models, built from ground-acquired imagery, were used to model soil loss equivalent to 425-720 cubic meters from 19 headcuts. Normalized by channel length, this represents a loss of 1.1-1.8 cubic meters per meter of channel. These Structure-from-Motion models provide baseline position/elevation for trend monitoring. Monitoring from ground or aerial imagery provides an objective, permanent indicator of sustainable riparian land management and identifies priority disturbance-mitigation areas. Image-based headcut monitoring must use data on the order of 2.6-cm GSD, or greater resolution, to effectively capture the information needed for accurate assessments of riparian conditions.

102.

SAN FRANCISCO GOLD MINE IN CENTRAL SONORA MEXICO IS TRAINING SOCIETY FOR RANGE RESOURCES CONSERVATION.

Salomon Moreno*[1], Teodoro Ramos[1], Martha H. Martin[1], Fernando A. Ibarra-Flores[2], Rafael Retes[2]

[1]University of Sonora, Santa Ana, Mexico, [2]University of Sonora, Hermosillo, Mexico

Gold mining is an important activity for rural workers in Northwestern Sonora, Mexico. Mining is among the ten vocations with the greatest number of employees and highest incomes, but no there are no data indicating what workers think about mining activity in the region. This study was conducted during 2014 in Estacion Llano Sonora, Mexico, a town near the San Francisco Mine (a socially responsible company), to understand what employees think about mining and their impact on society and natural resources. Three hundred workers were randomly selected from the official list of employees to be surveyed. The study was set so the number of surveys would yield a 95% confidence (P<0.05). Fifty five percent of the workers are 31 to 50 years old and 68% agree that the mine is the main source of income in their households. The average income varies from 4,000 to 12,000 pesos a month. Monthly income from other duties was 2,000 to 3,200 pesos. All survey participants agree witht the utilization of natural resources; 26% water, 17% soils, 17% plants, 14% animals, 14% wood and charcoal and 12% seeds and fruits. Eighty percent of the workers affiremed that they have received some type of training from the mine. Seventy percent recognize that the company has invested money and efforts to train family members in range management courses to protect the land, to sow trees and to learn about water harvesting and conservation along with seed harvesting for range improvement practices and teaching grazing strategies for cattle. Resutls of the survey suggest that San Francisco Mine is concerned about training local people to take care of vegetation, soil, and apply good natural resources conservation practices.

103.

INFLUENCES OF LIVESTOCK GRAZING MANAGEMENT AND WILD HORSE USE ON MEADOW FUNCTION IN SAGE-GROUSE HABITAT.

Sara L. McBee*[1], Sabrina M. McCue[1], Sherman R. Swanson[2], Brad Schultz[3], Kent McAdoo[4]

[1]University of Nevada, Reno, Reno, NV, [2]College of Agriculture, Biotechnology, and Natural Resources, University of Nevada, Reno, Reno, NV, [3]Humboldt County Extension Educator, Winnemucca, NV, [4]University of Nevada Cooperative Extension, Elko, NV

An assessment of how wild "feral" horse use and livestock grazing management strategies influence meadow function is critical for understanding late brood-rearing habitat suitability for the greater sage-grouse in herd management areas (HMAs) and horse territories (HTs) that are managed for livestock grazing. Suitablility indicators for sage-grouse late brood-rearing mesic/riparian habitat include: proximity to sagebrush cover, availability of preferred forbs, and site stability [proper functioning condition (PFC)]. Due to the prevailing arid climate within the Great Basin, late brood-rearing habitat, especially in riparian-wetland areas, is often limited. We randomly selected a meadow site in 30 randomly selected allotments that are managed for livestock grazing, within HMAs and HTs boundaries, and categorized as greater sage-grouse core management habitat (Coates et.al, 2014, update March

2015). In a five-year study we will sample for long-term and short-term indicators using vegetation, soil, and hydrologic sampling methods derived from Assessment, Inventory and Monitoring for Lentic Systems (Dickard et al. in preparation). Wildlife trail cameras will record animal use to understand the correlation between meadow functioning condition and grazing use variables (season, duration, and intensity). We hypothesize that without the full set of management strategies that addresses both wild horse and livestock use in riparian-wetland systems, proper functioning condition indicators for lentic systems will be significantly influenced by grazing use variables than when compared to environmental variables. Furthermore, livestock grazing season and duration use will have a greater significance in meadow proper functioning condition indicators for lentic systems than when compared to wild horse season and duration use. This research will help guide grazing management decisions for riparian-wetland systems where wild horses and cattle graze together so that managers can fulfill commitments to manage for PFC and for sage-grouse habitat.

104.

LIVESTOCK WATER QUALITY IN RESERVOIRS VARIES ACROSS 7 YEARS IN EASTERN MONTANA.

Mark K. Petersen*[1], Jennifer M. Muscha[2]

[1]USDA-ARS Fort Keogh LARRL, Miles City, MT, [2]USDA-ARS, Miles City, MT

Concentrated dissolved minerals in naturally occurring water accessible to livestock grazing semi-arid landscapes can negatively influence animal productivity and well being. Twelve indicators of water quality (Ca, Cl, F, Fe, Mg, Mn, Na, Nitrate-N, pH, SO_4, total dissolved solids (TDS) and temperature) were measured at 12 reservoirs accessed by livestock for water over 7 years from 2009 through 2015 at the 22,257 ha USDA-ARS Fort Keogh Livestock and Range Research Laboratory, Miles City, Montana to estimate variation. Samples were collected twice yearly in 2 seasons, May (wet) and September (dry). Year, season, and their interaction was analyzed as a 7×2 factorial arrangement of treatments. A year by season interaction ($P < 0.05$) was found for F, Fe, Mn, Nitrate-N, pH, and temperature. Concentrations of Na, SO_4, and TDS differed by year and by season ($P < 0.05$). Concentrations were higher in the dry season in years 2011, 2012, and 2015 for SO_4 and TDS and 2012 and 2015 for Na. Concentrations of Ca and Mg were different between years ($P < 0.05$). Concentrations were highest for Ca and Mg in 2011 and 2012. Chloride concentrations were not different between years and seasons. Higher and then lower precipitation in 2011 followed by below average precipitation in 2012 and below average precipitation in 2015 was associated with elevated mineral concentrations in the reservoirs. Average concentrations of Ca, Cl, Mg, nitrate-N, pH and TDS levels across sources did not exceed the upper maximum intake level for beef cattle. In contrast, concentrations of F, Fe, Mn, Na, and SO_4 exceeded upper levels for beef cattle, implicating these minerals may negatively impact range beef cattle performance.

105.

IMPACT OF WILD HORSES AND GRAZING UNGULATES ON RIPARIAN CONDITIONS IN IDAHO.

Molly M. Kaweck*, Karen L. Launchbaugh, Eva K. Strand

University of Idaho, Moscow, ID

Heavy grazing in riparian areas can lead to soil erosion, loss of bank stability, reduced infiltration, increased downstream siltation, reduced water quality, and drier, hotter habitat conditions. We investigated the impacts made by wild horses on riparian health, their interaction with other ungulates, including livestock and wildlife, and their activities when at water as compared to livestock and wildlife. Prior research on wild horses has failed to address the potential impact wild horses may have on riparian conditions, which is important in the development of grazing permits and management decisions. To assess the impact of wild horses, we adapted methods for monitoring riparian health. We measured changes in vegetation stubble height, woody browse use, stream bank alterations, and forage utilization. At two regions in Idaho, each with 4 riparian study sites, we documented presence of wild horses, livestock, and wildlife with 16 game cameras. By using game cameras and measuring vegetation we attributed change in riparian conditions to the animal species present. Many ungulates used our riparian study areas, including elk, pronghorn, mule deer, wild horses, cattle, as well as upland game birds, wolves, bears, mountain lions. Unexpectedly, human recreation influenced riparian conditions as well. It is clear that grazing ungulates affect riparian health. The potential impact of wild horses on riparian areas could compound known impacts from livestock. Thus, wild horses should be considered when determining management plans dealing with riparian health.

106.

SIERRA NEVADA MEADOW PLANT COMMUNITY DYNAMICS UNDER MODERN GRAZING MANAGEMENT STRATEGIES.

Kristin Oles*[1], Dave Weixelman[2], Leslie Roche[1], Kenneth W. Tate[1]

[1]University of California, Davis, Davis, CA, [2]U.S. Forest Service, Nevada City, CA

Sierra Nevada mountain meadows are important resources that provide numerous ecosystem services (e.g. water storage, species diversity, and flood mitigation), recreational opportunities, and summer livestock forage. However, livestock grazing has the potential to degrade sensitive riparian habitats and the numerous services they provide. The U.S. Forest Service implemented riparian use standards and guidelines for meadows grazed under public lands grazing permits in the 1990s to better manage livestock so that both production and ecological goals are balanced. At that time, the USFS established long-term plots to monitor the effects of the new standards on meadow plant communities. We have collaborated with the U.S. Forest Service to examine the long-term trends in plant communities in grazed Sierra Nevada mountain meadows under these new standards and guidelines. In addition to the long-term plant community monitoring data and USFS historical grazing records, we have collected meadow-level site-specific livestock utilization data in 57 meadow sites. We will use the plant community data, grazing records, and utilization data to determine whether grazing use best predicts long-term trends in meadow plant community. We expect that grazing use will not be the best predictor for plant community, but that it will be better explained by local factors like climate or site characteristics. This study will provide an evaluation of the U.S. Forest Service riparian standards and guidelines over a long time period and will inform future grazing management practices.

107.

RIPARIAN POST-FIRE RESPONSE: FACTORS INFLUENCING VEGETATION RECOVERY AND CHANNEL STABILITY.

Camie M. Dencker*[1], Sherman R. Swanson[2], Kent McAdoo[3]

[1]University of Nevada, Reno, Reno, NV, [2]College of Agriculture, Biotechnology, and Natural Resources, University of Nevada, Reno, Reno, NV, [3]University of Nevada Cooperative Extension, Elko, NV

The Bureau of Land Management (BLM) Emergency Stability and Rehabilitation Handbook suggests a rest from grazing following wildfire for two years or until objectives are met for the recovery of vegetation and key processes. It is important to understand and predict riparian response to fire since wildlife, humans, and livestock production all depend on riparian functions for food, habitat, recreation, and water. Long duration grazing restrictions cause economic hardships in rural Nevada communities that depend on public land livestock grazing, yet land managers must consider multiple uses and the functionality of riparian systems.   Little research focuses on post-fire riparian response and how recovery varies among stream types or in relation to condition, attributes, and drivers.   To quantify stream recovery, we use the protocol Multiple Indicator Monitoring (MIM) of Stream Channels and Streamside Vegetation (Burton et al. 2011). It is becoming a standard method for quantifying riparian objectives. We do so at 25 streams across Nevada BLM lands burned in 2012 fires. We focus on reaches of management concern (e.g., functional at-risk, threatened species habitat, or aspen stands). Long term MIM indicators include greenline plant composition (stability rating and wetland indicator value), woody species height class, streambank stability and cover, woody species age class, and greenline-to-greenline width. We evaluate the predictive ability among indicators, and investigate how streams vary in response among stream types, grazing history, position in the watershed, hydrogeomorphic interactions, prior condition and phases of the gully evolution cycle. The questions addressed by this study include: What are the most important predictors of post-fire stream vegetation and streambank stability? How does recovery vary in relation to pre-fire grazing, particularly season, duration, and rotation of use? What are the differences in response among vegetation types, stream types, and prior condition?

108.

ASSESSING WATER AND VEGETATION DYNAMICS IN A SEMI-ARID RIPARIAN CORRIDOR IN OREGON.

Alek Mendoza*, Carlos Ochoa, Jaycee Leonard, Julianne Robinson

OREGON STATE UNIVERSITY, Corvallis, OR

This project conducted in a semiarid watershed in north-central Oregon aims to improve understanding of land management decisions in vegetation and water features. The study site comprises a 1-km riparian corridor that has been under a Conservation Reserve Enhancement Program (CREP) where an approximate 10-m buffer along each side of the creek has been left out of production during the last several years. Over the years, the riparian corridor has been heavily encroached by red alder (*Alnus rubra*) trees and reed canary grass (*Phalaris arundinacea*) is the dominant understory species. A call for renewal of the CREP offered an opportunity to compare soil, vegetation, and water

quality conditions of land enrolled in CREP and grazed land. In the summer of 2014, we began data collection for determining baseline conditions. An intensive field data campaign to inventory overstory/understory vegetation was conducted in 2015. Soil sampling to characterize soil morphology and physical properties is underway. Piezometers equipped with water level loggers were installed at two selected locations, and multiple ambient and stream temperature sensors have been deployed along the creek. Also, water uptake by overstory riparian vegetation is being evaluated using data collected with sap flux sensors. Beginning in the spring of 2016, the riparian reach will be partitioned in half to allow for the re-introduction of cattle grazing in one half portion that will be expanded into a riparian pasture. Soil-plant-water quality conditions will be assessed right before and following periodic flash grazing prescriptions. Expected results from this study will enhance base knowledge regarding land management impacts on riparian structure and function.

109.

WILDLIFE HABITAT IMPROVEMENT USING RANGE IMPROVEMENT PRACTICES.

Charlie D. Clements[1], Daniel N. Harmon[1], Mark Weltz*[1], Jeff White[2]

[1]USDA, Reno, NV, [2]Newmont Mining, Elko, NV

Wildfires in the Intermountain West are and annual event. The introduction and subsequent invasion of cheatgrass (*Bromus tectorum*) onto millions of hectares of rangelands throughout the West has resulted in devastating wildfires. With each passing wildfire season more and more critical wildlife habitats are consumed and converted to annual grass dominance. Cheatgrass truncates secondary succession by out competing native perennial grass seedlings for limited moisture and providing a fine textured, early maturing fuel that has increased the frequency of wildfire from an estimated 60-110 years down to 5-10 years in many habitats. The best known method at suppressing cheatgrass, and its' associated fuels, is through the establishment of long-lived perennial grasses. Range improvement practices through mechanical and chemical applications can improve success rates of rangeland rehabilitation efforts, ultimately benefitting the many wildlife species that depend on these ever-changing habitats. Our research as yielded favorable results from disking cheatgrass in the spring, prior to seed development, and then fallowing the site through the summer and seeding completive/desirable species that fall. This approach resulted in a cheatgrass seed bank reduction of 73%, above-ground cheatgrass density reduction of 83% and a reduction of associated cheatgrass fuel by more than 300%. This mechanical cheatgrass control method resulted in a 975% increase in seeded species (28.8/m²) establishment. Chemical treatments using soil active herbicides like Landmark, *Sulfometuron Methyl*, have also resulted in significant cheatgrass density reductions, 98.7%, and Plateau, *Imazapic*, 95.6%. These chemical applications applied in the fall and fallowed for one-year along with proper seeding methodologies (fall seeding, seeding depths, selected species) have resulted in significant seeded species establishment which has resulted in a 930% reduction in cheatgrass fuels. This type of rangeland rehabilitation success is very beneficial to wildlife species, particularly mule deer (*Odocoileus hemionus*) and sage grouse (*Centrocercus urophasianus*).

110.

IMPACTS OF LIVESTOCK AND WILDLIFE HERBIVORY ON SEED BANK AND BUD BANK IN MIXED-GRASS PRAIRIE.

Lan Xu*[1], Patricia S. Johnson[2], John R. Hendrickson[3], Kevin K. Sedivec[4], Jameson R. Brennan[2], Mark A. Liebig[3]

[1]South Dakota State University, Brookings, SD, [2]South Dakota State University, Rapid City, SD, [3]USDA-ARS, Mandan, ND, [4]North Dakota State University, Fargo, ND

Vegetation recovery and resilience following disturbance is related to germinable seeds and regeneration from vegetative propagules. Ecological site can affect plant composition and intensity of disturbance can influence population persistence via plant functional traits. Impacts of livestock and prairie dogs on seed and bud banks were evaluated by sampling two ecological sites (Clayey vs. Loamy) for two years 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, grazing by cattle only and grazing by both herbivores (year 2). 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. The soil cores and seed flats were maintained in a greenhouse with ambient photoperiod during the 2014 and 2015 growing seasons. Plants were identified as they emerged, counted and then removed. Species richness, abundance, and viability of seed bank and bud bank were determined. Impact of livestock on seed and bud banks on on-town were evaluated in year 2. Both ecological sites have considerable potential for revegeation from the soil seed and bud banks. However species composition and abundance differed. More native than introduced, annual than perennial, and forbs than graminoids emerged from seeds in both ecological sites while more graminoids than forbs regenerated from vegetative propagules. Germinable seed bank species richness and seedling abundance were greatest for on-town samples compared to both off-town sites on Loamy ecological sites. Distance from burrow did not affect species richness or abundance for either ecological sites.

111.

LONG-TERM EFFECTS OF PREVIOUS MECHANICAL DISTURBANCE ON NATIVE PLANT AND SMALL MAMMAL COMMUNITIES IN THE SONORAN DESERT.

Felix Ayala-A.*[1], Reyna A. Castillo-G.[2], Alejandro E. Castellanos-V.[2], Francisco G. Denogean-Ballesteros[3], Ana Bertha Martinez-D.[1]

[1]Universidad de Sonora, Santa Ana, Sonora, Mexico, [2]Universidad de Sonora, Hermosillo, Sonora, Mexico, [3]Universidad de Sonora, Santa Ana, Mexico

Brush management techniques are widely applied on rangelands for multiple objectives; two common objectives are to increase forage production for livestock and to maintain a healthy wildlife habitat. Our objectives were to determine the effects of previous disturbances and the establishment of exotic grasses on native herbaceous vegetation and small mammal abundance and species richness on a desert scrubland community. The study was conducted in the southern end of the Sonoran Desert in the state

of Sonora, Mexico. Three pairs of 2 ha were selected for sampling: in each pair of sites, one was previously cleared by mechanical means and seeded with buffelgrass 25 years before and the other did not have previous mechanical disturbance (control). For vegetation sampling, response variables included canopy cover of woody plants, canopy cover of herbaceous plants and native species richness; for small mammals, Sherman traps were used to evaluate abundance and 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 mechanical brush management practices on the southern end of the Sonoran desert reflect an increase in herbaceous vegetation, reducing brush species composition.

112.

RESTORING SAGEBRUSH AFTER MEGA-FIRES: SUCCESS OF DIFFERENT RESTORATION METHODS ACROSS AN ELEVATION GRADIENT.

April Hulet*[1], Kirk W. Davies[2], Matthew D. Madsen[3], Chad S. Boyd[4], Mike Gregg[5]

[1]University of Idaho, Moscow, UT, [2]USDA - Agricultural Research Service, Burns, OR, [3]Brigham Young University, Provo, UT, [4]USDA-Agricultural Research Service, Burns, OR, [5]US Fish and Wildlife Service, Richland, WA

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.). We used 350 plots spread across approximately a million acres of sagebrush rangelands in Oregon that burned in two mega-fires in 2012. All sagebrush restoration methods were seeded in the fall of 2013, and then repeated on adjacent plots in 2014 with the exception of sagebrush seedlings; sagebrush seedlings were planted in the spring of 2014 and 2015. For Wyoming big sagebrush plots (elevation 4000 to 5000 ft.), precipitation was on average 4% less than the 30 year average between September 2013 and August 2014. Between September 2014 and May 2015 precipitation was on average 36% greater than the 30 year average. Plots seeded in the fall of 2013 had on average < 0.01 sagebrush plants/m2 for all restoration methods. Plots seeded in the fall of 2014 had an average of 12.0 sagebrush plants/m2 (natural recovery plots had 0.2 sagebrush plants/m2). For the mountain big sagebrush plots (elevation 5500 to 7000 ft.), precipitation was on average 28% and 18% less than the 30 year average between September 2013-August 2014 and Sept 2014-May 2015 respectively. Seeded plots were on average 4-fold greater than natural recovery plots (5.3 vs 1.2 plants/m2) the first year. Seed pillows had the greatest average sagebrush seedling density at 9.9 plants/m2. Data is being further analyzed based on a suite of environmental characteristics with the expectation that this information will help land managers successfully restore sage-grouse habitat after wildfires by pairing restoration methods with site characteristics.

113.

DETERMINATION OF THE OPTIMUM SEEDING DENSITY FOR WEEPING LOVEGRASS [*ERAGROSTIS CURVULA* (SCHRADER) NEES].

RaÃºl Corrales*[1], Carlos R. Morales[2], Alicia Melgoza[2], Federico Villarreal-Guerrero[2], Alan Alvarez[1]

[1]Universidad AutÃ³noma de Chihuahua, Chihuahua, Mexico, [2]Universidad Autónoma de Chihuahua, Chihuahua, Mexico

The high costs and the low probability of success in reseeding grasses, make this practice to be considered as the last option for rangeland rehabilitation. In Mexico, buying the seed is one of the factors that contribute to the cost increment of reseeding. The aim of the study was to determine the optimum seeding density (SD) to maximize the establishment and forage production of weeping lovegrass (*Eragrostis curvula*, var. Ermelo). The experiment was conducted under greenhouse conditions during 120 d where four SD were compared. One of the treatments consisted of a SD of 1.5 kg ha-1 of pure live seed (SD 100%), and was defined based on the recommendations of several researchers and because it is the SD commonly used. The other densities were defined based on the SD 100 and were estimated as SD 50%, SD 75% and SD 125%. The seed quantity was adjusted according the percentage of the pure live seed of the lot. Seeding was evenly distributed and the seed was placed at a depth of 0.3-0.7 cm. The plots of 0.16 m2 were distributed in randomized blocks with four replications in a pool of 0.7 m of sandy loam soil. The variables evaluated were: dry matter of the first cut at 60 d (DM1), dry matter of the second section 120 d (DM2) and survival rate (SV%). Statistical analysis was conducted in SAS 9.1.3 under MIXED procedure and ORTHO CONTRAST with $\alpha = 0.05$. For DM1 no difference was found ($P > 0.05$) among SD; 2881 ± 387, 3235 ± 387, 3582 ± 387 and 3992 ± 387 (for SD 100, SD 50, SD 75 and SD 125, respectively). In addition, DM2 also showed no difference ($P > 0.05$) in SD; 629 ± 107, 652 ± 107, 659 ± 107 and 602 ± 107 (for SD 100, SD 50, SD 75 and SD 125, respectively). In SV% differences were not observed ($P > 0.05$) among SD; 29, 35, 33 and 33% of SV (for SD 100, SD 50, SD 75, SD 125, respectively). The SD 50 and SD 75 did not present a decrement of forage production and plant survival. Furthermore, SD 125 did not show an increment of forage production or plant survival. The same yields and plant setting with a reduced planting density was obtained in this study. Furthermore, reducing the SD for weeping lovegrass can significantly reduce costs

114.

GERMINATION AND ESTABLISHMENT OF NATIVE SPECIES FROM THE CHIHUAHUAN DESERT WITH DIFFERENT WET-DRY SEQUENCES.

David E. Prado[1], Alicia Melgoza*[1], Ricardo Mata-Gonzalez[2], Eduardo Santellano[1], Carlos R. Morales[1]

[1]Universidad Autónoma de Chihuahua, Chihuahua, Mexico, [2]Oregon State University, Corvallis, OR

Arid land plants are adapted to limited and erratic rainfall. For that, they implement several strategies. Some species can germinate and establish even in years of drought (precipitation below the average). Other species germinate only in ¨exceptionally¨ wet years. In addition, speed of germination represents another strategy where some species germinate quickly after a rain event, while others do it slowly. Rainfall in the Chihuahuan desert is very irregular and only in few years rainfall is above the average. Therefore, we evaluated germination, establishment and speed of germination of nine native plant

species of the Chihuahuan desert with different wet-dry sequences. These wet-dry sequences were obtained from previous studies that analyzed rainfall patterns in the state of Chihuahua, México during a period of 35 years. The evaluated species were *Acacia greggii, Agave Americana, A. lechuguilla, Menodora scabra, Plantago patagonica, Tecoma stans, Viguiera decurrens, Yucca elata,* and *Zinnia grandiflora*. The rate and speed of germination of all the species were reduced by low soil moisture. The highest wet-dry sequence obtained the highest germination values. The species *T. stans* and *A. greggii* had the highest germination rate (P<0.05) with 59.52 and 53.57%, respectively. Seedling establishment was also affected by soil moisture with only *A. greggii* getting established in all of the sequences evaluated. In contrast, all the other species got established only in the high wet-dry sequences. This study sets the basis for a propagation protocol and an ecological restoration efforts using native plant species from the Chihuahuan desert.

115.

SEED AND FORAGE PRODUCTION OF GRASSES UNDER IRRIGATION AND FERTILIZATION IN CHIHUAHUA, MEXICO.

Edith Sáenz[1], Carlos R. Morales*[2], Ruben Saucedo[3], Pedro Jurado[3], Carlos Lara[3], Alicia Melgoza[4], Juan A. Ortega-Gutiérrez[4]

[1]Universidad Autónoma de Chihauhua, Chihuahua, Mexico, [2]Universidad Autónoma de Chihauhua, Chihuahua, Mexico, [3]INIFAP, Chihuahua, Mexico, [4]Universidad Autónoma de Chihuahua, Chihuahua, Mexico

In Mexico, only small quantities of grass seed are produced. This low seed production has been the main cause of the high costs and low demand to use in rehabilitation programs. The objective was to evaluate different treatments of fertilization and their effect on seed and forage production of two grasses under irrigation. The research was conducted at the Experimental Site Aldama-INIFAP, located in the municipality of Aldama, Chihuahua, Mexico. The species studied were buffel grass (*Pennisetum ciliare*) and willman lovegrass (*Eragrostis superba*). The variables evaluated were seed production and forage production. The experimental units consisted of 12 m2 plots and the experimental design was randomized blocks with three replications. By applying 80 to 120 kg ha-1 of N, seed production was increased 50% compared to the control in buffel grass, with seed production yields from 215 to 324 kg ha-1. In addition, an increase of 46% on forage production was obtained with a dose of 120-60-00 with forage production yields from 9344 to 14556 Kg h-1 of dry matter (DM). In willman lovegrass the treatments 120-60-00 and 60-30-00 + mycorrhiza showed the highest seed production (P > 0.05). The highest forage production (9192 Kg ha-1 of DM) was obtained by the application of the treatment 120-60-00 (P >0.05). By applying 120-60-00 kg ha-1, seed production was increased 37% compared to the control, with seed production yields from 217 to 312 kg ha-1. Moreover, an increase of 26% on forage production was obtained with a dose of 120-60-00 with forage production yields from 7130 to 9192 Kg h-1.

116.

GERMINATION AND GROWTH OF *BOUTELOUA CURTIPENDULA* (MICHX.) TORR. UNDER DIFFERENT RADIATION ENVIRONMENTS.

RaÃºl Corrales*[1], Saúl Vásquez-Montes[2], Federico Villarreal-Guerrero[2], Angélica Cervates-Trejo[2], Carlos R. Morales[3]

[1]Universidad AutÃ³noma de Chihuahua, Chihuahua, Mexico, [2]Universidad Autónoma de Chihuahua, Chihuahua, Mexico, [3]Universidad AutÃ³noma de Chihauhua, Chihuahua, Mexico

Native grass species for livestock present limitations for their establishment and propagation in deteriorated rangelands of Chihuahua, Mexico. Revegetation represents an alternative; however, nursery plant production of grasses is costly, especially if the nursery house has to be controlled to keep an appropriate climate. Among the climatic factors, radiation is key, as it impacts plant growth rate if is not appropriate for the species. The objective was to evaluate the effect of four radiation environments on the germination and growth of *Bouteloua curtipendula.* The radiation environment was modified inside three small structures (scaled greenhouses) of 1.05x0.50x0.75 m (length x width x height), covered with red, blue and green cellophane. These colored structures were located inside an experimental polyethylene greenhouse (12x5x3.5 m). A standard germination test was performed in five petri dishes (replications), each containing 10 seeds, placed inside each scaled greenhouse. The same amount of petri dishes were placed inside the greenhouse and served as the control. Similarly, nine seedlings of 12 days after emergency were accommodated inside each treatment and the control to evaluate growth. Homogeneous temperature and relative humidity conditions were ensured to attribute the effect on growth and germination rate to the radiation environments. The germination rate was 94.0±1.3, 92±1.7, 86±1.63 and 86±1.41% for the red, blue, green colors and the control, respectively. Plant growth was 0.35±0.08, 0.27±0.07, 0.26±0.03 and 0.22±0.05 m for the red, blue, green colors and the control, respectively. A comparison of means ($\alpha < 0.05$) indicated the red color produced the highest germination rate and growth followed by the blue. Differences in germination between the green color and the control were not significant. Moreover, all the treatments produced a significantly higher growth than the control. Red and blue radiations can potentially reduce time and costs during seedlings production of *Bouteloua curtipendula* for revegetation purposes.

117.

A RESTORATION FRAMEWORK FOR SELECTING POTENTIAL GREATER SAGE-GROUSE HABITAT: LANDSCAPE AND SITE-SPECIFIC DECISIONS.

David A. Pyke*[1], Steven T. Knick[2], Jeanne C. Chambers[3], Mike Pellant[4], Jeffrey L. Beck[5], Eugene W. Schupp[6]

[1]U.S. Geological Survey, Corvallis, OR, [2]U.S. Geological Survey, Boise, ID, [3]U.S. Forest Service, Rocky Mountain Research Station, Reno, NV, [4]Bureau of Land Management, Boise, ID, [5]University of Wyoming, Laramie, WY, [6]Utah State University, Logan, UT

Sagebrush-grassland ecosystems are one of the most imperiled ecosystems in North America. Fire has resulted in large areas instantly losing their shrub component with little hope to regain it soon without assistance. Consequently, Greater Sage-Grouse, a species of conservation concern, experiences

immediate and large-scale habitat loss because it depends on sagebrush at multiple scales. As a result, managers are faced with a need to restore sagebrush-grasslands that meet both landscape and site-specific requirements. Managers are seeking decision support tools for implementing restoration objectives across landscapes in a cost-effective manner. Using recent concepts about sagebrush ecosystem resilience to disturbances and resistance to invasive annuals, we developed a decision tool that meets these objectives and that also will address restoration of habitat for Greater Sage-Grouse. The decision support tool is assembled in three parts. Part I provides background ecological and management concepts that are necessary for the practitioner to use two successive decision tools. Part II describes a hierarchical approach to restoration with the initial decisions conducted at the landscape level. It is geared toward decision makers who must prioritize where limited funds could be applied to gain the greatest benefit across a region. We used examples of probabilistic models and GIS data intersections to develop a hierarchy of potential habitat for restoration from the landscape to the site-specific scale. Part III describes project-level restoration tools. These latter parts are designed to be followed in a step-by-step progression to ensure that critical decisions are made in the appropriate order to ascertain best management practices.

118.

DIVERGENT MANAGEMENT EFFECTS LEGUME SEED BANK COMPOSITION AND OTHER FUNCTIONAL GROUPS IN NORTHERN TEMPERATE PASTURES.

Lysandra A. Pyle*[1], Edward Bork[2], Linda Hall[1]

[1]University of Alberta, Edmonton, AB, [2]University of Alberta, EDMONTON, AB

Legumes are an important component of pastures, improving forage productivity and quality through biologically fixed nitrogen, and thereby reduce input costs. Management actions such as grazing systems, stocking rates, or the use of inputs (e.g. broadleaf herbicides, manure or fertilizer), can eliminate legume presence and biomass. Repopulating pastures with legumes often occurs via volunteer establishment from the seed bank. Success of this process depends on a many factors including micro-site availability, competition for light, and disturbances from grazing. Our objective was to determine the presence and abundance of legume seeds and other vegetation (i.e. forages and weeds) in a standardized volume of soil sampled from 102 pastures across central Alberta, Canada during 2012 and 2013. At each pasture, 53 soil cores, 3.25 cm in diameter and 6 cm deep, were extracted 5 m apart in a W-shaped configuration. Cores from each pasture were bulked, placed in a greenhouse for 12 months, and emergent seedlings counted after positive identification. Management was determined retrospectively by interviewing landowners to gather information on pasture age, planting history, fertilization regime, and disturbance history, including grazing and herbicide use. Survey results were accompanied by a range health assessment. Significant management factors were identified using multivariate techniques (perMANOVA and NMDS). Ultimately, this information will link seed bank composition of pastures to particular management regimes, and thereby identify which management practices may produce seed banks capable of facilitating legume re-establishment.

119.

ECOSYSTEM SERVICE OUTCOMES ACROSS A GRADIENT OF WOODLAND MANAGEMENT.

Danny J. Eastburn*, Kenneth W. Tate, Leslie M. Roche

University of California, Davis, Davis, CA

California's oak woodland-annual grasslands support an array of ecosystem services. Understanding the relationship between land management options and the supply of multiple ecosystem services is essential to sustainability and conservation of these working-landscapes. Specifically, balancing tradeoffs between agricultural production, invasive plant species, and the maintenance of other ecosystem services will be a key challenge in an already variable and changing climate. Here, we highlight an example framework for understanding multiple ecosystem service provisioning across a managed oak woodland-annual grassland system. We examined soil and vegetation properties indicative of key provisioning, regulating and habitat ecosystem services across an existing gradient of woody management We found clear tradeoffs in management outcomes. Conversion to open grassland (0-9% canopy) generated forage production 2-fold greater than the woodland (50-100% canopy) and 1.5-fold greater than savanna (10-49% canopy) sites. Gains in agricultural productivity were offset by reductions in plant diversity, soil carbon stores, and reduced infiltration rates. The woodland mineral soil surface horizon contained a mean 50.2g C/kg soil, which is nearly 2-fold the concentration measured in the grassland and 1.2-fold more than the savanna. Infiltration rates were 10-fold greater in woodland sites compared to open grassland. Grassland sites were found to be the least diverse; and woodlands exhibited the most diverse, less invaded and native rich plant communities. The savanna supplies intermediate levels of all ecosystem services quantified and highlights a local management opportunity to balance multiple ecosystem service goals. At the landscape scale, maintaining a heterogeneous mosaic of vegetation patches optimizes the benefits of different ecosystem management options— including increased agricultural productivity, maintaining water and nutrient cycling capacity, protecting genetic resources, and enhancing the number of habitat types.

120.

VEGETATION CHANGES FOLLOWING CONTOUR FURROWING IN THE SHORT GRASS PRAIRIES AT NORTHERN SONORA MEXICO.

Martha H. Martin*[1], Fernando A. Ibarra-Flores[2], Fernando A. Ibarra-Martin[2], Rafael Retes[2], Zuhaila Lomeli[1]

[1]University of Sonora, Santa Ana, Mexico, [2]University of Sonora, Hermosillo, Mexico

Short grasslands represent a very important ecosystem for cattle and wildlife in northern Mexico but few efforts had been conducted to restore productivity on these environments. This study was conducted at Cananea, Sonora, Mexico to monitor vegetation changes following contour furrowing. Furrows were constructed with a large disk furrower mounted on a bulldozer during the summer of 2013. Furrows were 1.0 meter tall and 3.0 meters wide. Vegetation changes were monitored on triplicate 20 by 20 m plots with and without contour furrowing (untreated check). Main species present were: blue grama (*Bouteloua gracilis*) sideoats grama (*Bouteloua curtipendula*), purple grama (*Bouteloua chondriosoides*), green sprangletop (*Leptochloa dubia*), wolfstail (*Licurus phleoides*) and

threeawn (*Aristida sp*.). Plant density, basal cover, and plant height were monitored during the summers of 2013 y 2014 on three permanent 1 m2 quadrats per plot. Forage production was estimated by clipping on ten 1 m2 quadrats per plot. A Randomized complete block design was used and data were analyzed by ANOVA (P≤0.05). Precipitation was close to long term mean and averaged 395 and 429 mm in 2013 and 2014, respectively. Means of all variables were greater (P≤0.05) on contour furrowing plots as compared with the checks. Plant density averaged 9.6 plants/m2 in the untreated checks and increased by 65% two summers following contour furrowing. Basal cover and plant height increased by 37.5 and 46.8% after two summer growing seasons on treated plots. Total forage production averaged 724.5 kg D.M/ha on untreated checks and 1243.5 kg D.M/ha on treated plots. Total biomass was increased by 71.6% two years following contour furrowing. We conclude that water harvesting by contour furrowing is an effective tool to restore productivity. Reducing water runoff increase grass density, height and forage production in short grass prairies.

121.

RESTORATION OF SONORAN DESERT MATORRALES BY BRUSH TRANSPLANTING IN SONORA, MEXICO.

Fernando A. Ibarra-Flores*[1], Martha H. Martin[2], Fernando A. Ibarra-Martin[1], Yessica Fontes[2], Rafael Retes[1]

[1]University of Sonora, Hermosillo, Mexico, [2]University of Sonora, Santa Ana, Mexico

Large areas of matorrales in the Sonoran desert are deteriorated showing low forage production for wildlife and cattle. In most cases these sites are in poor condition and require range seeding to restore productivity. This study was conducted during 2014 at rancho el Aguila in north-central Sonora Mexico. Two hundred plants each of ironwood (*Olneya tesota*), foothill palo-verde (*Cercidium microphyllum*), mesquite (*Prosopis glandulosa*) and baby bonnet (*Coursetia glandulosa*) were grown on plastic containers under greenhouse conditions during April 2014 and were nursed by 90 days until they were 30 to 50 cm tall. One hundred plants of each species were randomly transplanted in the field at 10 meters intervals along contour furrows 1 meter tall and 3 meters wide constructed with a bulldozer. Plants were planted in august during the summer rains in pits 20 cm wide and 30 cm depth. One hundred other plants were transplanted in bare ground with no furrows (untreated check). Plants in both treatments were not irrigated at transplanting and the site was fenced to protect from cattle grazing. A randomized design was used and data were analyzed by ANOVA (P≤0.05). Precipitation was 410 mm during 2014. Species survival and plant height was different (P≤0.05) on areas with and without contour furrowing. Plant survival in the contour furrows averaged 48.5% among species with 45, 48, 65 and 35% for ironwood, foothill palo-verde, mesquite and baby bonnet, respectively. Plant survival in the checks averaged 11.3% among species with 12, 5, 20 and 8% survival for ironwood, foothill palo-verde, mesquite and baby bonnet, respectively. Species height on the contour furrowed plots varied from 58 to 165 cm while on the controls from 40 to 72 cm. We conclude that range rehabilitation trough brush transplanting along contour furrows is an alternative to restore productivity in Sonoran Deserts ecosystems.

122.

FROST SEEDBED CONDITIONS ON SAGEBRUSH STEPPE RANGELANDS OF THE GREAT BASIN.

Bruce A. Roundy*, Matthew Madsen, Turmandakh Badrakh

Brigham Young University, Provo, UT

Restoration of burned or degraded sagebrush steppe commonly requires seeding desirable perennial species in fall. Seeds are drilled or aerially broadcast and often 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 with high winter seedling mortality. To help guide seed treatments such as abscisic acid (ABA), a plant hormone that delays germination, we analyzed fall, winter, and spring seedbed temperatures for 3-4 years on 14 sagebrush steppe sites, 8 of which had been encroached by pinyon and juniper trees. Sites were representative of the central to northern Great Basin. These seedbeds predominately have many short frost periods from October through March. For example, there was an average of 58 frost periods < 1 day long and only 1.9 periods 1-2 days long at 1-3 cm deep. Treatments to avoid freezing would have to typically delay germination for about 5-6 months beginning in October. This research will help guide subsequent field experiments to compare frost tolerance of seeded species and seed treatments to increase seeding success and restore weed-dominated rangelands.

123.

NORTHERN BOBWHITE HABITAT RESTORATION IN AREAS INVADED BY WARM-SEASON, NON-NATIVE PLANT SPECIES.

Benjamin R. Olsen*[1], Timothy E. Fulbright[2], Fidel Hernandez[1], Eric D. Grahmann[1], David B. Wester[1], Forrest S. Smith[1], Michael W. Hehman[3]

[1]Caesar Kleberg Wildlife Research Institute, Kingsville, TX, [2]Texas A&M University-Kingsville, Kingsville, TX, [3]Hixon Ranch, Cotulla, TX

Restoring native vegetation on landscapes that have been invaded by non-native plant species such as buffelgrass (*Pennisetum ciliare*) and Kleberg bluestem (*Dichanthium annulatum*) may re-establish connectivity between isolated patches of northern bobwhite (*Colinus virginianus)* habitat and increase habitat availability. Our overall objective is to determine 1) the influence of habitat restoration on bobwhite nesting ecology, home range, and density and 2) habitat-selection behavior in relation to plant communities and thermal environment. We conducted a pilot study from 2008-2012 and found that repeated cultivation followed by reseeding native plants was the best approach to restore native grasses and forbs. Based on results of these pilot studies, we initiated a large-scale, non-replicated experiment in 2013 with a 118-ha native plant restoration site and a 109-ha control. Reseeding locally adapted native plant species will occur in August 2015. A diverse mix of native plants will be seeded in configurations that optimize bobwhite habitat and fulfill bobwhite needs of thermal cover, nesting, and foraging needs. We will determine the effects of restoration on home range size and habitat selection by radio-tracking a target of 20 bobwhites in the restoration site and 20 in the control. Bobwhite densities will be estimated using whistle counts. Bobwhite nest predators will be identified by using trail cameras to monitor nests. Other previous attempts to restore native plants in areas dominated by warm-season,

non-native plants have proven unsuccessful. Our study is the largest of its kind; however we cannot be certain that such a restoration will result in improved bobwhite use. Warm-season, non-native grasses are predicted to continue their expansion. Knowledge of how to combat non-native grass invasions will be imperative in ensuring the conservation of many wildlife species in the future.

124.

REVEGETATION 4 YEARS AFTER RUSSIAN-OLIVE (*ELAEAGNUS ANGUSTIFOLIA* L.) REMOVAL ALONG THE YELLOWSTONE RIVER IN EASTERN MONTANA.

Jennifer M. Muscha*[1], Mark K. Petersen[2], Erin Espeland[3], Robert Kilian[4], Joe Scianna[5]

[1]USDA-ARS, Miles City, MT, [2]USDA-ARS Fort Keogh LARRL, Miles City, MT, [3]USDA-ARS, Sidney, MT, [4]USDA-NRCS, MIles City, MT, [5]USDA-NRCS, Bridger, MT

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 a 2 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. The herbaceous seeding consisted of 4 grasses and 10 forbs and was broadcast seeded on the ground. Four shrubs and/or four tree species were planted in the S, T, and TS treatments. Canopy cover was measured in 2010 before Russian olive removal and in 2012-2015. Non-native forb cover was over 3 times lower in 2015 (11±2.5%) compared to the highest cover in 2013 (37±2.5%). In 2015, the T treatment plots had the lowest non-native forb cover (4±6%) and the TS treatment had the highest cover (20±6%). Annual brome cover was highest in 2010 (32%±3%), lowest in 2012 (15%±3%), and similar in years 2013-2015 (avg. 23%±3%). Seeded herbaceous species established with cover 8 times higher in 2015 (44±2%) than 2012 (5.5±2%). After just four years since active restoration, the herbaceous seeding with planted shrubs had the lowest cover of annual bromes (14±3%) and highest cover of seeded herbaceous species (33±2%). Nine of the 14 species seeded germinated in over 80% of the treatment sub-plots. Seeded herbaceous species cover is continuing to increase over time but we feel it might be too early to make a definitive conclusion on the impact in reducing non-native species invasions.

125.

SAGEBRUSH AND RANGELAND HEALTH IN WESTERN SOUTH DAKOTA GRASSLANDS.

Jennifer N. Walker*

South Dakota School of Mines and Technology, Belle Fourche, SD

Due to the need to provide habitat for the Greater Sage-Grouse, sagebrush cover and density have become important objectives in management of rangelands across the western United States.   For grassland ecosystems of western South Dakota, however, sagebrush-dominated plant communities may

represent a departure from the historical range of variability. This project aims to explore the relationship between sagebrush density and rangeland health in this area. The hope is to help land managers to develop vegetation objectives that successfully balance the habitat needs of the Greater Sage-Grouse with healthy ecological function. To help determine healthy parameters for sagebrush communities in western South Dakota grasslands, areas with various densities of Wyoming big sagebrush (Artemisia tridentata ssp. Wyomingensis) are compared at different scales to determine the relative degrees of ecological function. At the broad scale, vegetation and soil moisture indices calculated from LandSat imagery are correlated to sagebrush cover. At the fine scale, adjacent plots with and without sagebrush are intensively sampled and compared in terms of soil quality indicators including infiltration, bulk density, soil surface aggregate stability, soil respiration, soil nitrate, total organic matter content, micronutrient and active soil carbon as well as ground-measured NDVI, perennial grass and forb cover, height, and diversity.

126.

ESTIMATING HISTORICAL EROSION CHANGES IN SOUTH DAKOTA DUE TO GRASSLAND CONVERSION.

Hector M. Menendez III*[1], Melissa R. Wuellner[1], Roger N. Gates[2], Benjamin L. Turner[3], Barry H. Dunn[1]

[1]South Dakota State University, Brookings, SD, [2]South Dakota State University, Rapid City, SD, [3]Texas A&M Kingsville, Kingsville, TX

Eastern South Dakota (SD) is a mosaic of grasslands, wetlands, and cultivated agriculture. A continued shift from grassland to cropland has occurred over the past 10 years and is expected to continue for the next 50 years. Land conversion will influence cumulative erosion from arable soils which will negatively impact ecosystem goods and services and agricultural production. Quantifying historical erosion rates and coupling these with trends in land management will aid in the development of land use models capable of estimating landscape scale externalities such as soil loss, water availability, flow regimes and quality. At present, the National Agricultural Statistics Survey can only produce reliable approximations of soil erosion at a state level from 1982 forward. This leaves a gap in knowledge of erosion prior to 1982. This is partially due to missing spatial and temporal land cover data for SD. However, an alternative source (thematic map) has recently been made available by the United States Geological Service of the contiguous U.S. from 1938 to 1992 which categorizes land cover for each year. These data may be used to generate missing erosion data prior to 1982 in order to better calibrate models estimating landscape scale externalities. Newly published land cover maps will be used to expand soil erosion data before 1982 to better understand the historic and future impacts of diminishing grasslands and land management choices. Erosion data generated using the thematic land cover map will be regressed against values generated from the NRCS erosion data for the period 1982-1992 for validation. Preliminary results will generate estimations of erosion from 1982 to 1992 using the RUSLE2 and make approximations possible for 1938 to 1981 erosion in SD. Additional erosion data will allow for a better understanding of land use and management decisions coupled with expected declines in grasslands.

127.

THE ECOLOGICAL-SITE BASED SHRUB MANAGEMENT HANDBOOK FOR UTAH: BRINGING CURRENT RESEARCH TO THE RANGE.

Rebecca K. Mann*[1], Tom Monaco[2], Kari E. Veblen[1]

[1]Utah State University, Logan, UT, [2]USDA-ARS, Logan, UT

Management of shrub cover is a common activity on rangelands and can be central to maintaining productive rangelands. However, results of management practices can be difficult to predict, in part because shrub responses differ by the ecological sites in which they occur. For instance, site attributes including climate, soil type, and landscape position will influence achievable plant species composition, susceptibility of target shrubs to reduction, and site vulnerability to disturbance. Tailoring shrub reduction techniques to specific ecological sites will help land managers meet their goals, make cost-effective decisions, and maintain productive, healthy rangelands. Although ecological sites are integral to the success of rangeland management, there is a scarcity of resources disseminating information about them in a usable format to those who need it most: livestock producers, land managers, and rangeland management advisors. To fill this void, we are introducing the Utah Shrub Management Handbook. It will include information on a) what ecological sites are and how to assess them, b) how to incorporate ecological site concepts into project planning, c) biology and management of Utah's commonly targeted shrub species, d) current technology for shrub reduction, and e) a framework for weighing costs and benefits of management actions. The handbook also includes preliminary analyses for long-term site-specific response to shrub reduction and field experiments investigating response of common target shrubs (snakeweed, rubber rabbitbrush, big sagebrush, greasewood) to chemical and mechanical control across eight ecological sites. The handbook is compiled by the Utah Shrub Management Group, with contributions from researchers, NRCS staff, rangeland advisers, and local producers. It is focused on furthering the integration of ecological site concepts into state-wide management activities. This presentation will illustrate why ecological sites are important to management decision-making and how outreach materials can be used to share scientific results with a broad, management-oriented community.

136.

EFFECTS OF EARLY DEFOLIATION MANAGEMENT YIELD AND SUBSEQUENT PERFORMANCE OF NEWLY ESTABLISHED NATIVE WARM-SEASON GRASS STANDS.

Vitalis W. Temu*[1], Christos Galanopoulos[2]

[1]Virginia State University, Petersburg, VA, [2]Virginia State University, Colonial Heights, VA

Effects of seed-drilling or transplanting and harvesting frequency on forage yield and subsequent sward structure of newly established native warm-season forage grass stands were assessed at Virginia State University's research farm. First harvest-year forage yields and subsequent, stand ground cover, sward heights, and canopy closure were compared. Six-week old seedlings of Andropogon gerardii (big bluestem), Tripsacum dactyloides (eastern gamagrass), Sorghastrum nutans (indiangrass) and Panicum virgatum (switchgrass), were transplanted onto smoothly-disked clean 6 x 7 m plots in June, at 30 and 45 cm plant spacing, within and between rows, respectively. For comparison, similar plots of each

species were seeded at ≤ 2 cm deep, in late July. As needed, tall-growing broadleaf weeds were chopped down but fertilizers were not applied. Plants were allowed uninterrupted growth, during the planting year, and dead standing biomass mowed down early in the succeeding spring. During the second year of establishment, 1.5 m strips were harvested one, two, or three times and respective subsequent sward measurements recorded in the following year. Data were analyzed for effects of planting method, harvest frequency, and species as a randomized complete block design. On air-dry basis, year total yields were consistently greater for transplanted   than seeded plots, being about 25,000, 21,000, 14,000, and 11,000 kg DM/ha for switchgrass, indiangrass, big bluestem, and gamagrass, respectively. Subsequent sward heights and canopy light interception greater for strips harvested once > twice > three times. Data indicate that transplanting will mostly result with better yielding stands and that intensive harvesting may compromise recovery and subsequent performance of newly established stands. More data is needed on combined effects of harvest intensity and fertilizer application on subsequent stand performance.